UNITED STATES DEPARTMENT OF THE INTERIOR

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES

PART 1, A–L

GEOLOGICAL SURVEY BULLETIN 896

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 896

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES
(INCLUDING ALASKA)

(Also includes the names and ages, but not the definitions, of the named geologic units of Canada, Mexico, the West Indies, Central America, and Hawaii)

Compiled by
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April 1, 1905, to April 30, 1937

PART 1, A–L

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Compiled by M. Grace Wilmarth

INTRODUCTION

The compilation of a lexicon of geologic names was suggested to the compiler more than 25 years ago, by Dr. T. W. Stanton, who served as chairman of the Committee on Geologic Names from 1912 to January 1931, when he became Acting Chief Geologist of the United States Geological Survey, and later served as Chief Geologist until his retirement September 30, 1935. Dr. Stanton suggested that the definitions should state, briefly, the lithology, thickness, age, underlying and overlying formations, and type locality; and the formal definitions herein given have been compiled in accordance with that suggestion.

The compilation of the lexicon was undertaken as a piece of "knitting work," or a byproduct, but during the years that have elapsed between the initiation and the completion of the task, the volume of routine work that has flowed across the compiler's desk has been so steady and so heavy that work on the lexicon has been very desultory, being stopped for intervals of weeks, months, and even a year at a time. During all of these pauses in the work the coining of new names went on apace, until the lexicon as it stands today probably includes three times as many names as were in the literature when the work was started. During the periods when no work was being done on the lexicon itself, however, data were constantly being compiled that were needed in its preparation and in the routine work of the committee.

After the lexicon was started it was found that many names had been redefined (some of them more than once), and that the original definitions are not those in current use. This made necessary the compilation of the different definitions, thus adding greatly to the labor and to the contemplated size of the book. Work on the lexicon also made evident the need for stratigraphic charts, against which the definitions, redefinitions, and geographic distribution of the units could be checked. For the last few years work on the lexicon has kept pace with the preparation of these State charts.

In order to avoid undesirable duplication of names, and to supply information frequently sought, the names, geographic areas, and ages of the principal underground geologic units have been listed; also the names and geographic regions of Pleistocene moraines, with a reference to the publication in which an outline or a description of each will be found. The names of coal beds and ore beds have not been listed.

The time terms have also been listed, but the full definitions of the era, system, and series terms having been given in United States Geological Survey Bulletin 769, 1925, only very brief definitions of them are given here, with a reference to Bulletin 769.

In order to reduce the size of the book certain words, frequently used, have in most places been abbreviated in the text. These abbreviations are listed beyond. The points of the compass have also been abbreviated, and in general the names of the States, except in the top captions. The word "the" has been eliminated wherever practicable. Certain signs have also been employed, as follows:

= indicates equivalent to or equivalent of.
+ means plus.
± means plus or minus, or more or less.
*** indicate intervening beds.

Some entries have been inserted for the benefit of the layman, or to direct attention to Survey usage—for example:

Palaeozoic. An early spelling of Paleozoic.
Cainozoic. An early spelling of Cenozoic.
Waverlian. A variant of Waverlyan.

The endeavor has been made to make the digests of the definitions as brief as possible. The material has usually been gleaned from many pages of the reports cited, but in order to economize time and space, all pages from which the digested material was obtained are usually not listed, but only the page containing the essential part of the definition or the inclusive pages of the paper cited.

It may be noticed that unequal treatment has been accorded to the names—that is, most names have only one entry (a digest of the original definition), many names have several entries, and some names have many entries. In explanation it may be said that the original definitions of most geologic names are the definitions still in current use; that other names have been redefined (some of them several times), necessitating a digest of the redefinitions; that still other names have had a long and interesting history leading up to their present commonly accepted definitions and location in the geologic column, necessitating brief mention of the views of the geologists who have contributed most to their elucidation; and that some other names are still "bones of contention," necessitating brief mention of divergent views regarding them. But to cite the reports of those who have simply described a geologic unit, already named, in some particular field in which they have worked, or to explain the misidentifications of the units in different areas, is quite outside the scope of this book. Where there is disagreement regarding the age of a unit, the views of several authorities usually are given.

Definitions and redefinitions are given of only the units found in the United States and Alaska, but the names and current age designations of the geologic units of Canada, Mexico, Hawaii, the West Indies, and Central America are also listed, together with citations to the publications in which they were first defined, as recorded in United States Geological Survey Bulletin 191, by F. B. Weeks, and subsequent accessions to that list by J. M. Nickles and Miss E. M. Thom; the compiler has examined very few of the books cited for the foreign names. Where it was possible to do so without the expenditure of much time, the original definitions of a few Canadian units are given. A few widely used paleontologic names by which some geologic units have been designated have also been listed, together with the geographic names by which they are now known.

The capitalization of time terms in digested matter is that of the author cited.

The stratigraphic papers summarized and used in the preparation of this lexicon are largely those listed in Bulletin 191 and the subsequent accessions to that list up to January 1, 1936. The lexicon contains some names of 1936 coinage, but part of the 1936 literature the compiler has, necessarily, left to her successor to digest and record.

Names printed in black-face type are in current use by the United States Geological Survey; names preceded by a dagger (†) have been either abandoned by their authors or rejected for use in the classification of the United States Geological Survey; names in roman type without a dagger have not been considered by the Committee on Geologic Names of the United States Geological Survey for use in Survey reports.

The age assignments of the units whose names are printed in black-face type are those at present in use by the United States Geological Survey. That some of these age assignments will be changed, as evidence accumulates, is to be expected. The age assignments of units not printed in black-face type are those given by their authors or in subsequent reports cited. The use of a well-known group name in parentheses following the age designation of a unit does not mean that the United States Geological Survey classifies the unit as belonging to the group mentioned, but that its fossils indicate correlation with that group.

The counties mentioned in the top captions are not intended to indicate exact geographic distribution of the unit described, but are given as clues to the part of the State in which it occurs.

Survey geologists have been generous of time and knowledge in the endeavor to connect geologic units of early reports with those in current use.

The compiler hopes that the lexicon will prove a time saver for the busy geologist, who, like all other "humans," needs frequently to refresh his memory quickly.

The State charts compiled in connection with this lexicon (photolithographs of which have been distributed by the United States Geological Survey) bear dates as follows:

Ala., March 1935.
Ariz., March 1932.
Ark., August 1934.
Calif., January 1927.
Colo., June 1931.
Conn., April 1929.
Del., November 1936.
Fla., March 1935.
Ga., March 1935.
Idaho, September 1932.
Ill., August 1936.
Ind., February 1930.
Iowa, April 1930.
Kans., October 1936.
Ky., February 1930.
La., March 1931.
Maine, September 1935.
Md., April 1929.
Mass., April 1929.
Mich., June 1929.
Minn., August 1929.
Miss., March 1935.
Mo., March 1930.
Mont., July 1932.
Nebr., October 1936.
Nev., February 1933.
N. H., September 1935.
N. J., April 1929.
N. Mex., February 1932.
N. Y., January 1928.
N. C., March 1935.
N. Dak., September 1931.
Ohio, February 1930.
Okla., January and February 1931.
Oreg., August 1934.
Pa., April 1928.
R. I., April 1929.
S. C., March 1935.
S. Dak., September 1931.
Tenn., August 1929.
Tex., September 1930.
Utah, December 1932.
Vt., September 1935.
Va., April 1929.
Wash., July 1934.
W. Va., April 1929.
Wis., August 1929.
Wyo., April 1925.

The following abbreviations are used in citations and in text.

A. A. P. G., American Association of Petroleum Geologists.
Acad., Academy.
Adv., Advancement.
aggl., agglomerate.
aggls., agglomerates.
Agr., Agriculture.
Agric., Agricultural, Agriculture.
Am., America or American.
Ann., Annual.
App., Appendix.
approx., approximate or approximately.
aren., arenaceous.
argill., argillaceous.
art., Article in a publication.
Ass., Association.
Asst., Assistant.
Ast., Astronomer or Astronomy.
av., average.
Bd., Board.
bdy, boundary.
Bien., Biennial.
Bi-Mon., Bi-Monthly.
Biol., Biological.
bldg., building.
Bot., Botany.
btw., between.
Bull., Bulletin.
Bulls., Bulletins.
Bur., Bureau.
calc., calcareous.
Camb., Cambrian.
Can., Canada.
Carbf., Carboniferous.
cgl., conglomerate.
cgls., conglomerates.
chap., chapter.

Circ., Circular.
Co., County or Company.
Coll., College or Collections.
Comm., Commission.
Comp., Comparative.
Conf., Conference.
Cons., Conservation.
contemp., contemporaneous.
Contr., Contribution.
Coop., Cooperative.
cor., corner.
Coun., Council.
Cret., Cretaceous.
deg., degree or degrees.
Dept., Department.
Dev., Devonian.
diam., diameter.
Dir., Director.
discon., disconformity or disconformably.
Dissert., Dissertation or Dissertations.
dist., district.
div., division.
dol., dolomite.
E., east.
Econ., Economic.
Ed., Education.
ed., edition.
Elem., Elementary.
elev., elevation.
Eng., Engineering, Engineer.
Engrs., Engineers.
Eo., Eocene.
equiv., equivalent.
est., estimated.
Extr., Extract.
fangl., fanglomerate.
fangls., fanglomerates.
fm., formation.
fms., formations.
ft., feet or foot.
Gd., Ground.
Gen., General.
Geog., Geographic.
Geol., Geology, Geologist, or Geological.
geol., geology, geologic, geological.
Govt., Government.
gyp., gypsum.
Hdb., Handbook.
Hist., History or Historical.
Hydrog., Hydrography.
in., inch or inches.
Indus., Industrial.
Inst., Institute or Institution.
Int., International, Interior.
Intr., Introduction.
Jour., Journal.
Lab., Laboratory
Lett., Letters.
Lib., Library.
ls., limestone.
lss., limestones.
loc., locality.
Lyc., Lyceum.
mag., magnesian.
Man., Manual.
Math., Mathematical or Mathematics.
max., maximum.
Meet., Meeting.
Mem., Memoir.
memb., member.
Memo., Memorandum.
Met., Metallurgical, Metallurgy, or Metals.
Mg., Mining.
mi., mile or miles.
Mid., Midwest, Midland.
Min., Mining, Mineral, Mineralogist, or Mines.
Mio., Miocene.
Misc., Miscellaneous.
Miss., Mississippian.
mm., millimeter or millimeters.
Mon., Monthly or Monograph.
ms., manuscript.
Mtn, Mountain.
Mtns, Mountains.
Mus., Museum.
N., North.
Nat., National, Naturalist, or Natural.
noncon., nonconformity, nonconformably.
n.s., new series.
Occ., Occasional.
Olig., Oligocene.
Ont., Ontario.
opp., opposite.
Ord., Ordovician.
Pa., Pennsylvania.
Pal., Paleontology.
Pam., Pamphlet.
Penn., Pennsylvanian.
Perm., Permian.
Pet., Petroleum.

Petrog., Petrography.
Phil., Philosophical.
Phys., Physics or Physical.
pl., plate.
Pleist., Pleistocene.
Plio., Pliocene.
pls., plates.
P. P., Professional Paper.
pre-Camb., pre-Cambrian.
Prel., Preliminary.
Proc., Proceedings.
Prog., Progress.
Pt., Point (of land).
pt., Part (of a publication).
Ptg, Printing.
Pub., Publication.
qtz, quartz.
qtzite, quartzite.
qtzites, quartzites.
qtzitic, quartzitic.
quad., quadrangle.
quads., quadrangles.
Quart., Quarterly.
Quat., Quaternary.
Reconn., Reconnaissance.
rept, report.
repts, reports.
Res., Resources, Reservation.
Rev., Review.
Roy., Royal.
R. R., Railroad.
Ry, Railway.
S., south.
Sci., Science, Scientific, Sciences.
sec., section.
secs., sections.
Secy, Secretary.
sed., sedimentary.
Sep., Separate.
sess., Session.
sh., shale.
Sil., Silurian.
sl., slate.
Soc. Society.
Spec., Special.
ss., sandstone.
sss., sandstones.
Sta., Station.
strat., stratigraphy, stratigraphic, or stratigraphically.
Summ., Summary.
Suppl., Supplement.
Surv., Survey.
syn., synonym.
Tech., Technical, Technology, Technologists.
Terr., Territories.
Tert., Tertiary.
Topog., Topographic or Topography.
Trans., Transactions.
Twp, Township.
Twps, Townships.
uncon., unconformity or unconformably.
undet., undetermined.
undiff., undifferentiated.
Univ., University.
U. S. G. S., United States Geological Survey.
vol., volume.
W., west.
W. S. P., Water Supply Paper.
yds, yards.
yrs, years.
Zool., Zoology.

LEXICON—Part 1, A-L

Aarde shale.

Pennsylvanian: Northeastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). [See under *Bachelor Creek ls.* On p. 21 *Aarde sh.* is described as consisting of 3 ft. of yellowish gray clayey sh. with Nodaway coal near base. On p. 20 it is given a thickness of 4½ ft.]

R. C. Moore, 1934 (personal communication April 20), stated that lower part of Howard ls. intertongues with upper part of Severy sh., which accounts for Aarde sh. containing Nodaway coal. The underlying Bachelor Creek ls. also interfingers in Severy sh., he stated.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 39, 205–207). Bachelor Creek ls. is basal memb. of Howard ls. in southern Kans., from Greenwood Co. southward. Where it is absent, as in N. Kans., the Nodaway coal and other beds that are strat. = Aarde sh. memb. of Howard ls. are classed as belonging to top of Severy sh., because bdy btw. the 2 shales can not be drawn. In northern area Severy sh. extends up to base of Church ls. Named for Aarde farm, sec. 4, T. 26 S., R. 11 E., Greenwood Co.

Aaron slate.

Pre-Cambrian: Central southern Virginia and central northern North Carolina (Virgilina district).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 15, 19–27, and map). *Aaron sl.*—A slate-like rock formed by mixtures of varying amounts of andesitic volcanic ash and ordinary land waste, which through pressure and other agents of metamorphism have been changed or altered into a kind of hybrid sl., in some places into a schist. Varies from nearly pure greenstone to fairly pure argill. ss. and sl., and in certain places is decidedly conglomeratic. The rock is by no means normal sl., and term "sl." was applied to it only after much hesitation and many vain attempts to find a better name. In field work it was called "sandy tuff." It immediately overlies Hyco quartz porphyry. Is well exposed at many places along Aaron's Creek [Person and Granville Counties, N. C.]. Assigned to Ord. (?).

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. geol. map of Va.). [The block of pre-Camb. extrusive rocks younger than Glenarm series and designated "greenstone volcanics" is stated to include a porphyritic amygdaloidal and tuffaceous facies called *Aaron slate.*]

Abbeville-York zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 6, 9, 12). *Abbeville-York zone (Archean)*.—This area is very wide along its northerly bdy, which is constituted by State line, but narrows along its SW. bdy, formed by Savannah River. Is bounded on NW. by Cherokee and Anderson-Spartanburg zones; on SE. by a line which proceeds southwesterly from a point on State line 1.5 mi. NW. of Hornsboro, thence crossing Lynches River 1.8 mi. above mouth of Rocky Creek, thence to Heath Springs, thence below Peays Ferry (Wateree River) by Longtown, thence to head of Sawneys Creek, thence across Broad River (above its confluence with Little River), thence S. of Little Mtn, thence N. of Culbreath Mine, thence N. of Meeting St. (2 mi.), and thence direct to a point near McCormick, whence it continues to Savannah River, S. of mouth of Little River. Marble, of seeming upper Cherokee equivalence, appears along upper limit of Abbeville-York zone interruptedly from E. side of Enoree River to E. side of Saluda River. Rocks consist of gneissoids, granite, syenite, quartz, mica and hornblende schists and slates, qtzite, gabbro, trachyte, porphyries, sericite schists, quartz monzonite schists, diorite slates, diorite, trachyte, pyroxenite, amphibolite, felsite, soapstone.

Named for exposures in Abbeville and York Counties.

Abbyville gabbro.

Pre-Cambrian: Central southern Virginia (Mecklenburg County).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 37–38, map). *Abbyville gabbro.*—Much altered intrusive hornblende gabbro of dirty greenish gray color; coarse grained. Occurs in vicinity of Abbyville, Mecklenburg Co., Va.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. geol. map of Va.), mapped the hornblende gabbro around Abbyville, Va., as of pre-Camb. age and as intrusive into Glenarm series (Algonkian?).

Abercrombie formation.

Middle Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Abercrombie fm.*—Most characteristic type is a blue-gray dense ls. whose thin bedding is caused by thin bands or partings of yellow, buff, pink, or light-gray fossiliferous sh. The ls. bands are ¼ to ½ inch thick. The shaly material is present only locally along many bedding planes and similar splotches of sh. occur less commonly within the ls. and not parallel to the bedding. With increase or decrease in amount of sh. the rock grades into lenticular sh. beds or into relatively massively bedded lss. Thickness 2,700± ft. Middle Camb. fossils. Grades into underlying Busby qtzite and into overlying Young Peak dol. Abercrombie Peak, on ridge S. of Dry Canyon, in Gold Hill dist., is underlain by this fm., hence the name.

See also U. S. G. S. P. P. 177, 1934.

Aberdeen formation.

Triassic: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 45, 66). [Assigned to Carbf.]

H. S. Bostock, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, p. 203). [Assigned to Triassic.]

Aberdeen sandstone. (In Pottsville formation.)

Pennsylvanian: Western Kentucky.

A. F. Crider, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 1, pp. 173–175). *Aberdeen ss.*—Coarse, massive, cliff-making ss., 40 ft. thick, forming steep cliffs in region of Aberdeen, Butler Co. Forms bluff on which Morgantown is situated. Base of ss. is 75 ft. above low water at Morgantown. Either rests on Aberdeen coal or is separated from it by 4 to 6 ft. of sh. Well-marked erosional uncon. at base.

Named for Aberdeen, Butler Co., where it stands out in prominent cliffs along Green River. Typically exposed at Aberdeen Ferry.

Aberdeen sandstone member (of Blackhawk formation).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Aberdeen ss. memb. of Blackhawk fm.*—Massive, medium-grained buff ss., 60 to 200 ft. thick, lying 160± ft. above Star Point ss. Underlies Castlegate "A" coal and overlies lower part of Spring Canyon coal group, but in places grades laterally into part of that coal group. Exposed near Aberdeen mine, NE. of Kenilworth, Castlegate quad., Carbon Co.

Abilene conglomerate.

Tertiary: Central Kansas.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 786, 789, 797). *Abilene cgl.*—Cgl., 15 to 20 ft. thick, lying about 150 ft. above base of Marion fm. Underlain by shaly buff lss. and overlain by buff lss. and marls of Marion fm.

L. C. Wooster, 1905 (The Carboniferous rock system of eastern Kans.). *Abilene cgl.* consists of ls. and quartz pebbles and is top memb. of Marion beds as here defined.

J. W. Beede, 1909 (Kans. Acad. Sci. Trans., vol. 22, pp. 248–256). *Abilene cgl.* is top memb. of Marion fm. [See under †*Marion fm.*]

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3). *Abilene cgl. memb.*—Top memb. of Marion fm. Is a peculiar, somewhat variable, conglomerated ls. At type loc., in vicinity of Abilene, it is a calc. cgl. containing some sand and ss. pebbles. In vicinity of Herington and Marion it is represented, according to Beede, by "heavy, hard, perhaps dolomitic stone, composed of fragments of yellow, orange, and gray masses firmly united in a light-gray cementing material." Overlies Pearl sh. memb.

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2, p. 63, footnote). So-called *Abilene cgl.* is Tert. [See fuller statement under †*Marion fm.* Other geologists continued to classify these beds as Perm.]

E. C. Parker, 1925 (A. A. P. G. Bull., vol. 9, No. 6, p. 982, in reply to question of C. N. Gould: "Is it not true that at the location the Abilene fm. is a mud or clay cgl.?"). This bed in type section at Abilene, Kans., at the few exposures where it is unaltered, is a soft gray ls. about 2 ft. thick. The interval down to top of Herington ls. varies from 40 ft. at Abilene, Kans., to about 50 ft. at Ponca City, Okla. In majority of exposures this calc. material has been partly or wholly dissolved and redeposited in same horizon, often with gyp. derived by solution from strata higher in the section. Due to this mode of origin, pieces of the green sh. above *Abilene ls.*, as it might better be named, have been included in some places in this massive bed of secondary ls. It can no more be called a cgl. than the top memb. of the Herington, which is often similarly altered at type vicinity.

W. A. Ver Wiebe, 1937 (letter dated April 15). Geologists of Wichita and other parts of Kans. are agreed as to Tert. age of Abilene cgl.

Named for Abilene, Dickinson Co.

Abilene formation.

Permian: Central and central northern Texas.

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pp. 95–96). *Abilene fm.*—Thin fossiliferous lss. separated by red and blue clays. Thickness 170 ft. Top memb. of Wichita beds. Occurs around Abilene and perhaps southward beneath Callahan Divide. Thins out and disappears to N., but underlying Lueders ls. persists to within a few mi. of Red River.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 45–46). The term *Arroyo fm.* is given to series of soft lss., marls, shales, and gyp., 260 ft. thick in Runnels Co., which occur on and near Los Arroyo, 2¼ mi. W. of Ballinger. There is one persistent bed of gyp. in lower part of fm., and some shales are red. It is apparently the same set of rocks to which Wrather applied *Abilene fm.* in Taylor Co., but that name had already been used for other fms. and *Arroyo* is substituted for it. The correlation of upper part of fm. with the ls. at the standpipe at Abilene was substantiated by W. A. Riney. This fm. is tentatively placed as top memb. of Wichita stage. Differs considerably from underlying Lueders fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 175). The preoccupied name *Abilene fm.* is discarded, and is replaced with *Arroyo fm.*

Abilene limestone.

See 1925 entry under *Abilene cgl.*

Abitibi group.

Pre-Cambrian: Quebec.

M. E. Wilson, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 276). *Abitibi group*, pre-Camb. (Keewatin?).

Abitibi River formation.

Devonian: Ontario.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 341, 373, 375). *Abitibi River ls.*, Dev., Canada.

R. H. Hawkins, 1933 (Am. Inst. Min. Met. Engrs., Contr. No. 40, p. 1), assigned *Abitibi River fm.* to Middle Dev.

Abo sandstone (also **Abo redbeds**). (Of Manzano group.)

Permian (lower): New Mexico (widespread).

W. T. Lee, 1909 (U. S. G. S. Bull. 389). *Abo ss.*—Coarse-grained ss., dark red to purple, usually conglomeratic at base; with subordinate amount of sh., which attains prominence in some places. Thickness 300 to 800 ft. Upper limit is drawn below the gyp., for obvious reason that in many places the overlying or Yeso fm. contains beds of gyp. and gypsiferous sh. at several horizons, through a thickness in some places of 1,000 ft. or more. Is basal memb. of Manzano group and rests uncon. upon Magdalena group. Named for Abo Canyon, at S. end of Manzano Range.

Abram conglomerate.

Pre-Cambrian: Western Ontario (near Sioux Lookout).

F. J. Pettijohn, 1930 (Jour. Geol., vol. 38, No. 6, pp. 568–573). Imbricated arrangement of pebbles in several bands of a pre-Camb. cgl. (which writer has chosen to call *Abram cgl.*), near Sioux Lookout, western Ont., is described. The Abram cgl. in all belts contains varied assemblage of pebbles; granites, greenstones, and green schists, felsites, metadiorites, metadiabases, and quartz are most common. One belt of the cgl. occurs on shores of Abram Lake.

Abram series.

Pre-Cambrian: Ontario (Abram Lake region).

F. J. Pettijohn, 1934 (Cgl. of Abram Lake, Ont., and its extensions: Geol. Soc. Am. Bull., vol. 45, pp. 480, 481, 484, 486–505). In 1930 (Jour. Geol., vol. 38, pp. 568–573) writer described and named *Abram series.* [His 1930 paper introduced *Abram cgl.*, which appears to apply to only basal part of this *Abram series.*] *Abram series* consists of (descending): (1) Mica schists(?); (2) sl. and sl. cgl. alternating, 1,000+ ft.; (3) graywackes, siltstones, slates, tuff slates, cherty slates, and iron fm., 1,250 ft.; (4) qtzite, some green schists, and rhyolite porphyry, 50 to 700 ft.: (5) massive to laminated arkosite with sporadic granite pebbles, underlain by massive arkosite with pebbles and boulder beds, 5,300 ft.; (6) boulder cgl., 0 to 1,000 ft.; (7) basal brown grit, 30 to 100 ft. Rests, with great uncon., on post-Keewatin intrusives, and underlies post-Abram intrusives ("Algoman").

Abrams mica schist.

Pre-Cambrian (?): Northern California (Trinity and Shasta Counties).

O. H. Hershey, 1901 (Am. Geol., vol. 27, pp. 225–245). *Abrams mica schist.*—Composed of thin folia of muscovite of dull colors (gray, light-brown, yellow and dull red) separated by irregular layers of white quartz, representing the original laminae. Very highly siliceous throughout. Is of sed. origin, being originally a series of argill. ss. beds in part finely laminated. Thickness about 1,000 ft. in upper Coffee Creek section, but may be much thicker at Bully Choop, to S. Named for Abrams P. O., in upper Coffee Creek region.

According to J. S. Diller (unpublished ms. on Weaverville quad.) the Abrams mica schist is 5,000 ft. thick.

N. E. A. Hinds, 1932 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 11, pp. 375–410), introduced *Siskiyou terrane* to include Abrams and Salmon fms.

Abrigo limestone.

Upper Cambrian: Southeastern Arizona.

F. L. Ransome, 1904 (U. S. G. S. P. P. 21). *Abrigo ls.*—Distinguished from other calc. fms. of Paleozoic by prevailing thin bedding, and particularly by conspicuous laminated structure produced by alternation of thin irregular sheets of chert with layers of gray ls.; the ls. layers are 2 to 3 inches thick, the chert layers usually thinner. Dominant color dark greenish yellow. Very fissile greenish yellow calc. shales are generally characteristic feature of lower half of Abrigo. Thickness 770 ft. Rests conformably on Bolsa qtzite and is apparently conformably overlain by Martin ls. (Dev.). Named for exposures in Abrigo Canyon, 3 mi. SW. of Bisbee. In Mount Martin section upper limit of Abrigo fm. is defined by a bed of pure white qtzite 8±ft. thick. This qtzite is persistent and is always found immediately underlying the Martin ls., which carries Dev. fossils. It apparently records the consummation of an increasing supply of sandy sediments during later phases of deposition of Abrigo ls. and contrasts with the more purely calc. beds of overlying Dev. fm.

N. H. Darton, 1925 (Univ. Ariz., geol. ser. No. 3, Bull. 119, pp. 48–51). Fossils collected from Abrigo ls. are now classified as Upper Camb. by E. Kirk and C. E. Resser; but it is possible that the higher beds may prove to be Ord.

A. A. Stoyanow, April 30, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 461–540), divided Abrigo ls. of Bisbee dist. (type area) into (descending): Copper Queen ls. (Upper Camb.), new name, 81 ft.; *Abrigo fm.* [restricted] (Upper Camb.), 420 ft.; and Cochise fm. (Middle Camb.), new name, 200 ft. The U. S. Geol. Survey has not yet had occasion to consider these innovations.

Acadia series.

A variant of *Acadian series.* Proposed by G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108).

Acadian series (or epoch).

Geographic name for Middle Cambrian deposits and the time covered by their deposition. For definition see U. S. G. S. Bull. 769, pp. 98–100.

Acadian disturbance.

A term applied by C. Schuchert and C. O. Dunbar (Textbook Geol., pt. 2, p. 65, 1933) to diastrophic movements in late Dev. and earliest Miss. time.

Acauminac formation.

Devonian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 208). *Acauminac fm.*, Dev., Canada.

Only record of name.

†Accabee gravels.

†Accabee phos-gravels.

Pleistocene: Southern South Carolina (Charleston County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 12, 20, 21). Resting on Bohicket marl sands a bed of coarse gravel (⅛ inch diam.) occurs, and embraces rounded lumps of phosphate rock and numerous quartz pebbles (2''); its littoral line overlaps and extends more northerly than Bohicket marl-sand. Along northerly exposures it attains elev. of 16 ft. (M. L. T.). This bed, which is generally missing, attains in places thickness of 4 ft.; it affords the irregular seam of phosphate rock known to miners as "flying rock." Is a marine deposit.

C. W. Cooke (personal communication, 1935). The beds described are a facies of Pamlico fm.

Named for exposures in pit at Corn Hill, near Accabee Flats, W. of Charleston.

†Acila shales.

A paleontologic name applied in early repts to Olig. beds in NW. Oreg. that were later named *Nye fm.* by H. G. Schenck. Contain sp. of *Acila.*

Ackerman formation. (In Wilcox group.)

Eocene (lower): Mississippi and southwestern Alabama.

E. N. Lowe, 1913 (Miss. Geol. Surv. Bull. 10, pp. 23–35). Lowest div. of Wilcox fm. might well be called *Ackerman beds*, because typically exhibited in great cut 1 mi. E. of town of Ackerman [Choctaw Co., NE. Miss.]. Consists of dark gray clays and sandy clays, lignite clays and lignite with occasional beds and concretionary masses of carbonate ore. Thickness 400 ft. Underlies Holly Springs sand and conformably overlies Midway group.

In present usage of names the Wilcox is treated as a group and the Ackerman as basal fm. of that group. The Ackerman represents lower part of Nanafalia fm. of Ala. as originally defined, but Nanafalia fm. has been restricted by C. W. Cooke to beds overlying Ackerman fm. (†Coal Bluff beds of early Ala. repts), which extends a short distance into Ala. (See under *Nanafalia fm.*, also under *†Coal Bluff beds.*)

Acme dolomite. (In Blaine formation.)

Permian: Central northern Texas and Texas Panhandle (Hardeman to Stonewall Counties).

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, p. 951 and pl. 9). *Acme dol.*—Above Mangum dol. the first prominent dol. is a series of several beds, 1 to 6 ft. thick, which has been called the Acme, from type exposure in Hardeman Co., where thick beds of gyp. below the dol. are mined. The Acme is traced southward to Stonewall Co. and may be correlated with reasonable certainty with McCaulley beds of Fisher Co. It lies 64 ft. above Mangum dol. and 90 ft. below Guthrie dol.

See also 1933 entry under *McCaulley dol.*

Acworth gneiss.

Pre-Cambrian: Northwestern Georgia (Cartersville district).

C. W. Hayes, 1901 (Am. Inst. Min. Engrs. Trans., vol. 30, p. 408). The extreme SE. corner of mapped area is occupied by *Acworth gneiss*, which, like Corbin granite, is probably Archean in age, and formed the foundation on which oldest sediments of region were deposited.

Appears to be same as Carolina gneiss. Named for development around Acworth, Cobb Co.

Ada formation.

Pennsylvanian: Central southern Oklahoma (Pontotoc and Seminole Counties).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 128–132, pls. 3, 27, and map. Name was also used by Morgan, but not defined. in Okla. Geol. Surv. Circ. No. 12, pl. and p. 15, 1923). *Ada fm.*—Ls. cgls. and coarse sss. are very prominent along greater portion of outcrop. The shales are mostly light colored. Near base is a thin black ls. that is very persistent in vicinity of Ada. Clastic material becomes less toward N. and in vicinity of Vamoosa is very scarce. With decrease in amount of clastic material the fm. becomes thinner. Average thickness is 100± ft. At N. edge of quad. it is only 60± ft. thick. Contains asphalt. Fossils scarce. North of Canadian River it appears to rest conformably on Vamoosa fm., but to S. it overlaps Vamoosa and several older fms. Underlies Vanoss fm.

Named for development within and to W. of town of Ada, Pontotoc Co.

Ada shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia, southwestern Virginia (Tazewell County), and eastern Tennessee (?).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe and Summers Counties, pp. 300, 421). *Ada shale.*—Olive green, fissile, calc. toward base, 30 to 60 ft. thick. Marine fossils. Underlies Talcott sh. and overlies Reynolds ls., all members of Bluefield group [fm.]. Type loc. on N. side of East River, in public road btw. Ada and Stony Gap, and less than ¼ mi. W. of Ada, Mercer Co. Also observed in Monroe and Summers Counties, W. Va.; in Tazewell Co., Va.; and far down in Tenn., being quite typical at Daisy, Hamilton Co. Can be traced NE. in W. Va. nearly to head of Greenbrier Valley and possibly to southern Pa.

Adair moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U.S.G.S. Mon. 53. Named for Adair, St. Clair Co.

Adamana shales.

Lower Triassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 335). *Adamana shales* proposed for Ward's 4th sh. bed above Aubreyan lss. [Kaibab ls.] in Moenkopian section of Navajo country. Exposed in full thickness (200 ft.) near R. R. station of Adamana, Apache Co.

Adams Branch limestone memb. (of Graford formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 391). *Adams Branch ls.*—Hard, fossiliferous, unevenly textured, bluish ls., base somewhat aren. in places. Thickness 25 to 30 ft. Memb. of Canyon div. Underlies Cedarton bed and overlies Brownwood bed. [Type loc. is Adams Branch, Brown Co., close to town of Brownwood.]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 34; Univ. Tex. Bull. 2132, pp. 59, 84, 96, 101, 102, 114). *Adams Branch ls.* is top memb. of

Graford fm. in both Brazos River and Colorado River valleys. Is 10 to 30 ft. thick in S. part of area and 100 locally to N. Is massive escarpment-forming ls. Forms escarpment 100 to 150 ft. high. Underlies Cedarton sh. and ss. and overlies Brownwood memb. of Graford fm. In Brazos River valley underlies Seaman Ranch sh.

E. H. Sellards, 1931 (News Letter from Bur. Econ. Geol. Univ. Tex., dated Sept. 1931), stated that *Adams Branch ls.* is approx. same as Palo Pinto ls., and treated it as a memb. of Palo Pinto fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 111), extended top of Graford fm. up to top of Merriman ls. (Clear Creek ls. of Drake), which had been mistaken for Adams Branch ls. in some previous repts, but which is a much younger ls. (See 1933 entry under *Graford fm.*) This definition of Graford fm. was adopted by U. S. Geol. Survey in 1935.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), drew top of Graford fm. of Colorado River region at top of Adams Branch ls. memb.

In 1935 the U. S. Geol. Survey adopted (for rept by Wallace Lee and C. O. Nickell, soon to be published by Tex. Geol. Survey) a definition of Graford fm. that included in it a great thickness of rocks younger than true Adams Branch ls. of Colorado River region. (See under *Graford fm.*)

Adamsian.

A time term employed by C. [R.] Keyes to cover rocks of Cordilleran region interpreted as having been formed during middle part of Huronian epoch. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Adams Lake series.

Adams Lake group.

Names applied by Canadian geologists to rocks of pre-Camb. age in Adams Lake region of southern British Columbia. (See G. M. Dawson, 1890, Canada Geol. Surv., n. s., vol. 4, pp. 29B, 31B.)

Adaville formation.

Upper Cretaceous: Southwestern Wyoming.

A. C. Veatch, 1907 (U.S.G.S.P.P. 56). *Adaville fm.*—Yellow, gray, and black carbonaceous clays, with irregularly bedded brown and yellow sss. and numerous coal beds. South of Hodges Pass tunnel there is at base a prominent white ss. (*Lazeart ss. memb.*), 100 to 200 ft. thick, immediately above which is Adaville-Lazeart coal, 20 to 84 ft. thick, and associated with it beds containing plants and invertebrate remains older than Laramie; the overlying strata contain lower Laramie leaves. Thickness of fm. 4,000+ft. Uncon. underlies Evanston fm. and overlies Hilliard fm. At Adaville mine, 2 mi. S. of Hodges Pass tunnel, on Oregon Short Line, a bed of coal 84 ft. thick has been cut, and as whole fm. shows a like phenomenal amount of coal, and is, moreover, well exposed at this point, it has been named *Adaville fm.*

Addington sandstone member (of Wise formation).

Pennsylvanian: Southwestern Virginia (Wise and Scott Counties).

J. B. Eby, 1923 (Va. Geol. Surv. Bull. 24). *Addington ss. memb.*—Hard white ss., 20 to 40 ft. thick, underlying Addington coal and resting on Clintwood coal or separated from it by few ft. [0 to 20, according to A. W. Giles, Va. Geol. Surv. Bull. 26, 1925] of sh. Named for Addington Station, 1½ mi. S. of Glamorgan, Wise Co.

Addington formation.

Permian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 8–9, etc.). *Addington fm.*—Uppermost memb. of red beds exposed in Jefferson Co. Few ft. to several hundred ft. thick; max. thickness on high bluffs just E. of Addington (Jefferson Co.). Is characterized by the brilliant red and vermilion hues of its sh. members, which are often broken by white and light-gray sh. and sandy sh. streaks. The sss. are characterized by black red color and slabby appearance on weathering. The weathered slabs are extremely hard and resistant. When freshly broken they resemble fine-grained reddish qtzite. In general the sss. show varying amount of pink or red color unless subjected to constant water saturation, in which case they are sometimes soft and light colored. Base is generally characterized by thin to massive, resistant, reddish ss. There is some evidence these beds are not entirely conformable with underlying Claypool fm. (Penn.). The Addington contains the only beds in county that are typical of lower Perm. red beds of Okla Assigned to Perm.

Addison formation.

Middle Ordovician (Trenton): Northwestern Vermont (Addison County).

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., pp. 275–279). *Addison fm.* [heading].—In central part of Ferrisburg Twp [NW. part of Addison Co.] there is a broad flat valley covered with Champlain clays through which protrude occasional knots of sh. and calcilutyte. The transition from the ls. to the shaly ls. and sh. is imperceptible. No contacts seen, but the change in kind of sediment is evident. The sh. is sometimes crossed by cleavage lines of sl. No fossils known. Since this broad band of sediment appears to be so distinct through 5 Twps it is proposed to distinguish it by the name *Addison shaly ls.* It is considered to be a local facies equiv. in age to the Canajoharie. [In tables on pp. 279 and 288 this fm. is called *Addison sh.*]

Addy quartzite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 61, map). *Addy qtzite.*—Chiefly massive, hard, crystalline, light-colored qtzite. Associated with it in subordinate amounts are belts of quartz mica schist highly metamorphosed banded slates, and well banded qtzites with much white mica developed. In vicinity of Addy the hard massive phase grades over into alternating interbedded qtzites and argillites in bands from a few inches to several ft. thick. Thickness 8,000± ft. Overlies Deer Trail argillite and underlies Chewelah argillite and Old Dominion ls.; apparently conformable both above and below.

Adelphian.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 45, pp. 150–151, 1926) to replace *Nebraskan*, as applied to Pleist. pre-Kansan till, "because of use of Nebraskan for other deposits." Derived from hamlet of Adelphi "8 mi. or so SE. of Des Moines, Iowa."

Adirondack gneiss.

Pre-Cambrian: Northeastern New York (Adirondack region).

C. H. Hitchcock, 1879 (Macfarlane's Geol. Ry Guide, p. 56). *Adirondack gneiss* included in Laurentian.

F. J. H. Merrill, 1901 (geol. map of N. Y.). *Adirondack gneiss (gneisses including granites).* [Mapped over large part of Adirondack region. The block is placed beneath the Grenville blocks, and according to later mapping the rocks are chiefly of igneous origin.]

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 82). [See 1930 entry under *Adirondack anorthosyte.*]

Adirondack anorthosyte.

Pre-Cambrian: Eastern New York (Adirondack Mountains).

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 82). It is pretty generally agreed that at about middle of Precambrian 3 igneous masses invaded Adirondack area. These were (1) the anorthosyte, (2) the "syenyte" and allied "granits," and (3) the "basic gabbros." Local expressions of these have cognomens, but there is need for a general term for each. It is here proposed to call them respectively by names long unofficially in use by some of us, respectively: (1) The *Adirondack anorthosyte;* (2) the *Ausable "syenyte" or nordmarkyte series* (named for development along Ausable River and in quarries around Ausable Forks, N. Y.; and (3) the *Elizabethtown gabbros* (named for development around Elizabethtown, N. Y.). The names *Mount Marcy, Whiteface,* and *Split Rock* [where published?] apply only to local differentiation and assimilation phases of the anorthosyte, of which *Marcy type* is most widespread and typical; and while term "Adirondack gneisses" has sometimes been loosely employed without definition for the Precambrian rocks of northern N. Y. as a whole, it lacks currency today and can have no claim against the appropriate application of *Adirondack* to the anorthosyte mass that constitutes all the high central peaks of true Adirondack Mtns. A cataclastic phase of this rock from S. of Ausable Forks, N. Y., has gone on market as "Adirondack granite."

Adirondack granite.

Trade name for a part of Adirondack anorthosyte of Chadwick.

Admiral formation. (In Wichita group.)

Permian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192–195 and charts). *Admiral fm.*—Basal fm. of Wichita group. Includes all strata btw. top of Coleman Junction ls. memb. of underlying Putnam fm. and top of Elm Creek ls. Thickness 270 to 350 ft. Named for village of Admiral, Callahan Co. [For subdivisions see 1922 entry under *Coleman bed.*]

Admiralty drift.

Pleistocene (pre-Wisconsin): Western Washington (Puget Sound region) and British Columbia.

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Admiralty till and clays.*—In order to give them distinctive names it appears desirable the term "till" should be restricted to the unstratified deposits and the simple term "clays" be applied to the stratified fms. Principal exposures in bluffs along shores of Admiralty Inlet.

Admiralty glacial epoch.

Pleistocene (pre-Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Admiralty glacial epoch.*—Covers Admiralty till and clays. Preceded Puyallup interglacial epoch.

Admire shale. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and southwestern Iowa (?).

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 53). *Admire shales.*—Fossiliferous shales, 40 ft. thick, overlying Emporia ls. and underlying Americus ls. [C. S. Prosser (Jour. Geol., vol. 10, p. 707, 1902) gave thickness of rocks btw. Emporia and Americus lss. as 300 ft., consisting chiefly of shales but including many thin beds of coal, and ss.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 72, 81, etc.). *Admire sh. memb. (revised).*—Adams in proposing *Admire* in 1903 introduced it for the shales lying btw. Emporia ls. and Americus ls., with thickness of 40 ft. Just what bed or beds Adams erroneously correlated as Emporia ls. in arriving at thickness of 40 ft. is not known. It may have been Falls City ls., which is poorly exposed SW. of Admire [Lyon Co., Kans.], about 60 ft. below Americus ls. It could not have been Emporia ls., which is much lower in section and does not crop out in this vicinity. Only upper part of Admire as later recognized by Prosser, Haworth, Moore, and others is exposed at Admire, which means that *Admire* as now used is not properly applied. The Admire sh. of Kans. geologists extends from base of Americus ls. down to top of Emporia ls. The Nebr. Geol. Survey is to use *Admire sh. memb.* for the beds beneath Americus ls. down to base of Brownville ls., because this portion of the section constitutes about what Adams defined as a memb. The Brownville ls. outcrops on creek just NE. of Admire and Americus ls. is exposed SW. of it. The Admire sh. memb. as thus revised is here divided into (descending): (1) West Branch sh., 24± ft.; (2) Falls City ls., 4± ft.; (3) Aspinwall sh., 25± ft.; (4) Brownville ls., 4± ft.

R. C. Moore, 1929 (Kans. Geol. Surv. Bull. 12, p. 43, footnote). As revised by G. E. Condra, "Admire sh." as here used includes, in ascending order, Willard sh., Tarkio ls. (apparently absent in southern Kans.), McKissick Grove sh., and *Admire sh. (restricted).* The Kans. Geol. Survey accepts this revised classification.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), discarded his 1929 definition of Admire sh., and adopted a still further restricted definition, i. e., for the beds *overlying* Brownville ls. and underlying Americus ls. (Brownville ls. being treated as a distinct unit); and divided it into (descending) West Branch sh., Falls City ls., and Aspinwall sh. Moore and Condra in their Oct. 1932 revised classification chart for Kans. and Nebr.

defined Admire sh. as underlying Americus ls. and overlying Brownville ls., but they transferred to it, at top, Houchen Creek ls. and Stine sh., which had previously been included in overlying Elmdale sh. They divided Admire sh. into (descending) Oaks sh., Houchen Creek ls., Stine sh., Five Point ls., West Branch sh., Falls City ls., Hawxby sh., Aspinwall ls., and Towle sh. Their Oaks sh. was apparently previously included in Elmdale sh., which overlies Americus ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 8–9), and R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 50), used *Admire group* to include the same subdivisions mentioned in 1932 definition above.

The Kans. and Nebr. Geol. Surveys now include the Admire in Perm. The U. S. Geol. Survey has not yet considered this change in bdy btw. Perm. and Penn. nor the restricted definitions of Admire. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Admire group.

Name used by G. E. Condra (1935) in SE. Nebr., instead of *Admire sh.* For subdivisions see Kans.–Nebr. chart compiled by M. G. Wilmarth, 1936.

Adolphus formation.

Cambrian: British Columbia.

L. D. Burling, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 109). *Adolphus fm.*, Camb., B. C. [In 1923 (Geol Soc. Am. Bull., vol. 34, pp. 725, 741) Burling called the fm. *Adolphus ls.*]

Aetna.

Permian: Western Oklahoma and Kansas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, p. 353). *Aetna*, from Aetna (Barber Co.), is here proposed as common name for Glass Mtn and Cave Creek fms., expressing the genetic and chemical relationship btw. them. [In table is called *Aetna cycle of precipitation of gyp.*]

Includes Blaine fm. and upper part of Enid fm.

Afton terrane.

Pleistocene: Iowa and Kansas.

C. R. Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, p. 148). *Afton terrane.*—Sands, 40 ft. thick, underlying Kansas till and overlying Nebraska till in Iowa.

Same as Aftonian of other geologists.

Aftonian stage of deglaciation (Pleistocene).

Aftonian stage is name applied to interglacial stage during which the Aftonian soil, gumbotil, vegetal and other interglacial deposits were formed. This stage followed the oldest or Nebraskan stage of glaciation and preceded the second or Kansan stage of glaciation. The name, which was introduced by T. C. Chamberlin (Jour. Geol., vol. 3, pp. 270–277, 1895), was derived from exposures btw. Afton and Thayer, Iowa.

Agamenticus complex.

Devonian (?): Southwestern Maine (York County).

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 149, 152–154). *Agamenticus complex.*—Chiefly biotite granite (dominant phase), alkaline granite, and syenite, also the small stock of Berwick quartz diorite (apparently later than main biotite granite), and other small bodies, such as those along S. side of York Harbor [see York Harbor biotite granite] and along NE. side of Brave Boat Harbor [see Brave Boat Harbor granite]. Three of dominant rock types occur on slopes of Mount Agamenticus. Assigned to Dev. (?).

Agassiz.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region.

Agassiz series.

Jurassic: Southwestern British Columbia.

N. L. Bowen, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 258). *Agassiz series,* Paleozoic, B. C.

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132). *Agassiz series,* Jurassic, B. C.

Agassiz Prairie formation.

Upper Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132). *Agassiz Prairie fm.,* Jurassic, B. C.

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, map, p. 487). *Agassiz Prairie fm.*—Argillite, 5,000 ft. thick, yielding *Anacardioceras perrini.* Assigned to Upper Jurassic. Uncon. underlies Peninsula fm. (Lower Cret.) and overlies Kent fm. (Upper Jurassic).

Agate Bay group.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 143–146). *Agate Bay group.*—Succession of relatively very thin beds with very highly vesicular stratiform amygdaloids, which must make up two-thirds of group; includes thin seams of reddish sss. and cgls. Overlies Lester River group and underlies Beaver Bay group, all included in Keweenaw series. Exposed on Agate Bay, NE. of Duluth.

Agathla sandstone.

Lower Triassic: Northeastern Arizona (Navajo County) and southeastern Utah.

D. Hager, 1924 (Min. and Oil Bull., vol. 10, No. 2, p. 137; No. 4, pp. 383–384, 423, 437). *Agathla ss.*—Pinkish ss., 10 to 15 ft. thick, a local representative of Moencopie beds. Uncon. underlies Shinarump cgl. near Agathla Peak, NE. Ariz. [N. part of Navajo Co.].

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, p. 1441, etc.). [See note under *Agathla sh.*]

Agathla shale.

Lower Triassic: Northeastern Arizona (Navajo County) and southeastern Utah.

D. Hager, 1924 (Min. and Oil Bull., vol. 10, No. 2, p. 137; No. 4, pp. 383–384, 423, 437). *Agathla sh.,* 40 to 50 ft. thick, underlies Agathla ss. and overlies Kaibab ls. near Agathla Peak, NE. Ariz. [N. part of Navajo Co.]. Is local representative of Moencopie beds.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1441, etc.). The Agathla ss., Agathla sh., Kaibab ls., Coconino ss., and underlying sh. of Hager's 1924 rept all belong to true Moenkopi fm.

Agawa iron-formation member (of Knife Lake slate).

Pre-Cambrian (Knife Lake series): Northeastern Minnesota (Vermilion district) and western Ontario.

J. M. Clements, 1903 (U. S. G. S. Mon. 45). *Agawa fm.*—Petrographically same as Soudan fm. Is iron bearing, 0 to 50± ft. thick. Conformably underlies Knife Lake slates and grades into underlying Ogishke cgl. Named for exposures on shores of Agawa Lake, Ont., 1½ mi. N. of int. bdy.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), included *Agawa iron-fm. memb.* and Ogishke cgl. memb. in Knife Lake sl., which they tentatively removed from Huronian series and assigned to their Knife Lake series (pre-Huronian and post-Laurentian).

†Agnotozoic era.

A term that has been used to include all pre-Camb. time, and also applied (originally) to the part of pre-Camb. time that was formerly called "Algonkian period." See U. S. G. S. Bull. 769, pp. 14–16.

†Agoniatite limestone.
†Agoniatites limestone.

Paleontologic terms applied in some early N. Y. repts. to a ls. occurring at a lower horizon in Marcellus sh. than Stafford ls. Disappears W. of Seneca Lake. Most fully developed in eastern N. Y. counties 20 to 30 ft. above base of Marcellus.

Agua sandstone member (of Santos shale).

Miocene (lower): California (Temblor Range).

L. M. Clark and A. Clark, 1935 (A. A. P. G. Bull., vol. 19, No. 1, p. 137). A ss. memb. in upper part of Santos sh., that is traceable from vicinity of Carneros Creek to mouth of Cedar Canyon, several mi. farther NW., and in places reaches thickness of 300+ ft., is here referred to as "Agua ss." It contains Vaqueros fossils at several localities.

Aguacate series.

Age (?): Costa Rica.

J. Romanes, 1912 (Geol. Soc. London Quart. Jour., vol. 69, p. 122).

Aguadulce formation.

Pleistocene: Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 258).

Agua Fria.

Probably lower Mesozoic: Sierra Nevada, California.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Agua Fria slates, lss., cherts, and tuffs,* 2,000+ ft. thick. Top fm. of Tuolumne group (probably lower Mesozoic) on Merced River and southward into Indian Gulch quad.

Aguas Buenas limestone.

Cretaceous (?): Puerto Rico.

D. R. Semmes, 1919 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 1, p. 64).

Agueguexquite formation.

Miocene: Vera Cruz, Mexico.

H. E. Thalmann, 1935 (Geol. Soc. Am. Proc. 1934, p. 116).

Aguja formation.

Upper Cretaceous (Gulf series): Western Texas (Brewster County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 271, 505). *Aguja fm.*—When in 1907 Dr. Udden described his "Rattlesnake" fm., the name had already been used for a fm. in Oreg. Pliocene. Accordingly the name *Aguja* is here substituted for Udden's name. Type loc. is Sierra Aguja (Needle Peak), in the flat in front of Santa Helena fault scarp, 6 mi. S. of Terlingua, Brewster Co. The slopes and surrounding flats contain a practically complete section of the beds, overlain by Tornillo clay, and situated close to Udden's original type loc. [Distribution and fossils discussed.] Upper part of fm. is of Navarro age and lower part of Taylor age.

Ahtell diorite.

Carboniferous: Southeastern Alaska (central Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 38, map). *Ahtell diorite.*—Intrusive. Chiefly quartz diorite or quartz diorite porphyry. Probably mainly upper Carbf. and perhaps extending into Perm. Composes hills drained by W. tributaries of Ahtell Creek.

Aibonito conglomerate.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

†Aiken beds.

Pliocene (?) and Upper Cretaceous: Western South Carolina (Aiken County).

E. Sloan, 1904 (S. C. Geol. Surv., ser. 4, Bull. 1, p. 72). *Aiken beds.*—The deposits exposed at Aiken, which include (descending) : Plio. (?), 40 ft. (divided into eolean sands, 8 ft.; Lafayette cobbles, 2 ft.; Lafayette loams, 10 ft.; Lafayette mottled clay, 6 ft.; coarse sands, 13 ft.; pebbles, 1 foot) ; Cret., 274 ft. (divided into Middendorf beds, 93 ft.; Upper Hamburg beds and Lower Hamburg beds, 181 ft.).

Ainoni volcanics.

Pleistocene (late) : Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and Gd. Water Res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Ainoni volcanics.*—Basalt and cinders. The basalt forms massive walls along Ainoni and Maunawili Streams and generally shows columnar jointing. Included in middle part of Honolulu volcanic series [q. v.]. Named for Ainoni Spring, which issues from E. margin of the basalt.

Ainslie sandstone.

Carboniferous (Mississippian) : Nova Scotia.

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 324).

Ainsworth formation.

Ainsworth series.

Paleozoic: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 60) ; 1920 (Canada Geol. Surv. Mem. 117, p. 11). *Ainsworth fm.* included in *Ainsworth series.*

Ainsworth formation.

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

F. Ward, 1922 (S. Dak. Geol. and Nat. Hist. Surv. Bull. 11). The Pierre of SE. part of Pennington Co. and SW. part of Jackson Co., S. Dak., includes at top 35 ft. of thin-bedded sandy sh., of predominantly yellow brown color but variegated with browner and purpler colors in upper part. These beds are called *Interior phase of Pierre.* The fossils warrant placing them in Pierre, although in field they were called *Fox Hills.* If accepted as Pierre the strong color contrast and sandier texture require explanation. The Nebr. Surv. has called these beds *"Rusty memb." of Pierre* (E. F. Schram, personal communication). They grade into underlying Pierre.

H. J. Cook, 1922 (Pan-Am. Geol., vol. 37, No. 5, pp. 421–424). The "Rusty" memb. of Pierre shales, or *Ainsworth fm.*, as it is sometimes called, uncon. underlies Chadron fm. to S. and E. of Black Hills uplift in S. Dak. and Nebr.

Air Point granite.

Pre-Cambrian: Southwestern Virginia (Roanoke County region).

A. I. Jonas, 1933 (Geol. Soc. Am. Bull., prel. list of titles and abstracts, vol. 44, pp. 29–30). *Air Point granite.*—Pink, orthoclase-microcline granite that intrudes granodiorite in Virginia Blue Ridge region. Is pre-Camb., as Lower Camb. sediments contain fragments of it.

A. S. Furcron, 1934 (Jour. Geol., vol. 42, pp. 407–410). *Air Point granite* was named by Jonas, from Air Point on Bent Mtn, Roanoke Co. Is widespread in Park area. Is probably youngest intrusive in dist., except some dikes, and is believed to be younger than Old Rag granite.

Aitkin formation.

Pre-Cambrian (upper Huronian) : Central Minnesota (Aitkin, Crow Wing, and Cass Counties).

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 101–106). The Upper Huronian (Cuyuna series) of Cuyuna dist. is lithologically divided into 3 conformable fms. (descending) Crow Wing fm., Aitkin fm., and basal cgl. The Aitkin fm. consists of gray slates and phyllites. It contains some iron carbonate, but extensive iron-bearing lenses are virtually lacking, and volcanics are absent.

It is nonmagnetic. It underlies large area in N. and E. parts of Aitkin Co., and extends into Crow Wing and Cass Counties.

†Ajax quartzite.

Middle Cambrian: Southeastern Arizona (Tombstone district).

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Ajax qtzite*, 500 ft. thick, overlies [?] Randolph ls. and underlies Emerald ls.

F. L. Ransome, 1920 (U. S. G. S. Bull. 710D). "Ajax" qtzite of Church is Bolsa qtzite.

Ajax limestone.

Lower Ordovician: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Ajax ls.*—In descending order: (1) Dark bluish gray cherty mag. ls., upper part calc., 440± ft.; (2) Emerald dol. memb. (30 to 40 ft. of cream white dol.); (3) dark-gray clouded dol. or highly mag. ls., partly cross-bedded and in part consisting of thin conglomeratic beds, also many thin lenses and nodules of light-gray chert, with qtzite and ls. cgl. at base, 90 ft. Grades into overlying Opohonga ls. and uncon. overlies Opex dol. Named for Ajax mine.

Ajibik quartzite.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 540+). *Ajibik qtzite.*—Has two main areas: A western one in which it rests upon Archean, and an eastern one in which it rests on Wewe sl. Where it rests on Archean the basal part is a cgl. or recomposed rock, the material of which is derived mainly from immediately subjacent fm. These basal cgls., slates, and graywackes quickly grade up into qtzite. Where the Ajibik rests on Wewe sl. there is usually an intermediate phase or interstratification of the two. In one exceptional locality (in sec. 6, T. 47 N., R. 25 W.) the basal memb. of the qtzite is a cgl. interstratified with sl., the fragments of the cgl. being mainly from Wewe sl. Central part of fm. in its ordinary phases is a rather pure, typical, vitreous qtzite. In some places this qtzite becomes conglomeratic and bears small pebbles of white quartz or red jasper. In other places it is interstratified with belts of mica sl. or graywacke. Thickness of fm. 700 to 900 ft. Conformably underlies Siamo sl. Typical exposures on Ajibik Hills, NE. of Palmer.

Akins shale member.

Pennsylvanian: Central eastern Oklahoma.

J. A. Taff, 1905 (U. S. G. S. Tahlequah folio, No. 122). *Akins sh. memb.*—Chiefly blue and black clay sh., with thin sss. Thickness 175 ft. Top memb. of Winslow fm.

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, p. 503). The Atoka, Hartshorne, McAlester, and Savanna fms. and a part of Boggy sh. are directly traceable into Winslow fm. as heretofore mapped in Muskogee Co. [Wilson identified the subdivisions enumerated above and did not use *Winslow fm.*]

T. A. Hendricks, C. H. Dane, and M. M. Knechtel, 1936 (A. A. P. G. Bull, vol. 20, No. 10, p. 1347). *Winslow fm.* is now abandoned. Wilson has recognized in it Atoka, Hartshorne, McAlester, Savanna, and Boggy fms.

It is still undet. to which of fms. into which †Winslow fm. is now divided the Akins sh. memb. belongs. (H. D. Miser, personal communication Feb. 1937.)

Named for Akins, Sequoyah Co.

Akron dolomite.

Silurian (Cayugan): Western New York and Ontario.

A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, pp. 544, 550). *Bullhead or Akron ls.*—Probably =Amherstburg bed of Mich. and Cobleskill of eastern N. Y. Name derived from exposure in village of Akron, Erie Co., N. Y.

The equivalency of the Cobleskill and Akron was accepted by most geologists, who continued to apply *Cobleskill* to the dol. of western N. Y. as well as of other parts of the State. C. A. Hartnagel, 1912 (N. Y. State Hdb. 19, p. 57) stated: *Cobleskill ls.* is absent along its line of outcrop across the State only in part of Albany Co.; in different parts of State it rests on Bertie, Brayman, Rosendale, Decker Ferry, and "Hudson River" fms. In 1917, however, G. H. Chadwick (Geol. Soc. Am. Bull., vol. 28, pp. 173–174) revived *Akron dol.* for western N. Y., stating: "The correlation eastward of the Akron with the Cobleskill remains to be worked out anew, but it is now believed to be substantially correct." The Canada Geol. Survey appears to employ *Akron dol.* for this fm. (See M. Y. Williams, 1919, Canada Geol. Surv. Mem. 111; and Cole, 1925, Ontario Dept. Mines 34th Ann. Rept., vol. 34, pt. 2, p. 10), while U. S. Geol. Survey designates it *Cobleskill dol.* (See Niagara folio, No. 190.) Grabau stated it is same as his Greenfield ls. (See under *Greenfield ls.*)

H. L. Alling, 1928 (N. Y. State Mus. Bull. 275, p. 21), showed *Akron* as younger than Cobleskill, and gave the sequence of beds given by Chadwick: Akron, Williamsville, Scajaquada (=Cobleskill), Falkirk, Oatka, but stated: Position of Cobleskill is still a matter of doubt. G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 80–82), continued to use *Akron dol.*

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 343–344). ***Cobleskill ls.*** is a typical coral facies, and while it does not show the reef character it has the reef species. To the dolomitic phase in Erie Co. the name ***Akron dol.*** has been applied. The Akron dol. is a little later faunal development than the Cobleskill. [Lists characteristic species of Cobleskill dol., also of ***Akron phase.***]

†Alabama period.

Tertiary: United States.

J. D. Dana, 1875 (Man. Geol., 2d ed., pp. 490–494, 509–510, 523). Time term to include, in Ala., the Vicksburg, Jackson, Claiborne, and Buhrstone, also contemp. deposits in other States. [He also used ***Alabama group.***]

†Alabama.

Eocene (middle): Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). [On this map the name ***Alabama*** (***Claiborne***) is applied to deposits underlying St. Stephens ls. and overlying the Lignitic, and the deposits thus designated are divided into Claiborne above and Buhrstone below.]

Replaced by Claiborne group.

Apparently named for exposures in Ala.

†Alabama white limestone.

Tertiary: Alabama.

T. L. Casey, 1902 (Phila. Acad. Nat. Sci. Proc., vol. 53, p. 513). White ls. exposed on Tombigbee River near St. Stephens and on Alabama River near Claiborne. [Same as †St. Stephens ls. (Olig. and upper Eo.).]

Alachua formation.

Pliocene (lower): Northern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 127–130, 157, 320). ***Alachua clays.***—Deposits of clay containing bones of extinct mammalia. These clays occur in sinks, gullies, and other depressions in Mio., Upper Eo., and later rocks of Fla., especially on W. anticline in higher parts of Alachua Co., and along banks of many rivers and streams. They appear in Alachua Co. to have been subjected to denudation after deposition, so that only those parts protected by their depressed position in cavities or gullies of harder rock remain undisturbed. The clay is bluish or grayish and extremely tenacious, so that it is most difficult to discover remains embedded in it. Occurs in patches, usually in depressions, but occasionally in short ridges whose lateral buttresses of limerock have disappeared through dissolving agency of rain water and carbon dioxide. [Mentions many localities of its occurrence in Alachua Co.]

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., p. 133). *Alachua clay* as here used includes "Peace Creek bone bed" of Dall, "which appears to be a local phase of the fm. which may have been eroded and redeposited in its present condition."

E. H. Sellards, 1914 (Fla. Geol. Surv. 6th Ann. Rept., pp. 161–162). *Alachua clay* and *Dunnellon fm.* are merely different facies of a single fm., and *Dunnellon* should not be used any longer.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *Alachua fm.* is here used to include "Dunnellon" fm., discarded by Sellards. The Alachua is a residual deposit derived from Hawthorn fm. and containing Plio. fossils. It uncon. overlies Ocala ls. or Tampa ls. and is overlain by loose wind-blown sand. The part of fm. to which name *Alachua* was originally applied consists chiefly of clay, accumulated in ponds or sinks, and at least 15 ft. thick. Great bulk of fm. that Sellards called "Dunnellon" is chiefly compact white or gray sand, closely resembling the sand in Hawthorn fm., from which it no doubt is derived. Greater part of Alachua fm. seems not to have been laid down under water. Sellards gives thickness of "Dunnellon" fm. as 75 to 100 ft.

Named for its many exposures in Alachua Co.

Alameda formation.

Pleistocene: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Alameda fm.*—Yellow sandy clay, of very uniform fine texture, which without much change in character passes into beds that carry marine shells. Intercalated with these marine deposits are nonpersistent beds of gravel of fluviatile origin, the conditions indicating delta formation alternating with marine or estuarine deposition. Thickness several hundred ft. Uncon. underlies San Antonio fm. and uncon. overlies Campus fm. Named for fact it is well developed at Alameda.

Alamito shale.

Pennsylvanian: New Mexico.

C. R. Keyes, 1906 (Jour. Geol., vol. 14, pp. 147–154), applied *Alamito shales* to beds said to uncon. overlie Lake Valley ls. Derivation of name not stated.

Alamitos zone.

A subsurface petroliferous zone, about 670 ft. thick, in Fernando group of Long Beach field, Los Angeles Basin, southern Calif. Is lower than Wilbur zone and higher than Brown zone. Includes Booth zone. Named for discovery well Alamitos No. 1.

Alamo sandstone member (of Yegua formation).

Eocene (middle): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1374, 1384). [See under *Mier ss. memb.*]

Alamosa formation.

Late Pliocene or early Pleistocene: Central southern Colorado (San Luis Valley).

C. E. Siebenthal, 1910 (Sci., n. s., vol. 31, p. 745; U. S. G. S. W. S. P. 240, p. 40). *Alamosa fm.*—Blue clays and interstratified sands; some gravel, and occasionally, in depth, boulders. Thickness 725 to 1,250 ft. Of late Plio. or early Pleist. (preglacial) age. Uncon. overlies Santa Fe fm. Occurs at foot of Conejos Range, at foot of Blanca Peak, and at other places. Occupies bottom of San Luis Valley proper. Named for Alamosa, Conejos Co., near center of valley.

†Alaqua phase.

Miocene (middle): Northwestern Florida.

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90–91). *Alaqua phase of the Mio.* is the Chesapeake. It overlies Euchee phase, and has larger shells than the Euchee. It is the fm. of upper bluffs at Abes Spring, and is perfectly and largely developed on bluffs of Yellow River from Ala. line to Milligen, Fla., the most northern of these beds being the low shell landing at Oak Grove, 6 mi. S. of Ala. line.

According to studies of Julia Gardner these beds are Shoal River fm., and Johnson's Euchee phase is probably younger and belongs to Choctawhatchee fm.

Named for Alaqua Creek, Walton Co.

Alaska Bench limestone.

Carboniferous (Pennsylvanian or Mississippian): Central Montana (Big Snowy Mountains).

O. W. Freeman, 1922 (Eng. and Min. Jour.-Press, vol. 113, No. 19, pp. 826–827). *Alaska Bench ls.*—Excessively hard, gray, fossiliferous ls. that weathers red. Forms a series of hogbacks and sloping benches around Big Snowy Mtns. Well exposed on top of Alaska Bench, E. of the Snowies, where it is 100 to 150 ft. thick, and just below it are 300 ft. of white to red sss., interbedded with varicolored sh., here named *Tyler ss.* Is overlain by 100 ft. of nonfossiliferous black sh. usually classified as part of Quadrant but which may in part belong to Ellis fm. [In his generalized section of Quadrant fm. for central Mont., on p. 827, Freeman showed 100 ft. of gray sh. btw. Tyler ss. and Alaska Bench ls., and 100 ft. of black sh. above Alaska Bench ls., all of which he included in the Quadrant.]

Alazan shale.

Tertiary: Mexico.

E. T. Dumble, 1912 (Sci., n.s., vol. 35, p. 907). [Assigned to Eo.]

Many others assigned this fm. to Eo.; but T. W. Vaughan (Geol. Soc. Am. Bull., vol. 35, p. 731, 1924) and C. Schuchert (Hist. geol. Antillean-Caribbean region, 1935, p. 199) assigned it to Olig.

Albanian series.

A term proposed by C. [R.] Keyes to replace Albany ls. (Perm.) of north-central Tex., "until it is made certain the Albany ls. and Vidrio ls. are not one and the same fm." (See Pan-Am. Geol., vol. 57, pp. 350, 351, etc., 1932, and vol. 59, pp. 144, 146, etc., 1933.)

Albany clay.

Pleistocene: Eastern New York and western Vermont.

E. Emmons, 1846 (N. Y. Nat. Hist., Agric., vol. 1, pp. 202–204). ***Albany clay.***—At Albany this Tert. clay is an important material for making brick, and is 10 to 20 ft. thick. In excavations at Albany a boulder is sometimes found in the clay, but always near top. [He also described *Lake Champlain clays*, and stated that the Tert. of the valley of Hudson is continuous with that in the valley or basin of the Champlain, and does not differ essentially from it.]

Asa Fitch, 1850 (Historical, topographical, and agricultural survey of county of Washington [N. Y.], pt. 3, Rocks and soils, pp. 872–878, 890–891). ***Albany clay fm.***—This is the gray and blue clay of the Quat. Div. of Prof. Mather, the Tert. clay or Albany and Champlain clays of Dr. Emmons, in the volumes of the State Natural History. As neither its geological age or name is well settled, I prefer designating it *Albany clay*, a name by which more readers will obtain a definite idea respecting it than by any other. Is well developed at Albany, from thence it reaches N., forming bluffs or river hills upon both sides of the Hudson, and continuously to Fort Ann, if not to Whitehall, and onward through whole length of Champlain Valley, particularly upon its Vt. side. Throughout most of its extent it rests on Hudson River sl., though in places extensive beds of gravel, 30 ft. thick, intervene btw. it and the sl. Is overlain by Saratoga sand fm. Is of blue, brown, gray, and white colors, and 6 to 150 ft. thick.

W J McGee, 1888 (U. S. G. S. 7th Ann. Rept., p. 611). ***Albany clays*** overlie the boulder clay in vicinity of Albany, and both belong to second ice invasion of glacial period.

F. J. H. Merrill, 1903 (N. Y. State Mus. 21st Rept. State Geol., p. r12). The so-called *Albany clays* are somewhat earlier in age than the typical marine clays of Champlain Valley.

J. B. Woodworth, 1905 (N. Y. State Mus. Bull. 84, p. 220). The term "Albany clays" was specifically applied to the glacial rock flours of Hudson Valley N. and S. of Albany in 1846. Included in Hochelagan fm.

Has also been called "Lake Albany clays."

Albany granite.

Late Devonian or late Carboniferous: Northern New Hampshire (White Mountains in north part of Carroll County).

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545) and 1877 (Geol. N. H., pt. 2, pp. 143, etc.). *Albany granite.*—Porphyritic granite spotted with rounded feldspars. Has been called trachytic. Thickness 1,000 ft. Younger than Conway granite and older than Chocorua granite.

G. W. Hawes, 1881 (Am. Jour. Sci., 3d, vol. 21, pp. 21+) and 1901 (Yale Bi-Cen. Pub., Contr. Min. and Petrog., pp. 400–414). *Albany granite* is a spotted or trachytic eruptive granite, younger than Conway granite and younger than andalusite schist, and believed to be older than Concord granite. Named by Prof. Hitchcock on account of extensive development in Albany, N. H. [In N. part of Carroll Co.]

M. Billings, 1928 (Proc. Am. Acad. Arts and Sci., vol. 63, No. 3, map, pp. 67–137), divided *Albany group*, as he called it, into 3 petrographic types, placed it as older than his Chocorua and Conway groups of granite, and included all in *Dev. (?)*. In 1935 Billings assigned all of these intrusives to late Dev. or late Carbf.

M. Billings, 1935 (letter dated Aug. 27). *Albany granite* belongs to White Mtn magma series.

†Albany formation.

Permian: Northern Texas and southwestern Oklahoma.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). *Coleman-Albany series.*—Shales, clays, and lss., barren of coal, overlying Waldrip-Cisco series and underlying Wichita beds.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361–402). *Albany div.*—Largely lss. and shales, with some ss. at base. Thickness 1,180 ft. Overlies Cisco beds and is overlain by Clear Fork beds. [See 1891 entry under *Wichita fm.*] Well developed in vicinity of Albany, Shackelford Co., Tex.

Has for many years been considered same as Wichita fm., better established name. See further explanation under *Wichita fm.*

Albany black shales.

An abbreviated form of *New Albany sh.* used by C. [R.] Keyes. (See Pan-Am. Geol., vol. 48, p. 147, 1927.)

Albany conglomerate.

Pre-Cambrian: Michigan.

See *Albany and Boston cgl.*

Albany conglomerate.

Lower Ordovician: Northeastern Vermont (Orleans County).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 107–110). *Albany phase of Irasburg cgl.* is characterized by presence of Camb. marble, by porphyritic andesite boulders more than a foot in diam., and by large well smoothed boulders of pure quartz. The porphyritic andesite boulders are present in both Irasburg and Albany.

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., p. 343). The *Irasburg, Albany and Northfield cgls.* form base of Ord. in eastern Vt.

Albany porphyritic nordmarkite.

Devonian (?): New Hampshire.

L. Kingsley, 1931 (Am. Jour. Sci., 5th, vol. 22, p. 143).

Albany quartz syenite.

Late Carboniferous (?): New Hampshire.

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, Summer Mag. No., p. 73).

Albany and Boston amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 25–27, 80, 81, 85, and chart). Younger than Albany and Boston cgl. and older than Pewabic West cgl.

Belongs to Ashbed group. The mineralized part is the Albany and Boston lode.

Named for occurrence in Albany and Boston mine, Houghton Co.

†Albany and Boston conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 53–57, 61, 81, 84, 86 and chart). Is cgl. No. 15 of Houghton Co., and=Allouez cgl. of Keweenaw Co.

Is same as Allouez cgl., of Central Mine group.

Named for occurrence in Albany and Boston mine, Houghton Co.

Albany and Boston flow.

Includes Albany and Boston amygdaloid and underlying trap.

Albee formation.

Pre-Silurian (Upper Ordovician?): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55–56). *Albee qtzite.*—Qtzite and sl., 4,000 ft. thick, underlying Ammonoosuc volcanics in Littleton and Moosilauke quads. No fossils, but are pre-Sil. and probably Upper Ord. [The name appears to replace Lisbon qtzite of his Feb. 1933 paper in Am. Jour. Sci., 5th, vol. 25, No. 146, p. 149.]

M. Billings, 1934 (Am. Jour. Sci., 5th, vol. 28, Dec., pp. 413–415), mapped *Albee fm.* (pre-Sil., Upper Ord. ?) at and around Albee Hill, Littleton quad. and other parts of Littleton and Moosilauke quads.

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps and p. 9). *Albee fm.*—A group of black and green slates, argill. qtzite, and qtzite, typically exposed on Gardner Mtn. Type loc. is that part of Gardner Mtn. which lies btw. Hunt Mtn. (just SW of Littleton quad.) and Albee Hill [in Littleton quad.], from which name was chosen. Probably Upper Ord.

Alberca sandstone member (of Yegua formation).

Eocene (middle): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, p. 1384). *Alberca ss.*—Massive gray ss., 80 ft. thick, lying 904 ft. below top of Yegua fm. and 559 ft. above base of the Yegua, in section from San Pedro de Roma on Mexican side of Rio Grande from Roma [Starr Co.], Tex. Lies 132 ft. above Alamo ss. memb. [Derivation of name not stated.]

Alberhill clay.

Eocene: Southern California (Riverside County).

P. H. Dudley, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 223). *Alberhill clays (Eocene)*. [All there is about it. Paper describes area btw. towns of Riverside and San Jacinto and Corona and Elsinore.]

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 505). The Eo. Alberhill clays have recently been described in detail by J. C. Sutherland (Calif. State Div. Mines, State Min. Rept. 31, Calif. Jour. Mines and Geol., Jan. 1935). [On map Dudley assigns this clay to *Eocene (Martinez)*.]

Alberta shale.

Upper Cretaceous: Alberta.

C. S. Evans, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 27).

Later repts assign *Alberta fm.* to Upper and Lower Cret.

Albertan.

A name proposed by G. M. Dawson (Jour. Geol., vol. 3, 1895, pp. 507–511) for the pre-Kansan drift of Canada. Probably corresponds to Nebraskan drift of United States. Named for province of Alberta.

Albert Canyon division.

Pre-Cambrian: British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 170).

Albertian series.

Name suggested by C. [R.] Keyes (Pan.-Am. Geol., vol. 44, pp. 217, 218, 1925, and vol. 46, pp. 207–208, 1926) to cover basal part of his expanded Selkirkic period, but it "may not include all the strata of Early Selkirkic age." Named for exposures in Albert Canyon, in which Canadian Pacific Railway runs westward out of the Selkirks.

Albin shale.

Upper Cambrian: Northeastern Iowa.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 319, 326). Berkey (Am. Geol., vol. 20, p. 373, 1897), in Minn., without defining either upper or lower limits, proposed *Franconia ss.* for this part of Mid Cambric succession as exposed at St. Croix Dalles. This name, after proper definition, might be retained were it not for fact that it was long ago preoccupied for a fm. in N. H. It therefore becomes invalid. Hence *Albin shales* is substituted. Uncon. underlies Allamakee dol. and uncon. overlies Dresbach ss. Named for fine exposures at Albin, Allamakee Co.

Albion gravel.

Pleistocene: Central northern Iowa.

S. W. Beyer, 1897 (Iowa Geol. Surv. vol. 7, pp. 210, 231). *Albion gravels.*—Stratified sands and gravels, 10 ft. thick, underlying Kansan till and forming base of section at Albion, Marshall Co. Assigned to Aftonian stage.

Albion schist member (of Westboro quartzite).

Pre-Cambrian: Eastern Rhode Island.

B. K. Emerson and J. K. Perry, 1907 (U. S. G. S. Bull. 311, pp. 8, 10–13, and map). *Albion schist memb. of Grafton (Westboro) qtzite.*—Quartz phyllite and fine-grained micaceous quartz schist upon which village of Albion stands. Of light gray color. Is a band down center of Grafton qtzite, which consists of two flanking bands of granular massive qtzite. The finer grain and presence of considerable beds of phyllite distinguish this memb. from rest of Grafton qtzite.

Albion sandstone.

Silurian (early): Western New York and Ontario.

E. O. Ulrich, 1913 (12th Int. Geol. Cong., Canada, pp. 26, 27, 30, 36, 49). *Albion stage* (also *Albion group*).—The need of a distinct formational name for upper Medina having become apparent in preparation of Niagara folio in course of publication by U. S. Geol. Survey, Dr. J. M. Clarke has cooperated by suggesting *Albion.* The fm. rests on lower Medina or Queenston. [This paper was in print and distributed at Toronto on or before the Cong. convened, which was Aug. 7, 1913.]

In U. S. G. S. Niagara folio (No. 190)—a small part of the edition of which was completed Aug. 17, 1913—the rocks btw. Queenston sh. and Clinton fm. were designated *Albion ss.*, of which Whirlpool ss. of Grabau constituted basal memb., the top beds ("Grey band" of early repts.) being named *Thorold ss. memb.*, the intervening beds consisting of red ss. and red and gray shales. This is classification still employed by U. S. Geol. Survey. Some geologists, however, have advocated abandoning *Albion* and restricting *Medina* to this upper part of original Medina. Others have recommended the use of *Cataract fm.* for lower 50 ft. of the Albion, and restriction of *Medina* to the beds above the Cataract. Others have recommended using *Cataract fm.* to include all beds included in Albion ss. Others have recommended restricting *Albion* to beds btw. Whirlpool ss. and Thorold ss. Others have recommended restricting *Albion* to beds btw. base of the Thorold and top of Queenston sh. (See fuller explanation under *Medina group, Cataract fm., Thorold ss. memb.*, and *Whirlpool ss. memb.*)

Albion moraine.

Pleistocene (Wisconsin stage): Western New York. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Named for Albion, N. Y.

Albion Range group.

Pre-Cambrian: Central and southern Idaho.

A. L. Anderson, 1934 (Jour. Geol., vol. 42, No. 4, pp. 377–379). The strata invaded by Cassia batholith are qtzites in lower part of the pre-Camb. *Albion Range group* here substituted for *Harrison series*, which is preoccupied. This group continues southward into Raft River Range of NW. Utah and resembles a series of pre-Camb. rocks in Wasatch Range, which Blackwelder has shown to underlie sss., cgls., and slates of late Algonkian age. Writer considers Albion Range group to be of pre-Beltian age. The group consists mainly of metaqtzites with some intercalated marbles and schist in its middle and upper parts. Lower part is more than 4,000 ft. thick and consists mainly of medium to fine-grained pure qtzite, completely recrystallized by dynamo-metamorphism.

†Albirupean formation.

Upper Cretaceous: Eastern Maryland and Virginia.

P. R. Uhler, 1888 (Am. Phil. Soc. Proc., vol. 25, p. 42 and map). *Albirupean fm.* here proposed for the great sandrock system lying uncon. beneath the greensand Cret. Is more decidedly marine than underlying Baltimorean. Excellent sections on Severn River show nearly all members of Albirupean fm. Thickness 200 ft.

B. L. Miller, E. B. Mathews, A. B. Bibbins, and H. P. Little, 1917 (U. S. G. S. Tolchester folio, No. 204, p. 6). The sands of Raritan fm. are in several places indurated by iron oxide or silica. The best examples of such sss. are the White Rocks near mouth of Patapsco River, which furnished Uhler with the name "Albirupean" for this series of strata.

Albirupean is derived from *albus*, white, and *rupes*, a rock.

Albirupean black marl.

Upper Cretaceous: Maryland.

P. R. Uhler, 1901 (Md. Acad. Sci. Trans., n. s., vol. 1, btw. pp. 185 and 201). *Albirupean black marl.*—A great marl bed which in many places forms summit of Albirupean fm.

Alboroto quartz latite (also **Alboroto group**). (In Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 36). *Alboroto fm.*—A fm. of Potosi volcanic series. Underlies Huerto fm. and overlies Summitville fm. in Platoro-Summitville dist.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Alboroto fm.*—In Platoro-Summitville dist. consists of 0 to 3,000 ft. of quartz latite and rhyolite flows with some tuff. Is overlain by Huerto fm. and rests uncon. on Summitville andesite. In Creede dist. the Alboroto becomes a *group*, divisible into 6 fms., and is uncon. overlain by Piedra fm. (the Huerto being absent) and rests uncon. on rocks much older than Summitville andesite.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Alboroto quartz latite*, and stated (p. 80) that the fm. is confined to N. and E. flanks of Alboroto dome.

Albright limestone. (In Conemaugh formation.)

Pennsylvanian: Northeastern West Virginia and western Maryland.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Preston Co., p. 140). *Albright ls.*—Dark gray ls. 2 ft. thick. Underlies Bakerstown (Barton[?]) coal and rests on 5 to 20 ft. of fire clay sh. that overlies Pine Creek ls. Occurs at Albright, Preston Co., W. Va.

Md. Geol. Surv. (vol. 11, 1922) applied *Albright ls.* in Md. to a younger ls., underlying the fire clay beneath "Upper Bakerstown (Maynardier) coal," and lying a short distance above "Lower Bakerstown (Thomas) coal."

Albuquerquan series.

A term introduced by C. [R.] Keyes to designate part of the pre-Camb. rocks of N. Mex., "exposed to the extent of more than 2,000 ft. in the Tijeras Canyon, E. of Albuquerque." (See his Conspectus of geol. fms. of N. Mex., 1915, p. 4.)

Albuquerque marl.

Tertiary (late): Central northern New Mexico (Albuquerque region).

C. L. Herrick, 1898. [See 1st entry under *Rio Grande series.* As here used applied to upper 6 ft. of so-called Albuquerque series.]

A. B. Reagan, 1903 (Am. Geol., vol. 31, p. 86). In Rio Grande embayment the Plio. marls will be called *Albuquerque marls.* In Jemez region they are called *Jemez marls.* They are a continuation of Santa Fe marls of Cope. At Albuquerque they are 350 ft. thick; in Jemez region 100 to 250 ft. They are older than Placita marl (Pleist.), and rest on a series of alternating softer and harder calc. sss. and cgls., of white to deep green colors.

Albuquerque series.

See under *Rio Grande series, Tert.*

Alcona moraine.

Pleistocene (Wisconsin stage): Eastern Michigan (Alcona Co.). (See Mich. Geol. Surv. Pub. 11, 1912.)

Alcova limestone member (of Chugwater formation).

Triassic (?): Central Wyoming (Natrona County).

W. T. Lee, 1927 (U. S. G. S. P. P. 149, pp. 14, etc.) *Alcova ls. memb. of Chugwater fm.*—Name here proposed for 8-ft. bed of marine ls. lying 335 ft. below top of Chugwater fm. at Alcova. It is hard, resistant, purplish ls., which outcrops in conspicuous ledges. Was noted at all localities examined in Big Horn Basin. Lies 420 ft. below top of "Red Beds" at Thermopolis and 345 ft. below top near Rawlins. At W. end of Casper Mtn it is only 73 ft. below top of Chugwater. Occurs throughout Casper Range but not observed E. of this range nor SE. of Freezeout Hills. Is probably Lower Triassic

Alcyone trachyte.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). *Alcyone trachyte.*—Gray vitrophyre where moderately fresh, but much of rock is altered and mottled greenish gray. Mainly flows, but probably some green porphyritic varieties are intrusive. Thickness estimated at 2,800 ft., but may not be more than 1,000 ft. Locally separated from overlying Esperanza trachyte by 100 to 150 ft. of sandy beds. Rests in places on 200 ft. of coarse-grained breccia. Named for Alcyone mine.

Alden limestone.

Mississippian: Central northern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 52, 92, 99). *Alden ls.*—Light-gray, thin-bedded, slightly oolitic ls., 30 ft. thick. Overlies Iowa Falls dol., with evidence of discon. Fossils poorly preserved, and exact age open to question. Tentatively referred to top of Kinderhook.

See *Gilmore City ls.*

Named for exposures in S. bank of Iowa River, just below wagon bridge at town of Alden, Hardin Co.

Alden limestone.

Ordovician: Southern Oklahoma (Arbuckle and Wichita Mountains).

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55–57). [See this entry under *Simpson group*, which is only recorded use of this name.]

Alden moraine.

Pleistocene (Wisconsin stage): *Northern Wisconsin.*

R. T. Chamberlin, 1905 (Jour. Geol., vol. 13, p. 242). The oldest of the three terminal moraines in St. Croix Dalles quad. Named for occurrence in Alden Twp, Wis. [Local and not same as Alden moraine of N. Y.]

Alden moraine.

Pleistocene (Wisconsin stage): *Western New York.* Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Named for Alden, Erie Co., N. Y.

Alderson limestone. (In Greenbrier limestone.)

Mississippian: Eastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 449, 462, 699). *Alderson ls.*—Usually a dark-gray calc. fm., weathering almost dirty yellow, 75 to 325 ft. thick, with abundant marine fossils and plants in chalky beds above middle. Top memb. of Greenbrier series [ls.]. Overlies Greenville sh. and underlies Lillydale sh. Type loc. on road toward Wolf Creek, ⅛ mi. S. of Alderson, Monroe Co., W. Va. Also observed in Summers Co., W. Va., and in Giles Co., Va. Can be traced NE. to Tucker Co., W. Va. Southward it corresponds to Glen Dean ls. and Golconda sh.

†Aldrich limestone.

Upper or Middle Cambrian: Central Alabama.

H. McCalley, 1897 (Ala. Geol. Surv. Rept. on Coosa Valley, Ala., pp. 41–42 and several later pp.). *Aldrich ls.*—Siliceous blue lss. and dolomites, 250 to 500 ft. thick, underlying Montevallo shales and sss. and overlying Weisner (Chilhowee) sss. and cgls. These lss. are typical near Aldrich, where they are 500 ft. thick. Are present in Shelby, Talladega, Calhoun, Cherokee, Cleburne, and Coosa Counties. Same as Beaver ls. of Hayes. [In Co. descriptions in this rept the ls. is called *Aldrich (Beaver) ls.*]

In several subsequent repts of Ala. Geol. Surv. (E. A. Smith and H. McCalley, Ala. Geol. Surv. Bull. 9, 1904; E. A. Smith, Ala. Geol. Surv. Undergd Water Res. Ala., 1907; W. B. Phillips, Ala. Geol. Surv., Iron making in Ala., 1912; and W. F. Prouty, Ala. Geol. Surv. Bull. 18, 1916) *Aldrich ls.* was applied to ls. underlying †Montevallo sh. and ss. and overlying Weisner ss. or qtzite. Later work by C. Butts led to discovery that the ls. at Aldrich is Conasauga ls., and that it *overlies* Rome (†Montevallo) fm., instead of underlies it; but elsewhere in Ala. and in NW. Ga. there is a ls. underlying Rome fm. and overlying Weisner qtzite that has proved to be the S. extension of Shady dol. of Tenn., and is now called by that name. The name *Conasauga ls.* has priority over *Aldrich ls.*, and latter name, as defined, having been misapplied, it has been discarded by U. S. Geol. Survey and Ala. Geol. Survey. (See C. Butts, 1926, Ala. Geol. Surv. Spec. Rept. No. 14, 1926, p. 51.)

Aldridge formation.

Pre-Cambrian: British Columbia.

S. J. Schofield, 1912 (The geology of East Kootenay, B. C.; Abstract of thesis, Mass. Inst. Tech., p. 3). Included in Purcell series.

Aldridge conglomerate.

Pre-Cambrian: British Columbia.

C. W. Drysdale, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 59).

Alexandria syenite.

Pre-Cambrian: Northeastern New York (Alexandria Bay quadrangle).

H. P. Cushing et al., 1910 (N. Y. State Mus. Bull. 145, pp. 10, 39, map). *Alexandria syenite* is early pre-Cambric but younger than Laurentian gneiss. Named for Alexandria Twp, W. and N. of Redwood.

Alexandria type.

Name applied by A. F. Buddington (N. Y. State Mus. Bull. 281, pp. 52–104, 1929) to a nonporphyritic granite intrusive into Grenville series of NW.

Adirondacks, which was called *Alexandria batholith of Laurentian granite* by Cushing, and on Canadian side was referred to as *Mallorytown granite* by J. F. Wright (Geol. Surv. Canada Mem. 134, pp. 1-63, 1923). Derivation of name not stated. Age relations to porphyritic Hermon type of granite not determined.

Alexandria group.

A term used by some geologists instead of *Alexandrian series* used by other geologists.

Alexandrian series.

Silurian: Mississippi Valley.

T. E. Savage, 1908 (Ill. Geol. Surv. Bull. 8, p. 110). *Alexandrian.*—Time term to include Cape Girardeau ls. (40 ft. thick) and overlying beds containing *Dalmanites danae* and *Whitfieldella billingsana.* Thickness 44 ft. in Alexander Co., Ill. Uncon. underlies Clinton. Since there seems to be no direct time equiv. of these beds in the Ord. or Sil. as generally defined the horizons are classed as Middle Sil. strata that more or less completely bridge the lost interval btw. the Cincinnatian and the Clinton. The term to have same rank as *Cincinnatian.*

Savage later included in his *Alexandrian series* all beds beneath Bainbridge ls. and above Maquoketa sh. and Thebes fm., both of which he assigned to Ord. (Richmond group). He divided it into (descending) Sexton Creek ls. (=Brassfield ls.), Edgewood ls., Girardeau ls., and Orchard Creek sh. The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, included in Alexandrian series of Savage the Kankakee and Edgewood of Ill. and Waucoma of Iowa, and showed it as absent in Wis. and Minn.

Alfred shale.

Upper Devonian: Western New York (Allegany County).

E. R. Eller, 1935 (Carnegie Mus. Annals, vol. 24, serial No. 164, art. 8, pp. 263-264). *Alfred sh.*—At Alfred Station consists of 2 beds, a layer of sh., about 5 ft. thick, very fine-grained, containing a large and diversified fauna of "Chemung" age, overlain by 40 ft. of barren siliceous sh., formerly used by nearby ceramic plants. Alfred sh. is overlain by 6 ft. of heavy calc. ss., which G. H. Chadwick (personal communication) considers to be top of Rushford ss. of Canadaway group. Search was made at outcrops where the ss. and sh. should have been found, but all attempts to trace these beds there [into Rushford ss?] have been unsuccessful. Possibly these rocks have changed in their lithological and paleontological characters or are only lentils which have not wide distribution. The fauna is limited to about 6 inches of the lower fine-grained sh.

Alger formation.

Silurian (Niagaran): East-central Kentucky and southwestern Ohio.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 27, 61). *Alger fm.*—Upper fm. of Crab Orchard div. (lower part of Niagaran div.) of east-central Ky. Essentially clay. Includes following members: Estill clay at top, Waco ls. in middle, and Lulbegrud clay at base; also Fiades clay, the equiv. of Estill clay and Waco ls. Overlain uncon. by Dev. ls. and underlain by Indian Fields fm. of Crab Orchard div.

The name *Alger sh.* was subsequently applied by some Ohio geologists to beds underlying West Union ls. and overlying Brassfield ls., also to beds underlying West Union ls. and overlying Dayton ls.

A. F. Foerste, 1935 (Denison Univ. Bull. Jour. Sci. Lab., vol. 30, pp. 127-140). In earlier studies *Alger clay* was used in Lewis, Adams, and Highland Counties to include not only the unfossiliferous clay shales overlying Dayton ls., but a higher series of similar clay shales interbedded with thin indurated shales, and which, on close search, frequently reveal distinct imprints of fossils belonging to *Mastigobolbina typus* fauna, which is at present unknown anywhere S. of Lewis Co. The name *Ribolt sh.* was proposed in 1931 for these upper shales, and *Alger clay sh.* was restricted to underlying unfossiliferous clay sh. Transition from Alger into Ribolt is not abrupt, and it is assumed that greater part if not all of Alger is also of upper Clinton age. [On p. 140 he says: No distinct line of separation has been observed btw. the Alger and Ribolt; therefore, since the Ribolt is known to be of upper Clinton age, the Alger also is referred to upper Clinton.] In Bath Co. rests on Oldham ls.; in Lewis Co. it underlies Ribolt sh. and rests on Dayton ls. Named for Alger, a station on R. R. btw. Panola and Irvine, about 1 mi. E. of Estill-Madison Co. line. Seems possible to trace *Alger clay* of southern Ohio into the clay at top of the Osgood of SE. Ind., but paleontologically this does not seem possible.

Algoma sand.

Pleistocene: Ontario.

W. E. Logan, 1863 (Canada Geol. Surv. Repts. 1843–63, pp. 887, 907–909). *Algoma sand.*—Yellow sand overlying Saugeen and Erie clays in part of country to N. of Lake Huron and btw. Georgian Bay and Ottawa River. Most largely developed along principal rivers of the dist. Much of region covered by it lies within dist. of Algoma, hence name. No fossils found. Relation to fossiliferous sands farther down the Ottawa, also to Artemisia gravel, is uncertain. [In table on p. 887 it is placed above Artemisia gravel.]

Algomah amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Younger than cgl. No. 8 (Bohemia cgl.). Belongs in Central Mine group, at or near horizon of Evergreen amygdaloid. The mineralized part is the Algomah lode.

Named for occurrence at Algomah mine, Ontonagon Co.

Algomah flow.

Includes Algomah amygdaloid and underlying trap.

Algoman revolution.

Term applied by A. C. Lawson to a pre-Camb. epoch of granitic intrusion which he considered to have immediately preceded the formation of the †Animikie rocks, but which some other geologists place at a lower horizon in the Huronian series, and which still other geologists regard as Laurentian. (See U. S. G. S. Bull. 769, pp. 123–124). C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), placed it below lower Huronian and above Knife Lake series (tentatively classified as pre-Huronian and post-Laurentian, but which may eventually prove to be lower Huronian).

Algoman granite.

Algoman gneiss.

Names that have been applied to the rocks intruded during the Algoman revolution.

Algomian revolution.

Same as Algoman revolution.

Algomic period.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). Latest period of Archeozoic era in Lake Superior region. Includes Soultan qtzites below, and unnamed lavas and granites above, separated by an erosion interval.

C. [R.] Keyes, 1917 (Iowa Acad. Sci. Proc., vol. 24, p. 56). [*Algomic* shown as older than Animikie, younger than his Soultan qtzites, and as including "Shuswap granites of Cordilleran region and Killarney granites of Interior region."]

†Algonkian period (or system).

A term that was for many years applied to the time (and the rocks) immediately preceding the Camb. period and succeeding the †Archean period, but which is no longer used by U. S. Geol. Survey, except in sense of a rock type, as *Algonkian type*, the meaning of which is "less highly metamorphosed than Archean type." For definition of "Algonkian period (or system)" see U. S. G. S. Bull. 769, pp. 103–127.

Algonquin.

Name applied to a glacial lake of Pleist. age in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.) Also to a Pleist. clay in Ontario. (See Ont. Bur. Mines Ann. Rept., vol. 18, pt. 1, 1909, p. 297.)

Aliamanu tuff.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and Gd. Water Res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Aliamanu tuff.*—Included in lower part of Honolulu volcanic series [q. v.]. Exposed near Aliamanu Crater, from which it was erupted.

Replaces Lower Salt Lake tuff of Wentworth, according to H. T. Stearns.

Alibates dolomite lentil (of Quartermaster formation).

Permian: Panhandle of Texas.

C. N. Gould, 1907 (U. S. G. S. W. S. P. 191, pp. 17–20). *Alibates dol. lentil.*—Massive white dol. more or less flinty, usually in two ledges, the lower one 8 ft. thick and upper one 2 ft. thick, separated by 4 or more ft. of red clay. Total thickness 15 ft. Local lentil in Quartermaster fm., near top. Separated from underlying Saddlehorse gyp. lentil by 50 to 60 ft. of red sh. with white bands and ledges of soft ss.

C. N. Gould and F. E. Lewis, 1926 (Okla. Geol. Surv. Circ. 13, pp. 8–25). *Alibates dol.* is approx. = Day Creek dol. and we recommend "Alibates" be dropped.

C. N. Gould and R. Willis, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 438). *Alibates dol.* of Panhandle of Tex. is same as Day Creek dol. of western Okla., which underlies Cloud Chief gyp. and overlies Whitehorse ss.

F. M. Bullard, 1928 (Okla. Geol. Surv. Bull. 47, pl. 8), mapped Day Creek dol., Whitehorse ss., and Dog Creek dol. in Hutchison, Carson, Potter, Moore and Oldham Counties, Tex., and did not show any Quartermaster fm. as present there. The exposures, however, are rather widely separated from the exposures of these fms. in Okla.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 167, 243), placed *Alibates dol.* and Saddlehorse gyp. in Quartermaster fm., stating that Alibates is in upper part of that fm. and the Saddlehorse 60 to 80 ft. above base of Quartermaster.

Named for Alibates Creek, Potter Co.

Alkali formation.

Recent: Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Alkali fm.*—Salt incrustations, 1 inch to 15 ft. thick, occurring as calderas and mounds. Type loc. Alkali Lake and Alvord Basin, Lake Co.

Alkali Creek.

Name applied by W. Granger (Am. Mus. Nat. Hist. Bull., vol. 28, 1910, pp. 244, etc.) to very fossiliferous red stratum in midst of Wind River fm. along Alkali Creek near Lost Cabin, NE. corner of Fremont Co., Wyo.

Allamakee dolomite.

Upper Cambrian: Northeastern Iowa.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 319–326). In proposing *Allamakee* for nether *dol.* of Cambric succession in Upper Mississippi valley it is with full cognizance of fact that for many years the fm. to which it is applied has been widely known as *St. Lawrence ls.* Latter designation is clearly a misnomer. [Keyes correlates typical St. Lawrence with Oneota.] Allamakee dol. seems to have as yet no recognizable representative in Minn. It uncon. underlies Waukon ss., and uncon. overlies Albin shales. Is older than St. Lawrence of Minn.

Probably named for exposures in Allamakee Co.

Allegany oil sand.

Drillers' term for an oil sand in Allegany Co., N. Y., which according to J. F. Carll, 1886 (2d Pa. Geol. Surv. Ann. Rept. 1885, chart opp. p. 4), lies about 50 ft. higher than Cherry Grove oil sand (of probable Chemung age), and according to C. A. Ashburner, 1888 (Am. Inst. Min. Engrs. Trans., vol. 16, chart opp. p. 958), lies 100 ft. below Cherry Grove oil sand.

Allegany drift.

A name applied by R. M. Deeley, 1913 (Geol. Mag. London, n. s., dec. 5, vol. 10, table opp. p. 14), to an old drift sheet in No. Am. Probably refers to the drift W. of Allegheny River in NW. Pa., which is now regarded by F. Leverett as probably of Illinoian age.

Allegany Park parvafacies.

Devonian or Carboniferous: Southwestern New York.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 28). The parvafacies of Big Bend magnafacies, which falls within boundaries of Venango stage and which is therefore coeval with Cattaraugus parvafacies of Smethport magnafacies, is herein termed *Allegany Park parvafacies*, for development in New York State Park of this name, S. of Salamanca, N. Y.

Allegheny formation.

Pennsylvanian: Pennsylvania, eastern Ohio, West Virginia, and western Maryland and Virginia.

H. D. Rogers, 1840 (Pa. Geol. Surv. 4th Ann. Rept. p. 150). *Allegheny series* (*Lower Coal Measures*).—Developed in valley of Allegheny River. Underlies Monongahela series, the bdy btw. the two series being marked by final outcrop of the shales exposed just above Ohio River at Pittsburg, and overlies fm. XII (coarse, massive white ss., about 100 ft. thick, which constitutes bottom of productive coal measures, and which appears to include at base the ss. on Tionesta Creek [Homewood ss. memb. of Pottsville fm.]. [The above definition includes Allegheny and Conemaugh fms. of present nomenclature.]

J. J. Stevenson, 1873 (Am. Phil. Soc. Trans., vol. 15, n. s., p. 16). *Lower Coal Group* (*Allegheny River series*).—Extends from the great cgl. [Pottsville fm.] (350± ft. thick) up to Mahoning ss. [This definition accords with current definition of *Allegheny fm.*, the shorter name.]

The present Pa. Geol. Survey classifies the Allegheny as a *group;* the U. S. Geol. Survey classifies it as a *fm.*

†Allegheny group.

Mississippian: Pennsylvania.

A. Sherwood, 1878 (Pa. Geol. Surv. Rept. G, pp. 11–42). *Vespertine or Upper* (*White*) *Catskill fm.*, consisting chiefly of gray ss., underlies Umbral (chiefly red shales) and overlies Lower (Red) Catskill group. The Catskill and Chemung are names well chosen. This is not quite the case with the Vespertine, unless we adopt the whole nomenclature of Rogers. As these rocks constitute the mass of the Allegheny Mtns I think the name *Allegheny group* would be more appropriate.

Corresponds approx. to Pocono fm., and name is also preoccupied.

Allegheny sand.

A subsurface sand lying lower in western Pa. section than Speechley sand and higher than Tiona sand. According to J. D. Sisler, 1933 (Pa. Geol. Surv., 4th ser., Bull. M19, p. 28), "this sand has been recognized for the first time by these correlations. It lies directly beneath the Speechley and above the Tiona. It first appears in records of wells on Allegheny

River north of Pittsburgh and seems to be continuous sand throughout the Allegheny River drainage basin. The Allegheny has locally been mistaken for the Speechley."

Allegheny system.

A term applied by F. Platt (2d Pa. Geol. Surv. Rept. L, 1876) to Allegheny fm. of present nomenclature.

†Allegheny River series.

See J. J. Stevenson, 1873, under *Allegheny fm.* Same as Allegheny fm., the shorter name.

†Allegheny River coal series.

Pennsylvanian and Mississippian: Pennsylvania and northern West Virginia.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. XXIII). *Allegheny River coal series* includes all beds btw. top of Lower Barren Measures [Conemaugh fm.] and base of Pocono ss. Rests on Catskill ss. Underlies Upper Productive Coal Measures [Monongahela fm.].

Allegrippis sandstone member (of Chemung formation).

Upper Devonian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, pp. 99–100). *Allegrippus cgl.*—White quartz pebbles in matrix of grayish white sand. Thickness 5 to 10 ft. Forms Allegrippus [Allegrippis] Ridge, Huntingdon Co. Overlain by olive shales and thin ss., and underlain by 450 ft. of shales, all belonging to Chemung fm.

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press). *Allegrippis ss. memb. of Chemung fm.*—Three sss. separated by sh. Thickness 100 ft. Lies 1,400 ft. above Piney Ridge ss. memb. of Chemung, and a considerable distance below Saxton cgl. memb. of Chemung.

†Allen limestone member.

Pennsylvanian: Southeastern Kansas.

G. I. Adams, 1904 (U. S. G. S. Bull. 238, p. 20). *Allen ls.*—Ls., 10 to 25 ft. thick, underlying Vilas sh. and overlying Concreto [Lane] sh.

Same as Plattsburg ls. according to H. Hinds and F. C. Greene (1915) and N. D. Newell (1935). Discarded by U. S. G. S. in 1912. Discarded by R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).

Named for Allen, Lyon Co.

Allendale sand.

A subsurface sand in Chester group (Miss.) of Wabash Co., SE. Ill.

Allens Creek facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 249, etc., 1931) to a lithologic development of his Edwardsville fm. (early Miss.) in a part of southern Ind.

Allensville member.

Mississippian: Central and southern Ohio.

J. E. Hyde, 1912 (History of Fairfield Co., p. 211) and 1915 (Jour. Geol., vol. 23, pp. 656, 657, 764, 771, 775–778). *Allensville memb.*—Chiefly very coarse, rather loose, reddish sands, 0 to 39 ft. thick, uniformly bedded, with some interbedded fine-grained sands and in one place 4 to 8 ft. of fossiliferous sh. Middle memb. of Logan fm. Underlain by Byer memb. of Logan fm. and overlain by Vinton memb. Traced from Newark to Ohio River. Lowest occurrence of coarse beds adopted as base of memb. Is = cgl. II of Prosser.

Logan fm. as used by Hyde included upper part of Black Hand fm. of Ohio Geol. Survey and U. S. Geol. Survey. These beds are upper part of Black Hand fm.

Named for exposures at Allensville, Vinton Co.

Allentown limestone.

Upper Cambrian: Eastern Pennsylvania (Lehigh Valley district).

E. T. Wherry, 1909 (Sci., n. s., vol. 30, p. 416). *Allentown ls.*—White to gray, dolomitic ls., largely oolitic; 2,000 ft. thick. Full of Cryptozoon. Underlies Coplay ls. and overlies Leithsville fm. Assigned to Upper Camb.

Is a part of Conococheague ls.

Named for exposures along Lehigh and Jordan Creeks in vicinity of Allentown.

Allison formation.

Upper Cretaceous: Alberta, Canada.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 239). *Allison (Belly River) fm.*, Cret., Alberta.

Allison barren member (of Mesaverde formation). (Also **Allison member.**)

Upper Cretaceous: Northwestern New Mexico (Gallup-Zuni Basin).

J. D. Sears, 1925 (U. S. G. S. Bull. 767). *Allison barren memb.*—Light-gray to white lenticular ss., light-gray clay sh., and thin irregular coal beds, but none of commercial importance. Thickness 800+ ft. Top memb. of Mesaverde fm. in Gallup-Zuni Basin. Overlies Gibson coal memb. and uncon. underlies Tert. deposits. Well exposed near village of Allison, McKinley Co.

C. H. Dane, in a rept (U. S. G. S. Bull. 860C) on Chacra Mesa-LaVentana coal field, N. Mex., which lies to E. of Gallup dist., revised the definition of Allison, by extending the unit upward to include all continental beds (including coal beds at top) up to marine sss. (Chacra ss. memb.) in top of Mesaverde fm. of this area. He called the beds in that area *Allison memb.* (instead of *Allison barren memb.*).

Allison Creek sandstone.

Cretaceous: Alberta.

W. W. Leach, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 198).

Alloa rhyolite.

Pre-Cambrian: South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121, 126). *Alloa rhyolite.*—Flow rhyolite and breccia near Alloa, on SE. flank of syncline in sec. 3, T. 11 N., R. 8 E. Is exposed on both sides of an elliptical mound on Shanks farm, just NE. of United Presbyterian Church, Caledonia Twp. Assigned to pre-middle Huronian.

Allouez conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv., vol. 1, pt. 2, pp. 53–57, 60, and chart). Is cgl. No. 15 of Keweenaw Co., and same as Albany and Boston cgl. of Houghton Co. Is 15 to 20 ft. thick at Central and Allouez mines.

Belongs to Central Mine group. The mineralized part is Allouez lode.

Named for occurrence in Allouez mine, Houghton Co.

Alloway clay.

Miocene (upper): Southwestern New Jersey.

H. B. Kümmel and G. M. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 142). *Alloway clay.*—A continuous bed of clay without sand beds of sufficient extent to show in outcrop. Usually light brown, although some parts are white, yellow, and black. Thickness 0 to 80 feet. Underlies Shiloh marl and overlies a thin bed of micaceous white talc-like clayey sand near Woodstown and towards Ewan Mills. Continuous from near Swans Mill, S. of Mullica Hill, Gloucester Co., to a point 2 mi. S. of Alloway, Salem Co., and isolated outcrops have been seen as far S. as Stow Creek Twp., Cumberland Co.

Is a part of Kirkwood fm.

Allsboro sandstone. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama.

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Allsboro ss.*—Coarse-grained ss., in places decidedly contorted, thus differing from other sss. of region. At a few places contains a little asphaltic material. Thickness 8 ft. Named for small village in Ala., near Miss. line. Overlies Alsobrook fm. and underlies Southward Pond fm. Is correlated with Bethel ss. [not true Bethel, but Yankeetown chert; true Bethel ss. underlies Renault fm., with which Morse correlates his Alsobrook fm.]

W. C. Morse, 1930 (Miss. Geol. Surv. Bull 23). Thickness of *Allsboro ss.* varies from 3 to 9 ft. In N. end of Allsboro, Ala., it consists of 5 ft. of massive and contorted ss. and bluish gray sh. Well exposed N. and S. of village.

†Alma limestone. (In Council Grove group.)

Permian: Northeastern Kansas.

C. S. Prosser, 1894 (Geol. Soc. Am. Bull., vol. 6, pp 44–45). Light yellowish gray massive ls., 5½ ft. thick, quarried at Alma and locally known as *"Alma stone."* Same as Cottonwood or Manhattan ls.

Replaced by Cottonwood ls.

Named for Alma, Wabaunsee Co.

†Almagre beds.

Eocene (lower): Northwestern New Mexico.

See under †*Largo beds*.

Almond formation. (In Mesaverde group.)

Upper Cretaceous: Southwestern Wyoming (Baxter Basin, Sweetwater County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Almond coal group.*—Soft white and brown sss., sandy sh. and clay, with many beds of coal and bituminous sh. Thickness 700 to 950 ft. Top subdivision of Mesaverde fm. in Rock Springs uplift, Sweetwater Co. Separated from underlying Rock Springs coal group (basal subdivision of Mesaverde fm.) by 800 to 1,000 ft. of massive white and yellowish ss., the upper third of which is conglomeratic, with fine black and gray quartz pebbles. Overlain by Lewis sh.

J. D. Sears, 1926 (U. S. G. S. Bull. 781, p. 20, pl. 5). In this rept. the Almond and Rock Springs coal groups are given rank of fms., and intervening body of white ss., 800 to 1,100 ft. thick, is named *Ericson ss.*, from excellent exposure near old Ericson ranch, on Salt Wells Creek, sec. 31, T. 16 N., R. 102 W., Wyo. The Blair, Rock Springs, Ericson, and Almond fms. compose Mesaverde group in Baxter Basin, but the Blair and Rock Springs fms. are=in time upper part of Mancos sh. of Moffat Co., Colo.

Almy formation. (In Wasatch group.)

Eocene (lower): Southwestern Wyoming.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Almy fm.*—Yellow and reddish yellow sandy clays, with irregularly bedded ss. and, near base, cgl. beds. Thickness 2,100 to 2,200 ft. Basal fm. of Wasatch group. Underlies Fowkes fm. and overlies Evanston fm. ("Upper Laramie"). Named for Almy (a town a few mi. N. of Evanston), where it is exposed in bluffs along E. side of Bear River, immediately overlying Evanston fm. (white beds).

Alnwick lake beds.

Tertiary (late Miocene or Pliocene): Eastern Colorado (Pikes Peak region).

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Alnwick lake beds.*—Fine-grained ss. and cgl., the latter containing pebbles representative of the volcanic series to W. Occurs in valley of Oil Creek about Alnwick. No fossils, but lake is younger than that at High Park, the deposits of which are named *High Park lake beds*. Assigned to Neocene.

Alpena limestone.

Middle Devonian: Northeastern Michigan.

A. W. Grabau, 1902 (Mich. Geol. Surv. Rept. 1901, p. 175). *Alpena ls.*, 25 to 34 ft. thick, underlies Thunder Bay series (Traverse upper shales) and overlies Traverse lower shales and lss.: all included in Traverse group.

R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21). *Alpena or "Middle" ls.* of Traverse fm. in Alpena dist. consists of 80+ft. of chiefly very massively bedded gray and buff high calcium ls. characterized by extensive system of coral reefs. Is more massive and resistant than overlying Thunder Bay series and than Long Lake series of Traverse fm., which it overlies.

W. A. VerWiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, pp. 181–192). *Alpena ls.* [*redefined*].—Hard crystalline ls., to which Grabau gave thickness in Churchill well as 25 to 35 ft., but there appears to be no good reason for placing bottom of this ls. at this depth, for same type of rock continues on down at least 80 ft., as clearly shown in quarry of Mich. Alkali Co. near Alpena, and drill core in N. part of this section gives thickness of 125 ft. of essentially same kind of rock. It would be more logical to draw base of Alpena ls. at base of No. 6 in Churchill well, which would give thickness of Alpena ls. 126 ft. This is definition used in this rept.

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526), restricted *Alpena ls.* as explained under *Traverse fm.*

Named for exposures at Alpena.

Alpine quartz diorite.

Late Jurassic or early Cretaceous: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 115–141, map). *Alpine quartz diorite.*—Usually of more uniform composition, color, texture, and structure than Viejas gabbro diorite, although of about same age. Cuts Black Mtn volcanics. Typical occurrence in general vicinity of Alpine, southern Peninsular Range.

Alpreston quartzite.

Middle Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 435). *Alpreston qtzite.*—Nearly white altered ss. of great hardness. Thickness 125 ft. Forms crest of hill W. of Elkhorn. [This hill is also to W. of Alpreston Gulch.] Basal bed of Camb. Probably=Flathead qtzite.

Alsate shale.

Lower Ordovician (Beekmantown): Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066, 1069–1070). *Alsate sh.*—In northern exposures is mostly sh., but to S. there are many ls. ledges. To SE. of Marathon the lss. come beneath the sh. beds, but as faunas show no great difference in age the two facies probably intergrade. Near type loc. the fm. consists of 25 to 50 ft. of indurated greenish sh., in part siliceous, containing nodular beds of dense yellow-weathering ls. and lenses of saccharoidal buff quartz ss., passing locally into fine cgl. At base is a coarse cgl. of irregular thickness, composed of rounded ls. and chert fragments. In Dagger Flat anticlinorium the fm. is 125 ft. thick. It underlies the coarse cgl. at base of Fort Peña fm. and overlies Marathon ls. Fossils are late Beekmantown. Named for Alsate Creek, which joins Peña Colorada Creek from W. at Fort Peña Colorada. Is well exposed in cut on creek 2½ mi. W.-SW. of Fort Peña, near road to Roberts ranch.

Alsen cherty limestone.

Lower Devonian: Eastern New York (Schoharie and Greene Counties).

A. W. Grabau, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 468–470). *Alsen cherty ls.* proposed for 20 to 50+ft. of cherty lss. which overlie the Becraft and contain a modified Becraft fauna. Are shown in hills above Alsen, at Becraft and Schoharie, and they are everywhere stratigraphically continuous with the Becraft. Have heretofore been classed as Port Ewen, but near Port Ewen Station the Port Ewen beds [restricted] rest discon. on the Alsen.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 190, 370, 377), adopted *Alsen ls.* for beds underlying Port Ewen ls. and overlying Becraft ls., and assigned all to the Helderberg.

Alsobrook formation. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama.

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Alsobrook fm.*—Upper 70 or 80 ft. at type loc. is clay sh. save for a thin layer of ss. near middle. A short distance S., on Cripple Deer Creek, upper third of fm. has changed to ss.—the Cripple Deer ss. memb. Basal bed of fm. is 1 to 10 ft. of ls., whose fossils (Chester) show it belongs with overlying beds, although lithologically it seems closely related to underlying Iuka fm., from which it is separated by large uncon. Underlies *Allsboro ss.* Named for Alsobrook homestead and Alsobrook bridge [Ala.], about which it is excellently exposed.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23, passim), gave many details of fm. and correlated it with Renault fm., which *overlies* true Bethel ss.

Alta formation.

Permian: Southwestern Texas (Shafter district, Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10–25). *Alta beds.*—Upper part yellow sand 1,500 ft. thick; lower part dark-colored mixture of silt, clay, and some sand, 2,000 ft. thick. Middle fm. of Chinati series. Underlies Cibola lss. and overlies Cieneguita beds. Few fossils.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 908). Cieneguita and Alta beds of Shafter region, formerly classed as Penn., proved to be of Leonard (Perm.) age. [See also C. L. Baker, 1929 (Univ. Tex. Bull. 2901, pp. 73+).]

Named for Sierra Alta Hill, on side of Sierra Alta Creek, Presidio Co.

†Alta shale.

Middle and Lower Cambrian: Central northern Utah (central Wasatch Mountains).

F. F. Hintze, Jr., 1913 (N. Y. Acad. Sci. Annals, vol. 23, p. 104). *Alta sh.*—Black or dark, micaceous, sandy sh., 150 to 200 ft. thick, uncon. underlying Maxfield fm. and conformably overlying Brigham qtzite. Walcott collected Middle and Lower Camb. fossils from this fm., which is named for its prominence at little town of Alta.

Replaced by *Ophir fm.*, "Alta" being preoccupied.

†Alta granodiorite.

A name that has been applied by some geologists to the stock of granodiorite (of late Cret. or early Tert. age) that crops out just E. of Alta, in central Wasatch Mtns, Salt Lake Co., Utah. (See F. F. Hintze, 1913, N. Y. Acad. Sci. Annals, vol 23, pp. 85–143.) As there is only one granodiorite in the region, the U. S. Geol. Survey has not adopted a geographic name for the rock, but uses the term *Alta stock* for the structural feature which it forms.

†Altamaha formation.

†Altamaha grit.

Miocene (lower): Southeastern Georgia, Alabama, and northern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 81–82, 157, 320). *Altamaha grit* (*Mio.*).—The bluffs of Altamaha River at Rocky Hammock exhibit first example on the river of a fm. to which name *Altamaha grit* may be applied. The last bluff of the grit is only a few rods above the bridge across Altamaha River at Doctor Town. Btw. Rocky Hammock and Doctor Town all bluffs of Altamaha River (which are mostly on right bank of river and sometimes reach elev. of 70 ft. above river) are composed of the grit, sometimes extremely hard and flinty and at others more disposed to crumble, but always composed of angular grains of slightly worn quartz mixed with more or less clay as a matrix and with water-worn quartz pebbles. These grits are obviously of a perezonal nature and represent, for the Georgian embayment, the operation through the agency of the southeastern drainage of Ga. of the same forces and analagous circumstances to those which on the borders of Mississippi embayment produced the

Grand Gulf perezone. Though the contact with the oyster-bearing Hawthorne beds of House Creek was not observed by Mr. Burns, there can be little doubt that latter are overlain by the grit where they join, and that the grits, which contain no fossils except a little silicified wood, are consequently of Mio. age.

In 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 334–348) Dall assigned "*Altamaha grits* of Altamaha River, Ga.," to upper Olig.

C. J. Maury, 1902 (Bulls. Am. Pal., vol. 3, No. 15, pp. 67–69, 81). *Altamaha grits* of Ga. correspond lithologically and faunally with Hawthorne beds of central Fla. [typical Hawthorn], which are upper Olig. [lower Mio. now].

R. M. Harper, 1906 (N. Y. Acad. Sci. Annals, vol. 17, pt. 1). *Altamaha grit* of southern Ga. is thin to 200 ft. thick, yellowish on fresh exposure; weathers dull reddish brown. Lies just above Chattahoochee fm. and is overlain by Lafayette. Probably Plio. [Mapped across southern Ga.]

S. W. McCallie, 1908 (Ga. Geol. Surv. Bull. 15). *Altamaha grit* is probably a phase of the Lafayette and therefore Plio. It consists of heavy-bedded indurated sands with clay and silica matrix. Overlies Chattahoochee fm.

J. O. Veatch, 1908 (Sci., n. s., vol. 27, pp. 71–74). *Altamaha fm.*—Name applied by Dall in 1892 to a ss. or gritty clay fm. prominently exposed along Altamaha and Ocmulgee Rivers of Ga. Is most widespread fm. of coastal plain of Ga. Covers approx. 21,000 sq. mi. As a whole consists of yellow and red sand and both massive and stratified layers of gritty clay, with local areas of indurated grit or ss. and clay. In Ga. is believed to be identical with Lafayette of McGee. Thickness 100 to 500 ft. [In 1909 (Ga. Geol. Surv. Bull. 18) Veatch gave thickness of *Altamaha fm.* of Ga. as 350 ft. and assigned it to Plio. In 1910 (Ga. Geol. Surv. Bull. 23) S. W. McCallie gave thickness of *Altamaha grit* as 200 ft., placed it btw. †Chattahoochee fm. and †Lafayette, and assigned it to Mio.]

J. O. Veatch, 1911 (Ga. Geol. Surv. Bull. 26). *Altamaha (Lafayette?) fm.*—A widespread but relatively thin series of sands and clays covering much of central and southern Ga. Thickness 150(?) ft. Tentatively referred to Plio. Doubtless a part of it is contemp. with so-called Lafayette fm. Inadequacy of knowledge of age and strat. relations of Altamaha fm. is conceded. [In table and on map is placed above Charlton fm. and below Okefenokee fm. (Pleist.). As herein mapped covers major part of southern Ga., but the deposits along Altamaha River (type loc.) are *mapped as Alum Bluff fm.*]

L. W. Stephenson and J. O. Veatch, 1915 (U. S. G. S. W. S. P. 341, pp. 90–91). "Altamaha grit" as proposed by Dall in 1892 applies to same deposits as Alum Bluff fm. Dall regarded the typical beds along Altamaha River as contemp. in general way with the older Mio., which was later classified by him and by others as upper Olig. R. M. Harper in 1906 and J. O. Veatch in 1908 correlated the same deposits with Plio. Veatch and Stephenson in 1911 [Ga. Geol. Surv. Bull. 26] questionably referred the fm. to Plio., although they recognized that *Altamaha fm.* as used by them and as previously used by Harper and by Veatch, included strata ranging in age from Olig. to Pleist. Investigations of recent years have led to conclusion that bulk of deposits included by Harper, Veatch, and Stephenson in Altamaha fm. are of Olig. age and probably contemp. with part of Alum Bluff fm. [In this rept the deposits along Altamaha River are mapped as *Alum Bluff fm.* and the broad area mapped in previous repts as *Altamaha fm.* is herein mapped as *undiff. Olig. to Pleist., inclusive.*]

H. K. Shearer, 1917 (Ga. Geol. Surv. Bull. 31, pp. 7–18). Upper part of Alum Bluff fm. is so-called Altamaha grit, an extensive deposit of irregularly bedded sands, clays, and gravels, locally indurated.

C. W. Cooke, T. M. Prettyman, and H. S. Cave, 1923 (Ga. Geol. Surv. Bull. 40), mapped the deposits over most of southern Ga. (including those along Altamaha River from Doctortown westward, and also northward over western part of Screven Co.) as Alum Bluff fm. Later work by Cooke proved that the deposits mapped as Alum Bluff fm. in this 1923 rept are chiefly Hawthorn fm., which is = Chipola fm. (basal fm. of Alum Bluff group of NW. Fla.) but of different lithology, and they are now called *Hawthorn fm.* by U. S. Geol. Survey. The Altamaha grit of Dall is upper part of Hawthorn fm.

Named for exposures in bluffs of Altamaha River, especially btw. Rocky Hammock and Doctortown, Wayne Co., Ga.

Alta Mira limestone.

Jurassic (?): Mexico.

G. E. Anderson, 1926 (Am. Inst. Min. Met. Engrs. Trans. [preprint], No. 1551, p. 3).

Altamira shale member. (In Monterey shale.)

Miocene (middle and upper): Southern California (Palos Verdes Hills).

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 131). *Altamira sh. memb.*—Basal memb. of Monterey sh. in Palos Verdes Hills. Lower 280 ft. are chiefly silty sh., including Portuguese tuff bed at top. Middle part, 400 to 675 ft. thick, is chiefly porcelaneous and cherty sh., the basal 2 to 6 ft. of which is here named *Miraleste tuff bed.* Upper 150 ± ft. consists of porcelaneous and cherty sh. Rests on Mio. basalt and on Franciscan (?) fm. Underlies Valmonte diatomite memb. of Monterey sh. Is of upper and middle Mio. age. Type region, on S. slope of hills along and adjoining Altamira Canyon, Palos Verdes Hills [Los Angeles Co.].

Altamont limestone.

Pennsylvanian: Southeastern Kansas and northeastern Oklahoma.

G. I. Adams, 1896 (Kans. Univ. Geol. Surv. vol. 1, p. 22). *Altamont ls.*—Variable ls. at summit of ridge at Altamont, usually rough and unsuited for building purposes. Thickness 12 ft. Overlies Pleasanton shales.

In SE. Kans. was for many years treated as lower memb. of Parsons fm. (being the so-called "lower Parsons ls." of early repts). Is underlain by Bandera sh. and overlain by Nowata sh. In Okla is treated as a distinct fm. R. C. Moore has recently abandoned Parsons fm., and now treats Altamont ls. as a fm. in his Marmaton group. These changes have not been considered by U. S. Geol. Survey for its publications.

Named for exposures at Altamont, Labette Co., Kans.

Altamont moraine (also **morainic system**).

Pleistocene (Wisconsin stage): Minnesota, Iowa, South Dakota, North Dakota, Montana.

T. C. Chamberlin, 1883 (U. S. G. S. 3d Ann. Rept., pp. 378, 385, 393, 403). The first or outermost moraine is well displayed at Altamont, Deuel Co., [S.] Dak., and may fittingly be known as Altamont moraine.

Originally regarded as outermost moraine of Wisconsin drift of southern Minn. and S. Dak., but F. Leverett has shown that the moraine at Altamont, S. Dak., the type loc., is not the outer moraine, and has introduced *Bemis moraine* for the outer moraine and restricted *Altamont* to the next younger moraine. Both Altamont and Bemis are of late Wisconsin age, according to W. C. Alden.

†Alternating beds.

A descriptive term applied in a titular sense in some early Tex. repts to the Lower Cret. beds later named *Glen Rose ls.*

Alto formation.

Upper Devonian: Southwestern Illinois.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Alto fm.*—Dark siliceous sh. and somewhat shaly ls., 40 to 75 ft. thick. Uncon. underlies Mountain Glen sh. and overlies Lingle ls. Is thought to represent Portage or Chemung. Named for exposure along a creek in NE. ¼ sec. 34, in Alto Twp, Union Co.

Alto coal group. (In Pottsville formation.)

Pennsylvanian: Central northern Pennsylvania (McKean County).

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R). *Alton coal group.*—Chiefly sh., sl., and fire clay; usually contains 3 well-marked coal beds—Alton upper, Alton middle, and Alton lower. No ls. or calc. beds. Thickness 20 to 35 ft. In Alton Basin, Lafayette Twp, McKean Co., it is 30 to 35 ft. thick. The lower coal is at base and its fire clay rests on Kinzua Creek [Connoquenessing] ss. Underlies Johnson Run [Homewood] ss. Is=Mercer coal group without question.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 201). The Alton coal group of Ashburner in McKean Co., Pa., probably represents Mercer coals.

Same as Mercer sh. memb. of Pottsville fm., the approved name.

Altona dolomite member (of Blaine gypsum).

Permian: Central Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 48). *Altona dol. memb. of Blaine div.*—Fossiliferous aren. dol. overlying a stratum of sh. (Jenkins clay of Cragin) and underlying Shimer gyp. memb., all of which are included in Blaine div.

C. N. Gould, 1906 (U. S. G. S. W. S. P. 154, p. 16), divided Blaine fm. of Okla. into (descending) Shimer gyp., red shales, Medicine Lodge gyp., red shales, and Ferguson gyp.; and ignored his previously named *Altona dol. memb.* and *Magpie dol. memb.*

C. N. Gould, 1927 (Obsolete Okla. geologic names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, pp. 235–238). *Altona dol.* and *Magpie dol.*, proposed by Gould in 1902 for dol. members in Blaine fm., were abandoned on revision of Perm. in 1906. [The equivalents of these dol. beds not explained.]

Named for Altona, W. part of Kingfisher Co.

Altoona limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth and W. H. H. Piatt, 1894 (Kans. Univ. Quart., vol. 2, pp. 115–117). *Altoona ls.*—Heavy lss., 50 to 60 ft. thick, capping the hills along Verdigris River from a few miles above Coffeyville to vicinity of Altoona. Separated from overlying Iola ls. by 100 feet of shales with interbedded sss., and from underlying Independence ls. by 80 to 150 ft. of shales and sss. Believed to be same as Erie ls.

Named for Altoona, Wilson Co.

Above is only record of this name.

†Altuda granite.

Age (?): Western Texas (Brewster County).

J. A. Udden, 1907 (Univ. Tex. Bull. 93, Sci. ser. No. 11, p. 70). *Altuda granite.*—An intrusive granite boss lies uncovered over an area of somewhat more than a square mi. 4 mi. N. of Mount Ord, SW. of Altuda. It is a moderately coarse-grained rock of reddish gray color, and weathers into large blocks, sometimes 20 ft. in length. It rises in a hill several hundred ft. high. The Carbf. sediments which surround this hill dip away from it and have evidently at one time formed a continuous cover over whole area.

P. B. King, 1931 (Univ. Tex. Bull. 3038, p. 100). Largest igneous mass in Altuda Mtn area is at so-called Granite Mtn, or Granite Knob, 1 mi. W. of the James ranch and 2 mi. S. of summit of the mtn. This rock was called "Altuda granite" by Udden. This is not only a misnomer, but implies a formational name for the rock, when no special term appears justified. Actually the rock is a syenite or syenite porphyry. It outcrops on several rugged hills, covered with large exfoliating boulders, and occupies an area of about a sq. mile.

Altuda shaly member (of Capitan limestone).

Permian: Western Texas (Glass Mountains).

P. B. King, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 217). *Altuda memb.*—Middle memb. of Vidrio fm. Thin-bedded dolomites, characterized by considerable amounts of sandy and shaly material. Thickness 0 to 400 ft. Is separated from underlying Word fm. by several hundred ft. of very massive cliff-forming dolomites, making up lower part of Vidrio fm. To W. these thin and gradually merge with Altuda memb. Overlain by 1,000± ft. of massive dolomites, which represent upper part of Vidrio fm. and interfinger with lower part of overlying Gilliam fm. Named for exposures in vicinity of Altuda section house.

P. B. King, 1931 (Tex. Univ. Bull. 3038, pp. 75, 131, 134, 136, quarto), treated *Altuda memb.* as a memb. of Capitan fm., and gave several detailed sections, in some of which he described it as chiefly ls. with considerable siliceous sh., and in others as almost wholly dol., and gave thicknesses of 347, 477, and 734 ft. [See 1931 entry under *Tessey dol.*]

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 737), changed name to *Altuda shaly memb. of Capitan ls.*, and also treated the Vidrio, Gilliam, and Tessey as members of Capitan ls.

Alturas formation.

Pliocene (upper): Northeastern California (Modoc County).

E. Dorf, Sept., 1933 (Carnegie Inst. Wash. Pub. 412, pp. 6, 23). A small flora has been collected from Rattlesnake Butte, 4± mi. E. of Alturas, Modoc Co. The beds, which are here referred to as *Alturas fm.*, consist of gray sandy tuffs and shales containing both plant and vertebrate remains. The mammalian remains collected by Stock appear to indicate upper Plio. age.

R. S. LaMotte, 1936 (Carnegie Inst. Wash. Pub. 455). Upper Cedarville fm. (Plio.) of Modoc Co., Calif., is overlain by Alturas fm., but at Camp 49, Nev., the Alturas is absent, and Warner basalt rests on the Upper Cedarville.

Altyn limestone.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southeastern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 321). *Altyn ls.*—Upper memb. consists of 600± ft. of argill. ferruginous ls., yellow, terra cotta, brown, garnet red; very thin bedded; well exposed in summit of Chief Mtn. Lower memb. consists of 800± ft. of massive ls., grayish blue, heavy bedded, somewhat siliceous, with many flattened concretions, rarely but definitely fossiliferous. Fossils suggest Grayson sh. Underlies Appekunny argillite. Type loc. in cliffs of Appekunny Mtn, btw. 6,000 and 7,400 ft. above sea, due N. of Altyn, in Swift Current Valley.

† Alum Bluff series.

Miocene (upper and middle): Northwestern Florida.

D. W. Langdon, 1891 (Ga. Geol. Surv. 1st Rept. Prog., pp. 91–97). *Alum Bluff series.*—Consists of (descending): (1) Black lignitic sand, much pyrites, and from efflorescence of ferrous sulphate arises name Alum Bluff, 10 to 15 ft.; (2) gray calc. sand filled with shells, *Mactra* leading, 10 to 15 ft.; (3) gray sand, slightly calc., 5 ft.; (4) light yellow sand, pockets of fossils, 35 ft. Overlies Chattahoochee series.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept). The beds described by Langdon [in rept above cited] belong to fm. later named *Choctawhatchee*, which is younger than Alum Bluff group as now understood. All of deposits now assigned to Alum Bluff group were under water at time of Langdon's visit to Alum Bluff, and were not discovered until Dec. 1889.

Alum Bluff group.

Miocene (middle and lower): Florida, southern Georgia, and southeastern Alabama.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 112–113, 122–123, 157, 158, 320). *Alum Bluff beds.*—The unfossiliferous sand and clay strata intervening btw. Chipola marl and the upper fossiliferous bed at Alum Bluff. Over the richly calc. rather ferruginous Chipola marl at Alum Bluff we find a total change of material and total disappearance of the fauna. There are from 5 to 15 ft. of gray siliceous sand and a little clay, without fossils, while above that a radical change of fauna is revealed by the fossils of *Ecphora* bed. To these transition strata I would apply the provisional name *Alum Bluff beds*, until such time as fuller information shall be available. That they represent in the series of Alum Bluff a period of important changes of level and probably of sea temperatures, and no inconsiderable portion of geologic time, is hardly open to dispute. Top fm. of older Mio.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept.). *Alum Bluff fm.* as here defined is underlain by Chattahoochee fm. and overlain by Choctawhatchee marl. It includes Chipola marl memb. (= Chipola marl of Dall), Oak Grove sand of Dall, and, in upper part, *Shoal River marl memb.* (new).

Julia Gardner, 1926 (U. S. G. S. P. P. 142, p. 2). *Alum Bluff* is raised to rank of a *group*, divided into (descending): Shoal River fm. (including †Shoal River marl memb. of Matson & Clapp and other deposits); Oak Grove sand; and Chipola fm. (including †Chipola marl memb. of Matson and Clapp and other deposits). It uncon. underlies Choctawhatchee marl and uncon. overlies Chattahoochee fm. [now replaced by *Tampa ls.*]. Thickness varies from 0 to 400 ft. Is of marine origin.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). At Alum Bluff, the type loc., the *Alum Bluff group* consists of Chipola fm., but there is possibility that 6 ft. of beds overlying the Chipola there may represent Oak Grove sand or Shoal River fm., or they may belong to the post-Alum Bluff Choctawhatchee fm. The Hawthorn fm. of Fla. and southern Ga. is contemp. with Chipola fm., but of different lithology, and it is now included in Alum Bluff group.

Named for exposures at Alum Bluff, on E. side of Apalachicola River, Liberty Co., Fla.

Alum Cave.

Pennsylvanian: Western and southwestern Indiana.

W. N. Logan, 1929 (Ind. Dept. Cons. 11th Ann. Rept., pp. 30 to 34), described the beds btw. coal V^a and coal V in W. and SW. Ind. as consisting of 35 ft. of shales and ls., to which he applied, in parentheses, the term *Alum Cave.* Derivation of name not stated.

Alvord formation.

Miocene (lower): Southeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Alvord fm.*—Coarse buff-colored tuffs and interbedded sands, more than 1,000 ft. thick, typically exposed on E. side of Alvord Valley, S. part of Harney Co. *Overlies Trout Creek fm.*

Alvord Creek beds.

Tertiary (middle Miocene): Southeastern Oregon (Steens Mountain).

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, pp. 7–130). *Alvord Creek beds.*—Well stratified acidic tuffs, predominantly white; 800 to 1,000± ft. thick. Occur in scattered exposures, near base of Steens Mtn scarp btw. Cottonwood Creek and Little Alvord Creek. To N. of Alvord Creek consist of (descending): (1) White tuff, 100± ft.; (2) flow of basic andesite, 100± ft.; (3) white tuffaceous sediments, 200± ft.; (4) buff stratified tuff, 50 ft.; (5) brownish tuffs, 200± ft. Fossil leaves about 100 ft. below top of No. 3 demand correlation with Mascall fm. (middle Mio), according to Chaney. Underlie Pike Creek volcanic series in S. part of Steens Mtn and underlie Steens Mtn andesitic series in N. part of Steens Mtn.

Amargosan series.

C. [R.] Keyes, 1923 (Pan-Am. Geol. vol. 40, pp. 52, 78). *Amargosan series* is proposed for the thick succession of volcanics and cgls. best exposed in Amargosa Desert and in Furnace Canyon near Death Valley, and believed to be Early Tertic in age. In Nev. divided into Greenwater volcanics above and Grapevine cgl. below. Uncon. above Zunian series and uncon. below Furnacean series.

Amarillo sandstone.

Jurassic (?): Northeastern New Mexico.

C. R. Keyes, 1905 (Am. Jour. Sci., 4th, vol. 20, p. 424). *Amarillo sss.*, 200 ft. thick, underlie Pyramid shales and overlie Endee shales in eastern New Mex. Are correlated with Wingate sss. of western N. Mex. [Derivation of name not given.]

Amarillo Big lime.

A subsurface unit at Amarillo, Tex. Appears to lie 1,500 to 1,700 ft. lower than Big Lake Big lime (Perm.) of Pecos River region.

Amazonia limestone bed. (In Lawrence shale.)

Pennsylvanian: Northwestern Missouri.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13, 2d ser., pp. 31, 170, 179). *Amazonia ls. bed.*—A ls., which in places attains thickness of 16 ft. in Lawrence sh. memb. of Douglas fm. Lies 25 to 100 ft. below top of the Lawrence.

The overlying beds are prevailingly aren., the underlying chiefly argill. At Amazonia, Andrew Co. (the type loc.) the Amazonia bed is 9 ft. thick, and consists of gray ls., nodular at top, weathering buff.

Amber sand.

A subsurface sand in southern San Juan Co., SE. Utah, that lies in Hermosa fm.

Amboy stoneware clay.

Economic term for a clay bed, 30 to 80 ft. thick, forming top memb. of Raritan fm. in NE. N. J. Named for occurrence at South Amboy. (See N. J. Geol. Surv. vol. 6, 1904.) Also called *Amboy fire clay.*

†Amboy clays.

A term that has been loosely used to include Amboy stoneware clay, South Amboy fire clay, and other clays worked at Perth Amboy and South Amboy, N. J.

Amelia-Goochland quartz monzonite gneiss.

Pre-Cambrian: Central Virginia (Amelia, Goochland, Powhatan, and southern Louisa Counties).

A. A. Pegau, 1932 (Va. Geol. Surv. Bull. 33, pp. 15, 20–22, pl. 1). *Amelia-Goochland quartz monzonite gneiss.*—Principal rock in Amelia and Goochland areas. Is a light to dark-gray micaceous augen gneiss with irregular banding. Some of it is conglomeratic. Is oldest rock type in the area. [On 1928 Va. geol. map A. I. Jonas assigned it to pre-Camb.]

Ament Bay arkosites.

Pre-Cambrian: Kenora district, Ontario.

F. J. Pettijohn, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1895, 1900, map, etc.).

American Falls lake beds.

Pleistocene: Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *American Falls lake beds.*—Buff, horizontal, evenly bedded, partly consolidated clay, sand, and silt, with an aphanitic, gray, pahoehoe basalt memb., 10± ft. thick, btw. American Falls and Gibson Butte, along N. side of Snake River. Thickness of fm. 150± ft. Older than Madson basalt and younger than Cedar Butte basalt. Type loc., bluffs along Snake River from American Falls dam, Power Co., to narrows, a distance of 5± mi.

American Flat latite.

Tertiary (Miocene): Southwestern Colorado (Ouray region).

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153). *American Flat latite.*—Light to dark gray porphyritic rock, notable for glistening biotite leaves. Intrusive into Henson tuff, topmost fm. of Silverton volcanic series. So closely resembles some of lower flows of Potosi volcanic series that in Silverton folio it was taken as basal flow of that series, but its intrusive character is now evident. Its largest known body is that of American Flat.

American Fork formation.

Cretaceous (Lower ?): Central southern Montana (Sweetgrass County).

E. Douglass, 1909 (Carnegie Mus. Annals, vol. 5, pp. 269–288). On Fish Creek, Sweetgrass Co., Mont., the Fort Benton fm. is underlain by several hundred ft. of clays, shales, and bedded sss., which until satisfactorily correlated with Dakota fm. may be called *American Fork fm.*, as they occur near American Fork of Musselshell River. They overlie Lower Cret. (?) red and somber clays containing bones of large dinosaurs and mollusks.

Probably=upper part of Kootenai fm.

American Nettie quartzite.

Upper Cretaceous: Southwestern Colorado (Ouray district).

J. D. Irving, 1905 (U. S. G. S. Bull. 260, p. 56). [In geol. section of Gold Hill on this page, the upper part of Dakota fm. is called *American Nettie qtzite.* It seems to be named for a mine.]

Americus limestone member (of Foraker limestone).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

M. Z. Kirk, 1896 (Kans. Univ. Geol. Surv. vol. 1, p. 80). *Americus ls.*—Two layers of ls. (upper one thin and bluish, lower one light buff and 16 inches thick) separated by 4 ft. of sh. Separated from overlying Dunlap [Neva] ls. by 50 ft. of sh. and from underlying Emporia ls. by an extensive sh. bed.

A. J. Smith, 1902 (A bulletin on Lyon Co. geology, McCord and McCord Printers). *Americus ls. system.*—Consists of (descending): (1) flag ls., 6 in.; (2) sh., 6 ft.; (3) good building stone containing many Fusulina, 21 in. (is known as *Americus ls.* and quarried near village of Americus; color neutral drab; weathers light buff; texture even, compact, and semicrystalline); (4) sh., 8 ft.; (5) ls., 1 ft.; weathers to dry bone fm. Rests on 45 ft. of sh. containing red ss. in places, and is overlain by 8 to 26 ft. of black, blue, and buff sh.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, pp. 703–737). *Americus ls.*—Consists of (descending): Ls., 6 in.; sh., 6 ft.; solid buff ls., 21 in. Is overlain by Elmdale fm. and underlain by sandy shales which are to be named by Adams.

G. I. Adams, 1903 (U. S. G. S. Bull. 211). *Americus ls.* underlies Elmdale fm. and overlies Admire shales (new name). Thickness 5 ft. Consists of (descending) (1) ls., (2) thin sh., and (3) ls., 16 in. thick.

L. C. Wooster, 1906 (Kans. Acad. Sci. Trans., vol. 20, pt. 1, pp. 75–82). *Americus beds,* 155 ft. thick, consist of Americus ls. and shales (above), 35 ft. thick, and Admire shales and lss. (below), 120 ft. thick. Underlie Elmdale beds and overlie Emporia beds.

E. Haworth and J. Bennett, 1908 (Univ. Kans. Geol. Surv. vol. 9). *Americus ls.,* 8 ft. thick, is quarried at Americus. Underlies Elmdale fm. and overlies Admire fm.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3). *Americus ls.,* 8 ft. thick, is a rather persistent ls., which on outcrop breaks into large blocks which are strewn down slope beneath. Underlies Elmdale sh. and overlies Admire sh.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, p. 45), divided the beds in Cowley Co., Kans., btw. Neva ls. above and Admire sh. below into (descending) Elmdale sh. restricted (80 ft. thick) and Foraker ls. (47 to 50 ft. thick), the latter including at base a ls., 2½ to 4 ft. thick, designated as *Americus (?) ls. memb.*

R. C. Moore, 1929 (Kans. Geol. Surv. Bull. 12, p. 45, footnote). Recent field work by G. E. Condra and me has shown definitely that Americus ls. of type loc. extends southward and constitutes basal part of the Foraker as described by Bass (Cowley Co. rept, Bull. 12 above cited) and by Heald [?] and others in Osage Co., Okla. [In footnote on p. 50 Moore states:] It is likely detailed strat. work will afford basis for definite determination of relations of type Foraker to Americus and Elmdale.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this ls. to Perm. and showed it as basal memb. of Foraker ls., and as consisting of two ls. beds separated by sh. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Named for exposures near Americus, Lyon Co., Kans.

†Americus beds.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Americus beds.*—Includes Americus ls. and shales, 35 ft. thick, and Admire shales and lss., 120 ft. thick [upper part only of Admire sh.]. Overlies Emporia reservoir shales [lower part of Admire sh.].

Preoccupied and conflicts with original and established definitions.

Named for Americus, Lyon Co.

Ames limestone member (of Conemaugh formation).

Pennsylvanian: Eastern Ohio, Pennsylvania, Maryland, West Virginia.

E. B. Andrews, 1873 (Ohio Geol. Surv. vol. 1, pp. 235, 271, 296). *Ames ls.*—Fossiliferous ls., 1 to 5 ft. thick, in Coal Measures of Morgan, Athens, and Gallia Counties, Ohio, about 140 ft. below horizon of Federal Creek or Pomeroy coal.

Adopted as a memb. of Conemaugh fm. Replaces "Crinoidal ls." of early repts. In W. Va. Surv. repts the names *Upper Ames ls.* and *Lower Ames ls.* are used, for lss. 4 and 3 ft. thick, respectively, separated by 10 to 20 ft. of green sh. called Ames sh. (See R. V. Hennen and D. B. Reger, W. Va. Geol. Surv. Rept. Preston Co., 1914, and Rept. Marion, Monongalia, and Taylor Counties, 1918.)

Named for exposures near Amesville, in Ames Twp, Athens Co., Ohio.

Ames shale. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 289). *Ames sh.*—Dark-green sh. with marine fossils; 15 ft. thick. Underlies Upper Ames ls. and overlies Lower Ames ls. [Later repts give thickness 10 to 20 ft. Probably named for occurrence in ls. identified as Ames ls.]

Ames red bed. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia and western Pennsylvania.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied *Ames red bed* to beds occurring some distance above Ames ls. and some distance below Barton coal at Morgantown, W. Va., and at Latrobe, Pa.

Ames monzodiorite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains).

See 1936 entry (D. Modell) under *White Mtn magma series*. Occupies small area NW. of Ames station.

Ames Knob formation.

Silurian: Central southern Maine (Knox County).

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 4). *Ames Knob fm.*—Lss. and red shales; with several cgl. beds and a basal cgl. memb. 16 ft. thick. Contains Niagara fossils. Thickness 580 ft. Rests on North Haven greenstone. Overlain by volcanic rocks. Named for exposures on shore of Southern Harbor, just NW. of Ames Knob, which lies ½ mi. W. of village of North Haven, Knox Co.

On 1933 geol. map of Maine, by A. Keith, these rocks seem to be included in Ord. and Camb. block.

Amherst schist.

Carboniferous: Central Massachusetts, southwestern New Hampshire, and northern Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 218, 219, 222, 224–225). *Amherst schist* (also *Amherst feldspathic mica schist*).—Coarse fibrolitic and feldspathic schist exposed in Mount Warner and across Amherst, Mass.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60, 72–76, and map). On W. border of Central Upland of Mass. the Brimfield schist becomes a normal garnetiferous mica schist called *Amherst schist*. The Amherst is at base a coarse lead-gray mica schist, generally without accessory minerals. This is succeeded above by a finer-grained corrugated mica schist, which is dark gray from graphite and abounds in dark-red garnet and red-brown biotite, set transversely to bedding. On Mt. Warner the schist reverts to Brimfield type and becomes a highly fibrolitic rusty garnetiferous brown biotite schist.

Amherst sandstone.

Quarry term for a ss. of Upper Triassic age, outcropping in Connecticut Valley. (See A. A. P. G. Bull., vol. 19, No. 1, p. 9, 1935.)

Amherstburg dolomite member (of Detroit River dolomite).

Lower Devonian: Southeastern Michigan (Detroit region) and western Ontario.

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 542). *Amherstburg dol.*—Mag. calcarenite, 0 to 30 ft. thick. Included in Upper Monroe [Detroit River dol.]. Underlies "Lucas" dol. and overlies Anderdon coral ls. Named for fact it forms bottom of eastern channel of Detroit River, opp. Amherstburg, Ont. Also exposed in Sylvania dist., Ohio.

Amisk group (also series).

Pre-Cambrian: Manitoba.

A. Bruce, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. D. p. 4).

Amity shale.

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 457–464). [See definition under *Woodcock ss.*] Outcrops mentioned. The fossiliferous beds at Rock Creek Village seem to be in the Amity. On Sagamore Creek, in Cuyahoga Valley, Ohio, the lowest exposure is in the Amity. Included in Bradfordian and also treated as a memb. of Chagrin fm. [which U. S. Geol. Survey classifies as Upper Dev. Derivation of name not stated.]

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Amity sh. memb. of Cattaraugus fm. (Dev.)* underlies Watson ss. memb. (new name) and overlies Panama cgl. memb. (Le Boeuf, Venango 3d oil, Wolf Creek). [The U. S. Geol. Survey classifies Cattaraugus fm. as *Dev. or Carbf.* In 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 86) Caster replaced his *Watson ss. memb.* (preoccupied) with *Bimber Run cgl. memb.*]

Ammonoosuc volcanics.

Pre-Silurian (Upper Ordovician ?): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55–56). *Ammonoosuc volcanics.*—Chlorite and sericite schists, of volcanic origin, 2,500 ft. thick, underlying Partridge sl. and overlying Albee qtzite in Littleton and Moosilauke quads. No fossils, but are pre-Sil. (Upper Ord. ?).

M. Billings, 1934 (Am. Jour. Sci., 5th, vol. 28, Dec., pp. 13–15), mapped the rocks of parts of Littleton and Moosilauke quads; and his map shows Ammonoosuc River flowing through his *Ammonoosuc volcanics* at and around Littleton and to southward. The name replaces what he called "Swiftwater-Lyman fm." in Feb. 1933 issue of Am. Jour. Sci., according to letter dated July 19, 1935.

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps, pp. 10, 20). Type loc. of *Ammonoosuc volcanics* is in dist. bounded on N. by Slate Ledge School and Partridge Lake and on S. by Youngs Pond (Ogontz Lake) and Tinkerville. The fm. is also well exposed along Ammonoosuc River but with a different metamorphic character. Most of material would be classified as tuff, breccia, or volcanic cgl., and was largely deposited by streams flowing westward from active volcanoes to E. It includes a number of rock types which grade into one another. Believed to be Upper Ord.

Amnicon formation. (In Oronto group.)

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Douglas and Bayfield Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, pp. 50, 54). *Amnicon fm.*—Red and greenish shales, arkosic ss., and some cgl. Thickness 5,000 ft.; 1,050 ft. exposed. Top fm. of Oronto group. Overlies Eileen ss. and conformably underlies Bayfield ss. group. Exposed on Fish Creek, near Ashland, and on Middle and St. Louis Rivers in Douglas Co. [Derivation of name not stated. According to map the rocks of American River region are Orienta ss. and trap rocks.]

†Amphitheater dolomite.

Permian: Central Oklahoma (Blaine County).

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 353, 358, 363). *Amphitheater dol.*—A lamina-built amphitheater ledge of dol. locally recognized below middle of Dog Creek fm. in Blaine Co.

C. N. Gould, 1927 (Obsolete Okla. geologic names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, pp. 235–238). Amphitheater dol. of Cragin (1897) was never in common use.

Not a geographic name.

Amsden formation.

Pennsylvanian (some Mississippian locally): Wyoming (rather widespread) and Montana.

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). *Amsden fm.*—Red shales, white lss., and cherty and sandy lss. Thickness 150 to 350 ft. Underlies Tensleep ss. and overlies (without apparent uncon.) Little Horn ls. [Now replaced by *Madison ls.*] Named for Amsden Branch of Tongue River, W. of Dayton.

In some areas fossils of Miss. age have been found in basal part of what is considered to be Amsden fm.

See under *Big Snowy group*, which H. W. Scott (1935) states underlies Amsden fm. in central Mont.

C. C. Branson (1936) proposed to call Miss. part of Amsden fm. the *Sacajawea fm.*, as explained under that name.

Amsterdam limestone. (Of Black River group.)

Middle Ordovician: East-central and eastern New York.

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 138, p. 72). [See 1st item under *Watertown ls.*]

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 145, table on p. 97). [*Amsterdam ls.* shown as top fm. of Black River group in Mohawk and Champlain Valleys and Saratoga region, and as younger than Watertown ls. of Watertown region, but not occurring in same section with Watertown ls. Underlies Trenton ls. and overlies pre-Leray part of Lowville ls. in Mohawk Valley and beds=Leray ls. memb. of Lowville in Champlain Valley.]

H. P. Cushing, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135–144). *Amsterdam ls.*—Is Mohawk ls. of Conrad, but that name was later abandoned, and this ls. was called "base of the Trenton." Vanuxem classed it with Black River ls., but it has of late years usually been referred to as Trenton, both along the Mohawk and at Saratoga; but it is older than anything in type section at Trenton Falls, and is properly referable to Black River, forming youngest div. of that group in N. Y. It is also a deposit in a different trough from that of type Trenton. On eastern Mohawk and Saratoga it rests on Tribes Hill or Little Falls. In Champlain Valley true Trenton ls. overlies it. Named for exposures along the Mohawk in vicinity of Amsterdam, Montgomery Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 414), and W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), assigned *Amsterdam ls.* to Black River group, which seems to be commonly accepted definition.

†Amyzon beds.

A paleontologic name applied by E. D. Cope (Am. Nat., vol. 13, 1879, p. 332, and Am. Phil. Soc. Proc., vol. 19, 1880, p. 61) to fresh-water Tert. beds in Elko Co., Nev., South Park, Colo., and central Oreg., which are characterized by sp. of fishes belonging to the genus *Amyzon*. The beds thus designated in central Oreg. underlie John Day fm., and are now known as Clarno fm., of lower Olig. and upper Eo. age.

Anacacho limestone.

Upper Cretaceous (Gulf series): Southwestern Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 240). *Anacacho fm.*—Hard yellow and white lss., with interbedded marls and occasional ss. ledges. Thickness 279 ft. Overlies Austin chalk in Uvalde and Kinney Counties and occupies strat. position of Taylor marls to E.

L. W. Stephenson, 1928 (Am. Jour. Sci., 5th, vol. 16, p. 492). *Anacacho ls.* of Anacacho Mtn is uncon. overlain by Escondido fm. and underlain by a thin development of Upson clay, which rests on Austin chalk. In Medina River section the Anacacho is overlain by a thin development of Taylor marl and rests on Austin chalk.

Named for Anacacho Mtns, Kinney Co., which are capped by the fm.

Anadarche member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 15–16). *Anadarche cgl.* lies 1,800± ft. above base of Hoxbar fm. It carries pebbles of chert and of early Penn. as well as pre-Penn. lss. Some 200 ft. higher in Hoxbar fm. is *Anadarche ls.*, a very dense, hard, bluish gray ls. up to 20 ft. thick.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 43–44). *Anadarche memb. of Hoxbar fm.* is 100 to 200 ft. thick. Consists, at top, of very dense, hard, bluish gray ls. up to 20 ft. thick, and, at base, of a ls. cgl., 0 to 10± ft. thick, which contains pebbles of pre-Penn. lss. and cherts and also of Penn. lss. [Does not describe the intervening strata of the memb.] Lies 500 to 800 ft. above Crinerville memb. and 400 to 600 ft. below Daube ls. memb. Type loc. is on Anadarche Creek, ⅛ mi. S. of NW. cor. of sec. 35, T. 5 S., R. 2 E.

Anadarche conglomerate. (In Hoxbar formation.)

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 16). (See under *Anadarche memb.*)

Anadarche limestone. (In Hoxbar formation.)

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 16). (See under *Anadarche memb.*)

Anaktuvuk group.

Lower Cretaceous: Northern Alaska (Anaktuvuk River region).

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 245). *Anaktoovuk series.*—Essentially heavy-bedded, impure, dark-gray or greenish, fine to medium grained ss. Lower Cret. fossils. Uncon. overlies Lisburne fm. (Dev.) and uncon. underlies Nanushuk series. Named for river, on which it occurs.

Analomink red shale.

Upper Devonian (Portage): Northeastern Pennsylvania (Monroe County).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, p. 1206). [See 1935 entry under *Delaware River flags.*]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 588). *Analomink red sh.* is a local unit of 100 ft. of red beds at its type loc., Analomink, Monroe Co. It is probably confined to Pike and Monroe Counties, except doubtful identification on N. Y. side of Delaware River, near Hawks Nest. White mistook this red sh. for his much younger New Milford red sh. It is valuable only as defining base of Delaware River flags in this neighborhood. Where it is absent the Delaware River flags rest on Trimmers Rock ss. [Table on p. 571 shows following downward succession: Delaware River flags, Analomink red sh., and Trimmers Rock ss. Table on p. 606 shows Trimmers Rock ss.=Delaware River and Analomink.]

Anamosa dolomite.

Silurian (Niagaran?): Central eastern Iowa.

S. Calvin, 1895 (Iowa State Univ. Bull. Lab. Nat. Hist., vol. 3, No. 3, pp. 186, 189). *Anamosa ls.*—Earthy, finely and perfectly laminated dol. not highly crystalline, forming top memb. of Niagara fm. in eastern Iowa. Overlies LeClaire ls. [Latter fm. is now regarded by E. O. Ulrich as of post-Salina Cayugan age.]

W. H. Norton, 1895 (Iowa Geol. Surv. vol. 4, pp. 130–135). *Anamosa stage; Anamosa or Mount Vernon beds.*—[See under †*Mount Vernon beds.*] Overlie LeClaire beds and underlie Bertram beds.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 269, 276). There seems to be no question of contemporaneity of the Leclaire and Anamosa. The Leclaire represents the "reef" type and the Anamosa and overlying Bertram consist of the more normal type of sediments deposited away from the "reefs." Exposures show interfingering of Anamosa type of sediment with the "reef" type of the Leclaire. It is possible the Bertram may be in part at least younger than the youngest Leclaire. Anamosa is younger than Hopkinton and Racine.

See also under *Gower dol.*

Named for Anamosa, Jones Co.

Anarchist series.

Carboniferous (?): Southern British Columbia and central northern and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 10, 11, 12, 118° to 120°). *Anarchist series.*—Qtzite, phyllitic shales, greenstones, with some ls. beds. Underlies Attwood series. [Mapped around Anarchist Mtn, B. C. on map 11.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 389).

Anastasia formation.

Pleistocene: Florida (east coast as far south as Broward County; west coast from Ten Thousand Islands as far north as Tampa).

E. H. Sellards, 1912 (Fla. Geol. Surv. 4th Ann. Rept., p. 18). The term *Anastasia fm.* is here applied to the extensive deposit of Coquina rock found along east coast of Fla. The rock is a mass of more or less water-worn shells, which in some localities are cemented to form a firm rock, but elsewhere may be slightly or not at all cemented. Some sand is frequently included in this fm. and the cementing material is calc. Typically exposed on Anastasia Island, also in cut made by Florida East Coast Ry on Tomora Creek near Ormond, and along the coast at Rockledge. Probably contemp., or partly so, with Miami ls. and other Pleist. fms. along southern coast.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Anastasia fm. redefined to include all marine deposits of Pleist. age that underlie lowest plain bordering E. coast of Fla. N of southern part of Palm Beach Co., and also including a local facies, consisting chiefly of shell marl irregularly hardened into sandy ls., which in some previous repts has been called "Palm Beach ls.," and which marks transition of Anastasia fm. into the contemp. Miami oolite. Most conspicuous part of Anastasia fm. is coquina containing a little quartz sand, and no doubt at some places the fm. may be almost wholly quartz sand. Thickness variable; near St. Augustine the coquina is 30+ ft. thick. It is probable the deposits referred to Anastasia fm. are not all of same age. It is not unlikely the fm. of the shell beds has been continuous since end of Plio., although the locus of deposition has been continually shifting. [The map accompanying this rept applied *Anastasia fm.* to the Pleist. marine beds of *west* coast of Fla. as far N. as Tampa Bay, and that is present accepted definition of name.]

Anawalt sandstone.

Mississippian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 245). *Anawalt ss.*—Massive, hard, fine grained, gray, 15 ft. thick. Lies about 500 ft. below Pocahontas No. 3 coal. Older than Hartwell ss. Included in Mauch Chunk series. Exposed at SW. edge of town of Anawalt, McDowell Co.

Anchor limestone member (of Monte Cristo limestone).

Mississippian (lower): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 17, etc.). *Anchor ls. memb.*—Massive gray ls. with numerous thin chert layers; in places large belts are altered to dol. Thickness 65 to 400 ft. Many lower Miss. fossils (listed). Underlies Bullion dol. and overlies Dawn ls.; all members of Monte Cristo ls. Well developed in region of Anchor mine, Goodsprings quad.

Anchor Mine tongue (of Mancos shale).

Upper Cretaceous: Eastern Utah (Book Cliffs coal field).

C. E. Erdmann, 1934 (U. S. G. S. Bull. 851, pp. 36–38). *Anchor Mine tongue* is one of the 3 westward-projecting tongues of Mancos sh. that inter-finger with basal Mesaverde strata. Its base or E. end lies in sec. 12, T. 10 S., R. 100 W., and in that vicinity it has typical Mancos lithology. Westward it changes from dark-gray sandy marine sh. into thin-bedded ss. and carbonaceous material representing deposition in shallower waters near shore. Near mouth of Hunter Canyon it separates upper and lower members of Sego ss. Is exposed at Anchor mines. Thickness ranges from 0 to 115± ft.

Anderdon limestone member (of Detroit River dolomite).

Lower Devonian: Southeastern Michigan (Detroit region) and western Ontario.

W. H. Sherzer and A. W. Grabau, 1908 (Sci., n. s., vol. 27, p. 408). *Anderdon ls.*—In most localities a more or less continuous coral and *Stromatopora* reef; very fossiliferous. Is middle memb. of Upper Monroe [Detroit River dol.].

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, pp. 540+). *Anderdon coral ls.*—Pure calcarenite or lime sand rock with embedded corals. Thickness 0 to 38 ft. Older than Amherstburg dol. and younger than Flat Rock dol. Only exposure in Anderdon quarry, Anderdon Twp, Essex Co., Ont. [On a later page (553–556) thickness is given as 40 to 50 ft. Later repts give thickness 0 to 150± ft.]

Anderson sandstone. (In Pottsville group.)

Pennsylvanian: Eastern Tennessee.

A. Keith, 1896 (U. S. G. S. Briceville folio, No. 33). *Anderson ss.*—Sss., sandy and argill. shales, and coal beds, like preceding fms. [Scott, Wartburg, and Briceville]. Bottom of series is marked by massive sss. in beds from 20 to 50 ft. thick, with total thickness of 100 to 120 ft. Above these follow 300 to 400 ft. of shales interbedded with thin layers of massive ss. which are capped in higher mtns by thick, massive sss. like bottom layers. Appears on mtn tops. Original thickness unknown, but 650 ft. remain. Overlies Scott sh. Named because of its frequent occurrence in Anderson Co.

Anderson phyllite.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 622, 641). *Anderson phyllite.*—Largely recrystallized dark-gray and black slaty rocks, with some calc. and a few sandy strata; much pyrite. Thickness 1,600 ft. Intergrades with overlying Ranger marble and with underlying Nash marble series. Named for old Anderson mining prospect, on Libby Creek, near contact of this fm. with Nash marble series. Assigned to early Algonkian.

Anderson clay.

A name applied to clay underlying Anderson coal in Jefferson Co., Ohio. Lies in Conemaugh fm. (Penn.), 15′2″ above Cambridge ls. (See R. E. Lamborn, Ohio Geol. Surv., 4th ser., Bull. 35, 1930, p. 134.)

Anderson Bay formation.

Triassic: British Columbia.

R. G. McConnell, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 70).

Anderson River group.

Age (?): British Columbia.

A. R. C. Selwyn, 1872 (Canada Geol. Surv. Rept. 1871–72, pp. 62–63).

Anderson-Spartanburg zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 6, 12). The *Anderson-Spartanburg zone* probably represents most prominent body of oldest phase of Archean exposed in S. C., to which all other rocks in State are probably junior, excepting tongues of the corresponding Carolina gneiss series which occupy portions of adjacent zones. It comprises a wide belt bounded on W. by Tiger zone along a line which irregularly extends from 82° long. on N. C. line to Brown's ferry on Savannah River; on N. by the State line; on E. by an irregular line which extends from a point approx. 1 mi. E. of Grover, along Whitaker Mtn Ridge, to mouth of Buffalo Creek, thence immediately N. of Gaffney to Thicketty Station, thence slightly W. of Thicketty Creek to West Mtn, thence to Graycourt Knob, thence near Wares Shoals (Saluda River), thence N. of Abbeville and immediately S. of Lowdensville, whence it proceeds along Rosses Creek to Savannah River, up which the bdy extends to Brown's ferry. It includes upper part of Cherokee, greater portion of Spartanburg, lower half of Greenville, lower three-fourths of Anderson, and a narrow northerly strip of Abbeville Counties. It is largely constituted of Carolina gneiss series and subordinately of Roan gneiss or hornblende series, and intrusive diabase and diorite. The rocks comprise granite, granitite, gneissoid slates, mica schists and slates, hornblende schists, graphite schists, etc. Pegmatization has been extensive. Many of rocks are garnetiferous.

Named for development in Anderson and Spartanburg Counties.

Andover granite.

Carboniferous (late): Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.). *Andover granite.*—Normal facies strongly resembles Squam granite. Includes a muscovite granite facies and aplite and pegmatite.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 86–87, 220–221, and map). *Andover granite.*—Typically a biotite-muscovite granite of moderately coarse and generally somewhat uneven grain. Generally more or less foliated and in many places strongly gneissic. Parts of it are porphyritic, and aplitic and pegmatitic phases abound. Color ranges from nearly white to dark gray. Composed essentially of feldspar, quartz, muscovite and biotite. Intrusive, and, with exception of few dikes, the youngest rock in region in which it occurs. Occupies large area around Andover.

†Andrew shale. (In Douglas formation.)

Pennsylvanian: Southwestern Iowa, northwestern Missouri, and eastern Kansas.

C. R. Keyes, 1899 (Am. Geol., vol. 23, p. 306). *Andrew sh.*—Upper memb. of Lawrence sh. [broad usage] in Mo. and eastern Kans. Overlies Iatan ls. memb. of Lawrence and underlies Plattsmouth ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936, for relations to present recognized units.

Named for Andrew Co., Mo.

Andrews schist.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 5). *Andrews schist.*—Calc. schist, 200 to 350 ft. thick. One of most conspicuous features is large number of crystals of ottrelite which spangle the rock. Muscovite and biotite also occur in frequent crystals, especially in upper parts of fm. The various micas are embedded in a fine matrix of carbonate of calcium of about same character as underlying Murphy marble. The feature which makes this schist of particular importance is development in it of deposits of brown hematite. At base the fm. grades into Murphy marble by interbedding and by diminution of amount of ottrelite. Upward it passes into Nottely qtzite, as the sandy material increases both in separate layers and as grains in the body of the schist.

Named for exposures at and in vicinity of Andrews, Cherokee Co., N. C. The town is situated on the schist.

Angela formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 333).

†Angelina series.

Tertiary: Eastern Texas.

R. T. Hill, 1902 (Franklin Inst. Jour., vol. 154, No. 2, pp. 153–154). *Angelina series.*—Later Eocene deposits of Tex. coastal plain. Overlies Camden series (earlier Eo.) and underlies Neocene. Includes Lufkin deposits (Yegua), Fayette sands, and Fleming beds (Frio clays). Thickness as given by Kennedy 1,407 ft.

Probably named for Angelina Co. or Angelina River.

†Angelina County beds.

Eocene: Eastern Texas.

See explanation under †*Lufkin beds.*

Angel Lake glacial stage.

A name applied by E. Blackwelder (Geol. Soc. Am. Bull., vol. 42, p. 918, 1931) to time covered by a Pleist. glacial deposit in Ruby Mtns, NE. Nev., which he correlates with Wisconsin stage. "The features of this stage can best be studied at Angel Lake, SW. of Wells" [Elko Co.].

Angola shale.

Upper Devonian: Western New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 24 and chart). ***Angola sh.***—Soft gray shales underlying Dunkirk sh. and overlying Rhinestreet sh. Included in Portage. [See also N. Y. State Mus. Mem. 6, 1903.]

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1019–1029). ***Angola soft shales with concretions.***—Upper 100 ft. soft shales; lower 68 ft. concretionary sh. Underlie Silver Creek light soft shales and overlie Rhinestreet black sh. Included in Portage group of Lake Erie section.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 76 and chart). ***Angola sh.*** named for Angola, Erie Co., where it is exposed along Big Sister Creek. Overlain by Hanover sh. and underlain by Rhinestreet sh. The Hanover and Angola = Hatch sh. and flags to E.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157). ***Angola shales*** are discon. overlain by Hanover shales and discon. underlain by Rhinestreet sh.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). ***Angola sh.*** is much younger than Hatch sh. and is = Gardeau sh. [narrow sense]. Is separated from overlying Hanover sh. [restricted] by Pipe Creek sh., with which it is discon. (?).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60. No. 3, p. 193). ***Angola sh.*** overlies Hatch and underlies Wiscoy. Is = (ascending) Grimes ss., Gardeau sh. (restricted), Letchworth sh., and Portage ("Nunda") ss.

Anguilla formation.

Miocene (lower): West Indies.

T. W. Vaughan, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 271).

Anian period.

A term introduced by C. [R.] Keyes. Probably an abbreviated form of his Anianic period.

Anianic period.

A time term introduced by C. [R.] Keyes to cover what appears to be the erosion interval separating the pre-Camb. rocks formerly called "Archean system" and "Algonkian system." "Derived from Anian Straits, an illusory waterway the discovery of which long played chief incentive to early geographic exploration of North American continent." (See Iowa Acad. Sci. Proc., vol. 21, p. 201, 1914, also Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Animas formation.

Tertiary? (Eocene?): Southwestern Colorado.

W. Cross, 1896 (U. S. G. S. Mon. 27, pp. 217–219). ***Animas River beds*** [*in heading*]; *Animas beds* [*in text*].—Yellowish brown clays, tuffs, sss., and cgls, in which andesitic material greatly predominates and presents a variety rivaling that in the Denver beds, of which they are considered the direct equiv. Thickness 700 or more ft. Overlie Laramie fm. and underlie Puerco fm. on Animas River below Durango.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). ***Animas fm. (restricted).***—Andesitic fluviatile deposits, of probable Eo. age, 0 to 2,670 ft. thick. Uncon. underlies Torrejon fm. and *uncon.* overlies McDermott fm.—an andesitic fm. 0 to 400 ft. thick, heretofore included in Animas fm., but believed to be of Cret. age. Animas fm. as here restricted appears to be present in only a limited area in SW. Colo.

In NW. New Mex. deposits believed to be approx. contemp. with it, but geographically separated from it and different lithologically, are here designated as *Ojo Alamo ss.*

†Animas interglacial epoch.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1912 (Jour. Geol., vol. 20, pp. 392–409), applied this name to interval preceding the Wisconsin (†Uinta) glacial stage and following the Durango (†Bighorn) glacial stage. The name *Animas* being preoccupied in same region, this interval was later (U. S. G. S. P. P. 166, 1932) described by them as *post-Durango and pre-Wisconsin interglacial stage.*

Animas moraine.

Pleistocene: Southwestern Colorado.

W. Cross and E. Howe, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 256–272), mention *Animas moraine* on several pages. The name is preoccupied in same region.

†Animas River beds.

Tertiary? (Eocene?): Southwestern Colorado.

See under *Animas fm.*

Animikean.

A term applied by some Canadian geologists to rocks formerly called "Animikie group" by other geologists. (See W. G. Miller and C. W. Knight, Ontario Bur. Mines Rept., vol. 22, pt. 2, 1914, p. 125.)

†Animikie group.

Pre-Cambrian (upper and middle Huronian): Canada, northern Michigan, Wisconsin, and Minnesota.

T. Sterry Hunt, 1873 (Am. Inst. Min. Engrs. Trans., vol. 1, pp. 331–395). *Animikie group.*—Dark-colored argillites and sss. underlying the great Keweenaw group and overlying Huronian crystalline schists along Thunder Bay (of N. shore of Lake Superior, in Canada). This is lower div. of upper copper-bearing series of Logan. Animikie is Indian name for Thunder Bay.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pp. 124, 135, 157–163), gave thickness of Animikie group (slates and qtzites) of the Huronian as 10,000 ft.

C. R. Van Hise, 1892 (U. S. G. S. Bull. 86), stated *Animikie series* is=upper Huronian; rests uncon. on lower Huronian; is uncon. overlain by Keweenawan series; and is=Penokee series.

C. W. Hayes, Robt. Bell, W. G. Miller, F. D. Adams, C. R. Van Hise, and A. C. Lane (composing the Special Committee of American and Canadian geologists appointed to determine the proper nomenclature for Lake Superior region), 1905 (Jour. Geol., vol. 13, pp. 89–104). *Animikie* (*Upper Huronian*) rests uncon. on Middle Huronian in Lake Superior region and is uncon. overlain by Keweenawan series.

Some geologists later restricted Huronian to pre-Animikie rocks, but the U. S. Geol. Survey continued to follow the definition adopted by the Special Committee in 1905, which included in it *Animikie group* (*upper Huronian*). Much has been written about the Animikie rocks and their correlation. R. C. Allen, 1915 (Jour. Geol., vol. 23, table opp. p. 703) transferred to middle Huronian the Animikie group, the Vulcan fm., the Felch schist, the †Hanbury sl., the Tyler sl., and the Quinnesec schist. In 1919 (Am. Inst. Min. and Met. Engrs. Bull. 153, pp. 2579–2594) he referred Quinnesec schist and upper part of †Hanbury sl. to upper Huronian, but included Vulcan fm. and lower part of †Hanbury in middle Huronian, and stated that his middle Huronian "carries the distinctive members of the old Animikie, the main iron-bearing series. Whether the name Animikie should be retained for the portion remaining as the Upper Huronian, or shall follow its most distinctive members into the Middle Huronian may be left for later decision."

A. C. Lawson, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 383). The Animikie rests, at Thunder Bay, on the peneplain evolved in Eparchean interval, and therefore is not Huronian in any sense. Its correlative N. of Lake Huron is very uncertain and may be nonexistent.

A. Leith, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 325). There are a few iron fms. within the Upper Huronian. Among them are the fms. at Iron River, Crystal Falls, Florence, the W. part of Marquette dist., and probably in Cuyuna dist. The great producers, however, including the iron fms. of Marquette, Mesabi, Gogebic, and Menominee dists., are now considered to be of Middle Huronian age. Because of this new correlation it seems necessary to abandon the term *Animikie*, because it includes fms. of both Upper and Middle Huronian age, separated by an uncon. which, at least in Marquette dist., is of great magnitude.

†Animikie series.

Same as †*Animikie group*.

Ankareh shale.

Triassic (?): Northeastern Utah (Park City region) and southwestern Wyoming.

J. M. Boutwell, 1907 (Jour. Geol., vol. 15, pp. 439–458). *Ankareh sh.* (also *Ankareh fm.*).—Siliceous detrital deposits, chiefly red shales, which frequently become sandy through considerable thicknesses. Also includes a number of well-marked beds of rather coarse whitish gray ss., 20 to 55 ft. thick. A few fossiliferous grayish blue lss. a few ft. thick are also intercalated. Thickness of fm. 1,500 + ft. The div. line btw. Ankareh and underlying Thaynes fm. is made on lithologic grounds, calc. members characterizing the Thaynes and siliceous members characterizing the Ankareh. The basal memb. is taken as the coarse massive ss. that lies at base of the red sh. as a whole and immediately overlies a thin ls. Only a part of this fm. occurs in Park City dist., the highest part being marked by a prominent massive white ss. memb. Named for Ankareh Ridge, Park City dist., on which it attains its fullest and most characteristic development within the dist.

The same year (1907) that Boutwell introduced the name *Ankareh sh.* in Park City dist., Utah, A. C. Veatch introduced the name *Nugget ss.* for approx. equiv. deposits in SW. Wyo.

H. S. Gale and R. W. Richards, 1910 (U. S. G. S. Bull. 430), restricted both Nugget ss. and Ankareh sh. (See 1910 entry under *Nugget ss.*)

J. M. Boutwell, 1912 (U. S. G. S. P. P. 77, p. 59), redefined his Ankareh sh., as explained in 1912 entry under *Nugget ss.*, and called the upper part *Nugget ss.*

The name *Ankareh* is no longer used in SE. Idaho. (See 1916 and 1920 entries under *Nugget ss.*) According to G. R. Mansfield (U. S. G. S. P. P. 152, 1927) the Ankareh sh. of Park City dist., Utah, as restricted by Boutwell in 1912 is=lower part of Nugget ss. restricted of Mansfield plus underlying Wood sh., Deadman ls., Higham grit, and Timothy ss. of SE. Idaho.

Annabelle shale. (*In Monongahela formation.*)

Pennsylvanian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 250). *Annabelle sh.*—Greenish gray and brown sh., 10 to 12 ft. thick. Underlies Uniontown ss. and overlies Uniontown coal. At Annabelle, Marion Co., it largely replaces Uniontown ss.

Annapolis formation.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

Annona chalk.

Upper Cretaceous: Northeastern Texas, Louisiana, southeastern Oklahoma, and southwestern Arkansas.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 308). Pure white chalk, called *White Cliffs chalk* in Ark. and *Anona chalk* in Tex. Underlies marls called *Brownstown marls* in Ark. and *Kickapoo marls* in Tex. Overlies Taylor marls.

According to 1925 and 1926 work of L. W. Stephenson and C. H. Dane (U. S. G. S. Press Bull. 8823, Sept. 10, 1926; A. A. P. G. Bull., vol 11, p. 9, 1927; Ark. Geol. Surv. Bull. 1, p. 79, 1929) the Annona chalk in Ark. underlies Marlbrook marl restricted (mistaken for the older Brownstown marl in early repts) and overlies Ozan fm. (upper and uncon. part of Brownstown marl of early repts, which is=in age lower part of typical Taylor marl). In NE. Tex. the Annona rests uncon. on Brownstown marl restricted (=lower part of Brownstown marl of earlier usage) and uncon. underlies marl that is believed to be upper part of Taylor marl. According to L. W. Stephenson, 1937 (U. S. G. S. P. P. 186G, p. 135), Ozan fm. is=lower part of Annona chalk of Red River Co., NE. Tex., which lower part of Annona is=lower part of Taylor marl.

Named for outcrops about 2 mi. NW. of Annona, Red River Co., Tex.

Annville limestone.

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M7, pp. 124, 133). Trade name for belt of "Cambro-Ordovician" [Upper Camb.] lss., a few hundred ft. wide and about 15 mi. long, that passes through or very near Myerstown, Lebanon, Annville, and Palmyra, Lebanon Co., Pa. Quarried in vicinity of Annville.

Anoka moraine.

Pleistocene (Wisconsin stage): Southern Minnesota (Kandiyohi, Meeker, and Anoka Counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 84–85). Included in Crow River morainic system. Village of Anoka, Anoka Co., is on this moraine.

Anona chalk.

See *Annona chalk.*

† Anorthosite series.

Pre-Cambrian: Canada.

F. D. Adams, 1893 (Jour. Geol., vol. 1, pp. 332–335).

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 59). As the area studied in Laurentide Mtns widened, a new fm. was found, a laminated gabbro. It was recognized as being largely composed of labradorite or anorthosite and so was first called "Anorthosite" or "Labradorian," and afterward "Norian." [For further particulars see index of Bull. 360.]

Antelope moraine (also **morainic system**).

Pleistocene (Wisconsin stage): Southern Minnesota, South Dakota, and North Dakota.

Named by T. C. Chamberlin, 1883 (U. S. G. S. 3d Ann. Rept., pp. 388, 393), *Antelope Hills or third moraine.* He believed it next succeeded the Gary moraine. Later the name was shortened to *Antelope moraine.* According to work of F. Leverett (U. S. G. S. P. P. 161, 1932) this moraine is not the third moraine. Named for Antelope Ridge or Antelope Hills, in SW. part of Lac qui Parle Co., Minn. Is of late Wisconsin age, according to W. C. Alden.

Antelope rhyolite.

Tertiary (?): Northwestern Arizona (Oatman dist., Mohave County).

C. Lausen, 1931 (Ariz. Bur. Mines Bull. 131, and map).

Antelope Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 385, 386). *Antelope Creek bed.*—Variable ss., friable to hard, pure to clayey, with a little cgl.

and some clay. Local deposit. Memb. of Strawn div. Underlies Indian Creek bed and overlies Comanche Creek bed.

Named for Antelope Creek, San Saba Co.

† Antelope Hills moraine.

Name originally proposed by T. C. Chamberlin (U. S. G. S. 3d Ann. Rept. pp. 388, 393, 1883) for the Antelope moraine of modern literature.

† Anterior sandstones and shales.

Descriptive term applied in early repts to a lower part of Newark group in Conn.

† Anterior trap.

Descriptive term applied in early repts to a basalt flow in lower part of Newark group in Conn.

†Anthracolithic.

A European term synonymous with *Carboniferous period* as used by U. S. Geol. Survey and other American geologists, i. e., including Perm., Penn., and Miss. series. Introduced by William Waagen in 1891. For definition see U. S. G. S. Bull. 769, p. 78, 1925.

Anticosti group.

Silurian: Canada and New York.

E. Billings, 1857 (Canada Geol. Surv. Rept. Prog. 1853–1856, pp. 247–345). *Anticosti group*, divided into divisions C, D, E, and F.

W. E. Logan, 1863 (Canada Geol. Surv. Rept. 1843–1863, pp. 298–344). *Anticosti group* includes Oneida cgl., Medina ss., Clintonl group, and Niagara group.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 680, 704). "Anticosti group" of Billings included Oneida, Medina, Clinton, and Niagara sh. and ls., and is synonym of Niagara period of Dana, 1863 and 1895. "Billings' term 'Anticostian,' although a synonym for Niagaran, will be retained for local application and value."

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, p. 365). *Anticostian* is best available series name for the Eontaric as here defined, that is, including approx. Medina, lower Clinton, upper Clinton, and Rochester.

The U. S. Geol. Survey uses *Niagara group* to include Lockport dol. and Clinton fm. (in which Rochester sh. is included as a memb.), and treats the Medina as a distinct group.

Anticostian.

See under *Anticosti group.*

Antietam sandstone.

Lower Cambrian: West Virginia, Virginia, Maryland, and southeastern Pennsylvania.

A. Keith, 1893 (as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68. The fm. was described, but not named, by Keith in Am. Geol. vol. 10, p. 365, 1892). *Antietam ss.*—Fine-grained white ss., 250 ft. thick, with scolithus and Lower Camb. fossils. Underlies Camb. ls. and overlies Harper's Ferry shales [Harpers sh. of present usage].

In SE. Pa. the lithologic character of fm. changes and it is there called *Antietam qtzite* in some areas and *Antietam schist* in other areas.

Named for exposures E. of Antietam Creek, in Harpers Ferry quad.

Antigua formation.

Tertiary: West Indies.

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, pp. 497, 526) and 1902 (vol. 58, p. 357). [Assigned to Tert.]

Later writers have assigned it to Cret., to Olig., and to Mio.

Antioch sandstone.

Permian: Central southern Oklahoma (Garvin County).

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1465, 1466). South of Washita River the upper part of Garber-Wellington section again contains thick sss., as at Antioch, in T. 3 N., R. 2 W. These Antioch sss. grade northward into the sh. of Paoli area, thus indicating that they did not come from same direction as the Garber of Cleveland Co. Btw. the Antioch sss. and the Pontotoc on E. the lower section is similar to that E. of Paoli, the sss. being very lenticular. [On p. 1466 Green states that on S. side of Washita River, in area SW. of Maysville, a good sh. section, 160 ft. thick, lies btw. base of Purcell ss. lenses of Hennessey sh. and *Antioch ss.*]

Antler formation.

Mississippian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 22).

†Antlers sand.

Lower Cretaceous (Comanche series): Southeastern Oklahoma and northeastern Texas.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 303). Pack sand, at base of mtns in southern Ind. Ter., identical in character with that of Trinity and Paluxy sands of Brazos section in Tex., except that the lss. which there separate them have thinned out in country N. of the Brazos. Uncertain whether it represents either one or both of the sands of Trinity div. of Tex., so provisional name *Antlers sands* is used.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 114). *Antlers sand* will be applied to equivalents of all the fms. of Trinity group (Paluxy, Glen Rose, and Travis Peak) as they coalesce along W. border region N. of Parker Co.

This name was many years ago discarded by Okla. Geol. Surv. and U. S. Geol. Survey, both of whom employ the older name *Trinity sand*, for the undiff. equivalent of Trinity group of Tex.

Named for Antlers, Pushmataha Co., Okla.

†Antoine dolomite.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 16, 17, and U. S. G. S. Mon. 36, pp. XXV, XXVI). *Antoine dol.* of Menominee dist. overlies Sturgeon qtzite and underlies Vulcan iron fm.

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62), and W. S. Bayley, 1904 (U. S. G. S. Mon. 46, on Menominee dist.), applied *Randville dol.* to the dol. overlying Sturgeon qtzite in Menominee dist., stating that it borders N. side of Lake Antoine for a part of its length, that it is uncon. overlain by Vulcan fm., the lower memb. of which consists of slates, cgls., qtzites, and jaspilites, and that Negaunee fm. is represented in Menominee dist. only by pebbles in the qtzite at base of Vulcan fm.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 333 and chart opp. p. 598), applied *Randville dol.* to the dol. overlying Sturgeon qtzite in Menominee dist., stating that a belt of the dol. borders N. side of Lake Antoine for a portion of its length, and that it is overlain by middle Huronian qtzite (correlated with Ajibik qtzite, Siamo sl., and Negaunee fm.) which "in most of dist. is not separated from upper part of Randville dol."

Antonio slate.

Pre-Cambrian: Central northern New Mexico (Manzano Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 5). *Antonio slates.*—Somewhat metamorphosed argill. beds, 2,000 ft. thick, which lie beneath Tijeras qtzite and are well displayed at N. end of Manzano Mtns. Underlain by other but as yet undet. sediments. [Derivation of name not given.]

Antonito limestone.

Pennsylvanian (?): Central northern New Mexico (Sandia Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 3, 5). *Antonito lss.*—Lowermost of heavy gray lss. exposed in fine sections at S. extremity of Sandia Range. Thickness 200 ft. Basal part of Maderan series and overlies Mosca ls. [Derivation of name not given.]

Antrim shale.

Upper Devonian: Michigan (Lower Peninsula).

A. C. Lane, 1901 (Mich. Miner, vol. 3, No. 1, p. 9). We are considering replacing *St. Clair* (preoccupied) by *Antrim,* the name of the county in which the shales are exposed.

A. C. Lane, 1902 (Mich. Geol. Surv. vol. 8, pt. 2, map at end). *Antrim.*—Mainly black sh., often bituminous. Underlies Berea grit and overlies Traverse [fm.].

R. B. Newcombe, 1933 (Mich. Dept. Cons., Geol. Surv. Div. Pub. 38, geol. ser. 32, pp. 47, 48), stated that *Antrim sh.* contains Miss. fossils in upper part.

Anvil ferruginous chert member (of Ironwood formation).

Pre-Cambrian (upper Huronian): Northwestern Michigan (Gogebic district) and northwestern Wisconsin.

W. O. Hotchkiss, 1919 (Eng. and Min. Jour. vol. 108, pp. 501, 505). *Anvil ferruginous chert memb.*—Dominantly wavy-bedded granular or fine-grained ferruginous cherts, 0 to 375 ft. thick. Top memb. of Ironwood fm. Eroded away in places. Overlies Pence ferruginous sl. memb. Named for Anvil mine, E. of Bessemer, Mich.

Anvil Rock sandstone member (of McLeansboro formation).

Pennsylvanian: Western Kentucky and southeastern Illinois.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, p. 45, and pl. showing section of Lower Coal Measures). *Anvil Rock ss.*—Massive ss., 31 ft. thick, separating Lower Coal Measures from Upper Coal Measures; universally known in SW. Ky. as "Anvil Rock," because of resemblance to an anvil of two conspicuous masses of the ss. situated on its northern escarpment on Hines Creek, Union Co.

G. H. Cady, 1926 (Ill. Acad. Sci. Trans., vol. 19, pp. 250–272). Anvil Rock ss. outcrops in Saline Co., SE. Ill., where it is 60±ft. thick and lies 5 to 20 ft. above base of McLeansboro fm. Relations to Bankston Fork ls. undet.

Anzar phase (of Santa Lucia series).

Paleozoic (provisionally): Southern California (San Benito County).

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 470, 471, and map). A metamorphic phase probably produced by serpentinization of basic phase of the igneous intrusion. There is a small area of red chert and granite associated with schist and gneiss W. of San Andreas fault in vicinity of Anzar Lake. The chert appears to be Franciscan and the serpentinized schist and gneiss an alteration of the granite; all are now confused in their relations because of faulting. In the accompanying strat. column they are included as *Anzar phase of Santa Lucia series.* Further study might show that the rocks of this limited region are either (1) entirely Franciscan, (2) a slight variation of the Santa Lucia, or (3) a separate series.

Apache group.

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 13). *Apache group.*—Chiefly qtzites, with subordinate shales and cgls. Thickness 800 to 1,000 ft. Underlies Globe ls. and uncon. overlies Pinal schist. Divided into (descending): Dripping Spring qtzite, 400 ft.; Barnes cgl., 10 to 15 ft.; Pioneer sh., 200 ft.; and Scanlan cgl. 1 to 6 ft.

F. L. Ransome, 1911 (Min. and Sci. Press, June 3, 1911). Recent work in Ray quad., which adjoins Globe quad. on S., has revealed that Dripping Spring qtzite as mapped in Globe quad. included two qtzites, each 400 ft. thick, separated by 250 ft. of cherty ls. The name *Dripping Spring* is restricted to the lower qtzite.

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380–385). The ls. overlying Dripping Spring qtzite restricted is here named *Mescal ls.* and the overlying qtzite, which comprises top fm. of Apache group, is here named *Troy qtzite.*

In 1932 N. H. Darton (Wash. Acad. Sci. Jour., vol. 22, No. 11, p. 319), removed Troy qtzite (which contains Upper and Middle Camb. fossils) from the nonfossiliferous underlying fms. of Apache group, which he assigned to Algonkian system (now discarded) because of their strong lithologic resemblance to Chuar and Unkar groups of Grand Canyon. The fms. now included in Apache group consist of (descending) Mescal ls., Dripping Spring qtzite, Barnes cgl., Pioneer sh., and Scanlan cgl.

Named for exposures on W. face of Apache Mtns.

†Apache sandstone.

Upper Cambrian: Grand Canyon.

D. Hager, 1924 (Min. and Oil Bull., vol. 10, p. 137). *Apache ss.*, a new name given me by Darton for beds below the Redwall. [Mr. Darton says (personal communication) that he referred to Tapeats ss., but that in conversation he may have called it Apache ss.]

Apache limestone.

Permian: Western Texas (Apache Mountains).

K. H. Crandall, 1929 (A. A. P. G. Bull., vol. 13, pp. 929, 939–940). In Apache Mtns, in SE. Culberson Co., there is exposed a ls. series about 1,000 ft. thick, which resembles Capitan ls. to marked degree. The local name *Apache ls.* has been applied to it. It consists of massive gray and white lss., exhibiting practically same lithological characteristics and fauna as the Capitan and an overlying, well-bedded pisolitic series resembling Carlsbad ls. No fossils found by writer, but Girty repts a few forms of Guadalupian age. It is almost certainly = Capitan and Carlsbad lss. The Apache ls. seems to be a barrier reef with accompanying lagoonal deposits.

Apache sandstone.

Upper Cretaceous: Eastern Colorado (Walsenburg district).

C. S. Lavington, 1933 (A. A. P. G. Bull., vol. 17, No. 4, p. 399). In Walsenburg dist. the basal zone of Pierre sh. contains a 20-ft. ss. memb. which H. W. C. Prommel in an unpublished rept has called *Apache ss.*

†Apalachicola group.

Miocene (middle and lower): Southern Georgia and northern Florida.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50, pp. 67–69). *Apalachicola group* was formerly designated *Chipolan stage* and *Chipola group*, but these names are abandoned because *Chipola* has been used to designate a marl belonging to the group. The group includes a number of beds differing widely in lithological character, though they are recognized by their fossils as integral parts of a single group. While lss. and marls predominate, the group also includes beds of nearly pure sand and clay. The entire period of deposition appears to have been characterized by accumulation of more or less terrigenous materials, and hence the lss. are usually rendered somewhat impure by an admixture of clay and sand. At certain times the conditions appear to have been especially favorable for development of organic life and some horizons, such as Chipola marl memb. of Alum Bluff fm. and the "silex bed" of Tampa fm., contain very large faunas. The Apalachicola group is separated into four fms.—Chattahoochee, Hawthorne, Tampa, and Alum Bluff. There is, however, some reason for believing that the first three are, in part at least, synchronous, though exact equivalence is difficult to determine where outcrops are widely scattered and faunal variations are slight. The Alum Bluff is clearly younger than Chattahoochee fm., upon which it rests. Assigned to Olig.

Includes Alum Bluff group and Tampa ls.

Named for exposures along Apalachicola River in western Fla.

Apishapa shale. (Of Colorado group.)

Upper Cretaceous: Eastern Colorado.

G. K. Gilbert, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 567). *Apishapa fm.*—Chiefly argill. laminated sh., dark gray, weathering yellowish. Thickness 500 ft. Upper fm. of Niobrara group in Arkansas Valley of eastern Colo. Overlies Timpas fm. and underlies Pierre group. Named for Apishapa River.

The Niobrara and Benton are not now treated as groups by U. S. Geol. Survey, the broader term *Colorado group*, which includes them both, being considered the more useful group name. Where the Niobrara deposits and Benton deposits are not subdivided, they are called *Niobrara ls.* and *Benton sh.*, respectively.

Apison shale.

Lower Cambrian: Eastern Tennessee, western North Carolina, and northwestern Georgia.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2; Kingston folio, No. 4; and Chattanooga folio, No. 6). *Apison sh.*—Brightly colored, slightly sandy or clayey shales, banded in red, purple, green, and yellow colors. A bed of gray siliceous ls. [†Beaver ls.] sometimes occurs btw. this and overlying Rome fm. Thickness of fm. more than 1,000 ft. Oldest fm. in region.

Named for exposures at Apison, James Co., Tenn.

According to C. E. Resser (personal communication May 1936) the Apison sh. is part of Rome fm., and so-called Beaver ls. of Knoxville folio is a ls. lentil in Rome fm.

†Appalachian group.

†Appalachian series.

†Appalachian system.

Paleozoic: Pennsylvania (Appalachian region).

H. D. Rogers, 1836 (Pa. Geol. Surv. 1st Ann. Rept., pp. 12–22), divided the Paleozoic rocks of Appalachian region into *Carboniferous system* and *Appalachian system*. In 1840 rept Rogers called the rocks *Appalachian system* and *Appalachian series*.

H. S. Williams, 1891 (U. S. G. S. Bull. 80, p. 60). Like objection exists to term "New York system" [as a name for *Paleozoic* in America]. While the base is well marked, the rocks of Pa. to top of Coal Measures should be added to them to complete the system. Adding the Carbf. system, as expressed in Pa., Ohio, and Va., a natural group of the first order is produced, which nearly corresponds to what we call *Paleozoic era*. Were we to adopt for this grand terrane the name *Appalachian group*, we should have a properly constituted name for an actual existing geologic group, free from theory, and its use would probably assist in the progress of science.

Appalachian revolution.

A period of mountain building and erosion in Appalachian region that is believed to have begun in late Penn. time and ended at beginning of Triassic time. (See C. Schuchert, Textbook of Geol., pt. 2, pp. 101, 427, 1924.) The 1933 edition of this Textbook, by C. Schuchert and C. O. Dunbar, assigns (p. 65) this revolution wholly to Perm. time.

†Appanoose beds.

Pennsylvanian: Central southern Iowa.

H. F. Bain, 1896 (Iowa Geol. Surv. vol. 5, pp. 378–394). *Appanoose beds.*—Shales, lss., coals, and clays forming lower part of Des Moines stage in Appanoose Co. Overlain by Chariton cgl. (top div. of Des Moines stage). *Includes Mystic coal.*

H. F. Bain, 1897 (Iowa Geol. Surv. vol. 7, pp. 426–469), divided Des Moines "stage" of Guthrie Co., Iowa, into (descending): (1) Sandy sh., 40–100 ft. (probably=Pleasanton sh. of Mo. and Kans.); (2) sh., sss., and lss. with 3 coals (probably=Appanoose fm. of Iowa and Henrietta fm. of Mo.); (3) sss., sandy sh., coals, etc. corresponding to Cherokee sh. of Kans.

H. F. Bain, 1905 (Iowa Geol. Surv. vol. 15, pp. 102–122). *Appanoose beds*, near middle of Des Moines fm., include Mystic or Centreville coal, also lss. known as "Bottom rock," "Cap rock," "Thirteen-foot ls.," and "Fifty-foot ls."

J. H. Lees, 1909 (Iowa Geol. Surv. vol. 19, pp. 598–604). *Appanoose fm.*=Henrietta fm. of Mo. Consists of (descending): *Lonsdale coal*, 1 to 2½ ft.; sh. with ls. and ss. seams, 25 to 100 ft.; coal and fine clay, 4 to 16 ft.; Chariton cgl., 15 to 25 ft.; shales and lss., 50 to 100 ft.; Mystic coal, 6 to 36 inches; fine clay, 1 to 8 ft.; ls., 15 to 35 ft. Underlies Pleasanton shales and overlies Cherokee beds.

Named for development in Appanoose Co.

Appekunny argillite.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southeastern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 322). *Appekunny argillite.*—Prevailingly gray, black, and greenish; thin-bedded; ripple marked; interbedded with white qtzite; carries flattened concretions resembling fossils. Thickness 2,000± ft. Overlies Altyn ls. Underlies Grinnell argillite. It is possible more detailed strat. study may develop fact that Grinnell and Appekunny argillites are really phases of one great fm., and that line of distinction btw. them is one diagonal to the stratification. Excellent exposure occurs on NE. spur of Appekunny Mtn, Mont., but also well exposed in cliffs throughout Lewis and Livingston Ranges.

Appistoki member (of Appekunny argillite).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southern Alberta.

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Appistoki memb.*—Middle memb. of Appekunny fm. Consists of 2,000 to 2,200 ft. of thin-bedded to thick-bedded metargillite, with minor beds of siliceous argillite and qtzite. On Rising Wolf and Appistoki Mtns, in S. part of Lewis Range, Mont., this memb. consists of a lower series of brownish to black metargillites and upper greenish series which forms heavy ledges and falls. Northward to Blackiston Brook, Alberta, the memb. becomes more highly siliceous, with beds of qtzite; the color becomes green in lower portions. Underlies Rising Wolf memb. and overlies Singleshot memb.

Appleton stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, pp. 51–52). *Appleton stage.*—Sss. and shales underlying Booneville stage and overlying Danville stage. Consists of (descending): Shales, few ft. to 40 ft.; Cross Plains ss., 50 to 200 ft.; Russellville shales, 500 to 600 ft.; and Washburn sss., 500 to 600 ft.

Represents middle part of Atoka fm.

Probably named for Appleton, Pope Co., Ark.

† Appomattox formation.

Pleistocene and Pliocene (?): Atlantic Coastal Plain, Virginia to Alabama.

W J McGee, 1888 (Am. Jour. Sci., 3rd, vol. 35, pp. 125, 328–330). *Appomattox fm.*—A series of predominantly orange-colored clays and sands of later Tert. age, regularly but obscurely stratified, sometimes interbedded with gravel or interspersed with pebbles. Thickness 0 to 100 ft. Typically exposed on and near Appomattox River from its mouth to some mi. W. of Petersburg. Rests on Potomac ss., from which it is readily distinguished by its greater homogeneity, the more complete intermingling of its aren. and argill. materials, its more regular stratification, and its more uniform and predominating orange color. It is as readily distinguished from overlying Columbia deposits by its vertical homogeneity, its comparatively regular stratification, distinctive color, and greater range in altitude, extending as it does from tide level to highest eminences of Piedmont escarpment btw. the Rappahannock and the Roanoke. Continues to thicken and expand S. of Appomattox River, until it forms the surface everywhere in vicinity of fall line save where it is cut away by erosion or concealed beneath Columbia deposits. Is typically exposed on the Roanoke opposite Weldon, N. C. Forms predominant surface fm. over a zone 40 or 50 mi. wide on the Roanoke, but attenuates and narrows northward, finally disappearing on Potomac Creek 4 or 5 mi. N. of Fredericksburg; and although it appears to thicken seaward it soon disappears beneath tide level and newer deposits. No fossils. Overlies Mio. and underlies Columbia fm. Fresh aspect and comparatively slight erosion indicate its age is much nearer Columbia fm. than Mio. It is probable it will be found to reach considerable volume in S. C., Ga., and Ala., and although precise relations have not been ascertained, it is indicated not only by physical considerations but by Fontaine's recent studies in Va. and Ala. that at least part of Orange Sand of Hilgard and other southern geologists is = Appomattox fm. of N. rather than Columbia, which is not known to extend much farther S. than N. C.

Includes equivalents of †Lafayette fm. (Plio. ?) and of Columbia group (Pleist.).

Apsey formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Apsey fm.*—Shales carrying 2 species of *Princetonia*, underlain by brown shales carrying *Shumardia*. Overlain by Maidment fm. and underlain by Brown Mead fm. Included in Clarenville series. [Derivation of name not stated.]

Apulia shale.

Apulia limestone.

Devonian: Central New York (Onondaga County).

T. A. Conrad, 1841 (N. Y. Geol. Surv. 5th Ann. Rept., p. 31). Sherburne group underlies Tully ls. and overlies *shales near Apulia* [Onondaga Co.], which rest on black sl.

W. W. Mather, 1843 (Geol. N. Y., vol. 1). Erie div. includes Ludlowville sh., Encrinal ls., Moscow sh., *Apulia and Sherburne shales*, and Cazenovia group. [Apulia sh. not described.]

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 790–808). *Apulia memb. of Tully fm.*—*Apulia* was proposed by Conrad in 1841 for a part of Hamilton group, but was early discarded and nearly forgotten. Because of scarcity of local names in Tully Twp the name is here revived, with a new meaning. Type section is in the ravine adjacent to June's quarry, 1½ mi. SW. of Apulia Station, Tully Twp. It is hard, heavy-bedded, aren. ls. containing *Hypothyridina* in great numbers and at several levels. Thickness at type section, 17 ft. 3 in.; at Moravia, 12± ft.; at Ovid, 4± ft.; at Bellona, 2½ ft. Underlies West Brook memb. of Tully and overlies Tinkers Falls memb. of Tully.

Aquashicola formation.

Silurian: Northeastern Pennsylvania (Carbon and Northampton Counties).

B. L. Miller, 1911 (Pa. Topog. and Geol. Surv. Rept. No. 4, p. 51). *Aquashicola fm.*—Shales, chiefly red but in part olive colored, with occasional layers of sss., which are numerous in lower part but rare in upper part. Thickness 1,275 ft. in Lehigh Gap dist. Called *Clinton shales* in repts 2d Pa. Geol. Surv., but are more recent than Clinton, because they overlie Shawangunk fm., which carries Salina fossils at Otisville, N. Y. Believed to be same as High Falls fm. Named for occurrence in valley of Aquashicola Creek.

Aquia formation. (Of Pamunkey group.)

Eocene (lower): Eastern Virginia, Maryland, and Delaware.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Aquia fm.*—More highly aren. and much more calc. than overlying Nanjemoy fm. Consists chiefly of greensands and greensand marls, frequently argill. Thickness 100 ft. Characterized by well-marked fauna representing a clearly defined paleontological stage. Is divided into Paspotansa memb. or substage above and Piscataway memb. or substage below, which are faunally separable over considerable parts of Md. and Va. Rests uncon. on Cret. This is an expanded definition of Aquia Creek stage or fauna, which did not include basal 60 ft. of unfossiliferous greensand. Is bottom fm. of Pamunkey group.

Type loc., Aquia Creek, Stafford Co., Va.

†Aquia Creek series.

Lower Cretaceous: Northeastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 326). *Aquia Creek series.*—Most typically developed within vicinity of Aquia Creek [Stafford Co., Va.], and I therefore decided to give that name to the memb. designated as "Brooke" by Prof. Fontaine. The materials were obviously derived to a great extent from the Rappahannock series. There is great difference in the fossil plants of Aquia Creek and Rappahannock series. The materials of Aquia Creek series, as well as their mode of deposition, are different from those of any of underlying members of Potomac fm., although they consist largely of redeposited sands, clays, and gravels of the earlier series. Uncon. underlies Iron Ore series of Potomac fm; and uncon. overlies Mount Vernon series of Potomac fm.

Ward later replaced *Aquia Creek series* with *Brooke fm.*, but the use of both of those names was discontinued years ago. According to later studies by W. B. Clark and B. L. Miller (Va. Geol. Surv. Bull. 4, 1912) the Aquia Creek series or Brooke fm. of Ward is included in Patapsco and Patuxent fms. of present nomenclature.

†Aquia Creek stage.

Eocene: Eastern Virginia and Maryland.

W. B. Clark, 1895 (Johns Hopkins Univ. Circ., vol. 15, No. 121, p. 3). The upper beds of Eo. of middle Atlantic slope may be designated *Woodstock stage*, and lower beds may be designated *Aquia Creek stage*. Fossils of Woodstock stage are closely related to "Claiborne" types, and those of Aquia Creek stage are decidedly "Lignitic."

W. B. Clark, 1896 (U. S. G. S. Bull. 141, pp. 54, 57; Am. Jour. Sci., 4th, vol. 1, pp. 369–370). *Aquia Creek stage or fauna*.—Greensands, 77 ft. thick, containing fauna resembling middle Lignitic. Named for Aquia Creek, Va. Separated from overlying Woodstock stage or fauna by 117 ft. of greensands and argill. sands, and from underlying Rancocas fm. (Cret.) by 60 ft. of greensand, at times argill., with basal pebble bed. [This 60 ft. of greensand was included in *Aquia fm.* as defined by W. B. Clark and G. C. Martin in 1901.] All included in Pamunkey fm.

The foregoing definitions apply to upper part only of Aquia fm. of present nomenclature.

Aquia Creek freestone.

Trade term for ss. quarried from Potomac group in vicinity of Aquia Creek, Stafford Co., Va. See under †*Rappahannock series*.

†Aquidneck series.

†Aquidneck shales.

Carboniferous: Southeastern Rhode Island and southeastern Massachusetts (Narragansett Bay region).

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 348–364 and map, pl. 31). *Aquidneck series* (mapped as *Aquidneck shales*).—Chiefly dark-blue fissile shales, with isolated thin beds of ss. and cgl., 3,000+ft. thick, overlain, in part of area, by 150 to 250 ft. of greenish sh. On E. side of Sakonnet River, and across Portsmouth and Middletown (on W. side of Sakonnet River), the upper greenish sh. is represented by Sakonnet ss., mapped as separate fm. The Aquidneck series grades into underlying Kingstown series through a series of "transition rocks" (mapped separately), and is overlain by Purgatory cgl. It forms almost whole of Aquidneck Island (near Newport, R. I.).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped Aquidneck shales of Foerste as Rhode Island fm.

Aquilonian.

Lower Cretaceous: California.

F. M. Anderson, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 6, p. 1253). *Aquilonian*, Upper Jurassic [of European classification], included in Knoxville series.

The U. S. Geol. Survey classifies Knoxville as Lower Cret.

Aquinnah conglomerate.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard).

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52, p. 160). *Aquinnah cgl.*—Semiconsolidated quartzose cgl. with numerous cetacean bones. Thickness 0 to 1½ ft. In previous repts called "osseous cgl."

and referred to Mio., but it contains the remains of a Pleist. horse. Underlies Dukes boulder bed at Gay Head Cliffs fold, on Marthas Vineyard, the only place it is known to occur. Is nonglacial and preglacial, and probably is an old stream gravel. *Aquinnah* is Indian name for *Gay Head.*

Arago group.

Eocene: Southwestern Oregon.

J. S. Diller, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 458–462, 475). *Arago beds.*—Great mass of shales containing here and there much material of igneous origin. Well exposed at Cape Arago [Coos Bay quad.]. Fossils relegate them definitely to position high in Eo. Uncon. overlain by Empire beds (Mio.).

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 336–343). *Arago beds.*—Name suggested by Diller. Consist of sss. and shales, containing fossils that suggest correlation with Clabornian of Gulf region. Are apparently newer than blackish rocks of region about junction of Little River and the North Umpqua. [Further along he calls latter beds *Umpqua beds.*] The Arago beds, which were not at first discriminated from those of the Umpqua, now appear, from differences in fauna, to require separation as a distinct series of beds.

J. S. Diller, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 319–320). *Arago fm.* occupies almost all of Coos Bay region. Is composed of sss. and shales. The coal-bearing strata of the Arago, which contain fresh and brackish water fossils, are here named *Coaledo fm.*, and the older and main body of the Arago, which contains only mere traces of coal and few strata containing brackish water fossils, is here named *Pulaski fm.* The Arago underlies Empire fm. (Mio.).

J. S. Diller, 1901 (U. S. G. S. Coos Bay folio, No. 73). Thickness of Arago fm. (divided into Coaledo and Pulaski fms.) 10,000 ft. Uncon. underlies Empire fm. and uncon. overlies Myrtle fm. [In Port Orford folio, No. 89, 1903, Diller gave thickness of Arago fm. in that quad. as 5,000± ft.]

R. Arnold, 1909 (Jour. Geol., vol. 17, No. 6). *Arago* includes (descending) Coaledo, "Pulaski," and Umpqua.

W. H. Dall, 1909. [See 1909 entry under *Tunnel Point ss.*]

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 565–595), gave thickness of Arago fm. as 10,000 to 15,000 ft. "May be = Ione of Calif."

R. Arnold and H. Hannibal, 1914 (Sci., n. s., vol. 39, pp. 906–908). *Arago or Ione fm.* is younger than any Tejon in Tejon or Puget Basins, which includes Olequa and Chehalis fms. Ione has priority over Arago. In Upper Umpqua Basin Arago fm. is 10,000 ft. thick, and consists of tuffaceous and arkose ss. Farther N., on Santiam River, it consists of coarse basic tuffs.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, and Jour. Geol., vol. 27). Lower part of Arago group may be = part of Umpqua fm. and Tyee ss. Has been considered by several to be later than Umpqua fm.

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., Oreg. Bur. Min. and Geol., vol. 3, No. 1, pp. 5–14, 25–31). Eocene of western Oreg. divided into (descending): Coaledo fm. (=Ione), 4,000 ft.; Tyee fm. (=Tejon), 2,000–5,000+ ft.; and Umpqua fm., 5,000 ft. [Did not explain relations of Tyee and Umpqua to Pulaski fm. of Diller.]

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 225–242). Umpqua beds are of approx. same horizon as *Siphonalia sutterensis* zone of Marysville Buttes, Calif., and are probably eastern equiv. of Arago fm., although they may be slightly lower than the Arago.

W. D. Smith, 1924 (Econ. Geol., vol. 19, No. 5) and 1926 (Commonwealth Rev. Univ. Oreg., vol. 8, No. 3), divided Eo. of western Oreg. into (descending) Coaledo, Tyee, and Umpqua.

Aragon formation.

Eocene (lower): Mexico.

W. L. F. Nuttall, 1930 (Jour. Pal., vol. 4, No. 3, p. 277).

Arapahoe formation.

Upper Cretaceous: Eastern Colorado (Denver Basin).

G. H. Eldridge, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, p. 97). [See †*Willow Creek beds, Tert.*]

W. Cross, 1893 (Int. Cong. Geol., Compte Rendu, 5th sess., pp. 437–438). *Arapahoe beds* are a fresh-water deposit whose most prominent memb. is a cgl. free from volcanic materials, containing pebbles of sed. rocks recognized as belonging to various horizons from the Laramie down to the red sss. of the Trias.

The age of this fm. was changed by U. S. Geol. Survey from *Tert.* (?) to *Upper Cret.*, in Dec. 1935, as explained under *Lance fm.*, last entry.

Named for development in Arapahoe Co.

Arbuckle limestone.

Cambrian and Ordovician: Central southern and southwestern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Arbuckle ls.*—Chiefly massive and thin bedded, white and light-blue lss. with cherty concretions, but with 500 to 600 ft. of dull-blue, massive and thin lss. in lower part, and 200 to 300 ft. of thin, sandy lss. at base. Total thickness 4,000 to 6,000 ft. Overlies Reagan ss. and underlies Simpson fm.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Arbuckle ls.*, 5,000 to 6,000 ft. thick, consists of (descending): (1) Medium and thin-bedded lss., 450 ft.; (2) massive, compact, mag. ls., 3,500 to 4,000 ft.; (3) thin-bedded granular ls. and compact blue ls., 250 ft.; (4) heavy-bedded, dull bluish, and cream-colored dolomites, 200 to 400 ft.; (5) thin-bedded siliceous ls., 50 ft.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 624, 642, 661, 666, pl. 27), introduced *Honey Creek ls. memb. of Reagan ss.* for lss. which he stated were originally included in Arbuckle ls. but are now transferred to Reagan ss.

H. D. Miser, 1926 (Okla. geol. map), followed Taff's original definitions of Arbuckle ls. and Reagan ss. and included Ulrich's Honey Creek ls. in Arbuckle ls.

In 1932 E. O. Ulrich raised *Honey Creek ls.* to rank of a fm. (See 1932 entry under *Reagan ss.*, also see under *Honey Creek ls.*) The U. S. Geol. Survey now recognizes Honey Creek ls. as a distinct fm., which is a slight restriction of Arbuckle ls.

Named for Arbuckle Mtns, of which it composes major part of central mass.

Arbuckle group.

Ordovician and Cambrian: Southern Oklahoma (Arbuckle and Wichita Mountains).

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55–57). *Arbuckle group* divided into (descending) Wolf Creek dol., McKenzie Hill ls., Chapman's Ranch dol., Signal Mtn ls. (may be a part of Fort Sill), Royer marble, and Fort Sill ls. Rests on Timbered Hills group, top fm. of which is Honey Creek fm.

†Arcadia marl.

Pliocene (lower): Southern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 131–132, 157, 320). Yellowish sandy marl, comprising a putty-like mixture of lime and sand, with minute phosphatic pebbles, a few small shark's teeth, and obscure prints of Ostrea, Spondylus, and other bivalves. When exposed to the air, away from the water, the marl hardens rapidly, sometimes forming a very hard and brittle rock, which splinters and rings almost like chert under the hammer. Thickness on Peace Creek about 9 ft. Assigned to Plio. Overlain by Peace Creek bone bed.

Now considered to be a facies of Caloosahatchee marl.

Named for exposures near Arcadia, De Soto Co., on Mare Branch, a tributary of Peace River, about 6 mi. N. of Arcadia.

†Arcadia clays. (In Claiborne group.)

Eocene (middle): Louisiana, Texas, Mississippi, Arkansas.

O. Lerch, 1893 (La. Geol. Surv., pt. 2, p. 85). *Arcadia clays.*—Well stratified gray marine clays, conformably underlying Jackson group and resting uncon. on upper lignitic. May provisionally be called "Arcadia clays" from town on Vicksburg, Shreveport & Pacific R. R. nearly centrally located in area they occupy in La.

As defined the clays occupy strat. position of Yegua (†Cockfield) fm., which name has priority. In some early repts the St. Maurice fm. was called "Upper Lignitic" and the Wilcox was called "Lower Lignitic."

Named for Arcadia, Bienville Co., La.

Arcadian amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 78, 131, 132, 133, pl. 10, etc.). Same as Isle Royale amygdaloid.

Belongs to Central Mine group, and according to B. S. Butler (personal communication) is probably same as Isle Royale amygdaloid. The mineralized part is the Arcadian lode.

Named for occurrence at Arcadian mine, Houghton Co.

Arcadian flow.

Includes Arcadian amygdaloid and underlying trap.

Arcadia Park formation.

Upper Cretaceous (Gulf series): Eastern Texas (Trinity and Brazos River regions).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 425). *Arcadia Park fm.* (from W. L. Moreman's unpublished description).—Type loc., Arcadia Park station, 7 mi. W. of Dallas, on Fort Worth-Dallas interurban. Thickness 100± ft.; thins to S. and N.; about 10 ft. thick at Austin. Type section consists of 20 ft. of blue clay at base, overlain by 1 to 3 ft. of thin ls. flags forming escarpment and dip-slope; upper 75 ft. consists of blue sh. containing numerous calc. concretions of various sizes. On Red River the upper part is sandy and lower part blue shaly clay with a few thin scattered ss. seams. In McLennan and Bell Counties the unit is laminated marl. At Austin the lower part is flaggy, laminated marl and upper part is blue sh. Is uncon. overlain by Austin chalk; the transition zone, Taff's "Fish Bed Cgl.," consists of clay containing gyp., phosphatic pebbles, and reworked pelecypods and fish remains. Is upper part of Eagle Ford. Overlies Britton fm.

†Archean period (or system).

A term that was for many years applied to the time (and the rocks) preceding the Algonkian period (now discarded) and covering the oldest known rocks, but which is no longer used by U. S. Geol. Survey, except in the sense of a rock type—that is, *Archean type*, the meaning of which is "very highly metamorphosed." For definition of the period see U. S. G. S. Bull. 769, pp. 127–135, 1925.

†Archeozoic era.

A time term covering part of Proterozoic era of U. S. Geol. Survey and other geologists. As originally defined it included all pre-Camb. time. In later usages it was applied: (1) To what for many years was known as "Algonkian period;" (2) to what for many years was known as "Archean period;" and (3) to Cambrian, †Algonkian, and †Archean periods combined. For original definition and diversity of usage see U. S. G. S. Bull. 769, pp. 17–20, 1925.

†Archer beds.

Pliocene (lower): Northeastern Florida.

W. B. Scott, 1894 (Geol. Soc. Am. Bull. 5, pp. 594–595). *Archer beds* contain mammalian fauna much older than those of Peace Creek beds, and represent a very different fauna. For strat. reasons Dall regards the Archer deposits as Plio.

Replaced by *Alachua fm.*, the older name.

Named for exposures at Archer, Alachua Co.

Archer County sand.

Same as Gose sand. Subsurface, Archer Co., Tex.

†Archimedes group.

†Archimedes limestone.

Mississippian: Southwestern Illinois, eastern Missouri, northwestern Arkansas, and northeastern Oklahoma.

Paleontologic names applied in early Mo. repts to Chester, Meramec, and Osage groups of present terminology or to parts of these groups. "First Archimedes ls." (also "Upper Archimedes ls.") was applied to the beds above Aux Vases ss. and beneath a ss. at Chester, Ill., called by Swallow "Chester ss.," which S. Weller stated is Palestine ss. of modern nomenclature; "Second Archimedes ls." was applied to Ste. Genevieve ls.; "Third Archimedes ls." was applied to Warsaw ls., also to Warsaw and Keokuk lss., and to Keokuk ls. alone. "Lower Archimedes ls." was also applied to the lower lss. (See B. F. Shumard, 1873, Mo. Geol. Surv. Rept. 1855–71, pp. 292–293.) In NW. Ark. and E. Okla. "Archimedes ls." was in early repts applied to Pitkin ls.

Archuleta shale.

Upper Cretaceous: Northwestern New Mexico (San Juan region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 260; also Conspectus of geol. fms. of N. Mex., pp. 2, 5). *Archuleta shales* is here proposed for *Animas fm.* of San Juan region, which is preoccupied. [On p. 2 he states it consists of 250 ft. of cgl., uncon. underlying Puerco fm. and uncon. overlying Maxwell shales. Derivation of name not stated.]

Corresponds to Ojo Alamo ss. and McDermott fm. (both Upper Cret.) of current nomenclature.

Arcola sand.

A subsurface sand in either Rico fm. or Hermosa fm. of southern San Juan Co., SE. Utah.

†Arctic Miocene.

Name applied in early repts to plant-bearing rocks in Greenland that are now classified as Eocene.

Arctomys formation.

Upper Cambrian: Alberta and British Columbia.

C. D. Walcott, 1920 (Smithsonian Misc. Coll., vol. 72, No. 1, p. 15). *Arctomys fm.*, Camb., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll., vol. 67, No. 8, pp. 461–462, Mar. 5, 1923. Underlies Sullivan fm.; uncon. overlies Murchison fm.; is 1,386 ft. thick; is Upper Camb.]

Arcturus limestone.

Pennsylvanian: Eastern Nevada (Ely region).

A. C. Lawson, 1906 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 4, No. 14, p. 294). Argill. and in part sandy ls. which may be designated *Arcturus shaly ls.*, although the shaly character is not always apparent. Is easily distinguished by abundance and yellow color of its regolith. Thickness 900 to 1,000 ft. Underlies Ruth ls. and overlies Ely ls.

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 26, 28, map). *Arcturus ls.* was named for Arcturus mining claim, on which the fm. occurs. It is 400± ft. thick, and lies in the broad central syncline of Ely dist. and in SW. corner of Ely quad. In both places it is partly covered by rhyolite flows or by volcanic tuff. Fossils listed. Overlies Ely ls. The "Ruth" ls. of Lawson is same as Ely ls.

Ardmore limestone member (of Cherokee shale).

Pennsylvanian: Northwestern and north-central Missouri and southeastern Kansas.

C. H. Gordon, 1893 (Mo. Geol. Surv. Sheet Rept. No. 2 (vol. 9) p. 20). *Ardmore ls.*—Irregular marly and concretionary fossiliferous ls. in Lower Coal Measures of Bevier quad. (covering parts of Macon, Randolph, and Chariton Counties), separated from underlying Lower Ardmore coal by 25 to 30 ft. of sh. with few interstratified ls. beds, and from overlying Bevier coal by 6 to 18 inches of clay. [Later repts give thickness 0 to 10 ft. Is †Hydraulic ls. of Swallow.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 56). Most important ls. in Cherokee sh. is in upper part. *Ardmore ls.* has priority for this bed, but Okla. name *Verdigris ls.* has usage.

Named for Ardmore, Macon Co., Mo.

Ardness formation.

Mississippian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 244).

Arecibo formation.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 10–17). Includes San Sebastian shales, Ponce chalky lss., Juana Diaz marls, Juana Diaz shales, Guanica coral reefs, and Quebradillas reef lss.

Arenal formation.

Eocene: Mexico.

J. L. Tatum, 1931 (A. A. P. G. Bull., vol. 15, p. 880). [Assigned to Eo.]

Arendtsville fanglomerate lentil (in Gettysburg shale).

Upper Triassic: Central southern Pennsylvania (Adams County).

G. W. Stose, 1929 (U. S. G. S. Fairfield-Gettysburg folio, No. 225). *Arendtsville fangl. lentil.*—Coarse cgl. of rounded cobble and boulders of qtzite, ss., quartz, and some aporhyolite in matrix of red sand, which extends for 20 mi. along foot of South Mtn in NE. part of Fairfield quad., NW. corner of Gettysburg quad. and SE. part of Carlisle quad. Estimated thickness 0 to 500± ft. It forms the large hills SW. and W. of Arendtsville, whence its name. In Carlisle quad. it passes into ls. cgl. (unnamed). Is top memb. of Gettysburg sh.

Argenta limestone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 37). Lss., 150 ft. thick, underlying Park sss., uncon. overlying Bingham qtzite, and composing basal fm. of Aubreyan series in Utah. [Derivation of name not stated.]

Argentine limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Argentine ls.*, new name. Underlies Island Creek sh. and overlies Lane sh. Basal part of Lansing group redefined.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Wyandotte ls.* Derivation of name not stated. On p. 46 *Argentine ls.* is described as consisting of 10 to 32½ ft. of white irregularly bedded ls. On p. 92 Moore states that Argentine ls. replaces what had been called Iola ls. at Kansas City.]

G. E. Condra, 1933 (Nebr. Geol. Surv. Paper No. 4, p. 11). Argentine ls. is the "Iola" at Kansas City, but according to Kans. geologists it is higher in section than Iola at type loc.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 59–60). *Argentine ls. memb. of Wyandotte ls.* consists of 20 to 30 ft. of light-gray, thin-bedded, wavy ls., underlying Island Creek sh. memb. and overlying Quindaro sh. memb. Named for Argentine railway station, Kansas City, *Kans.* Type exposure in a quarry S. of 26th and Metropolitan Ave. Comprises main part of so-called Iola ls. of Mo. and NE. Kans., which is younger than true Iola ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

†Arickaree shale.

Upper Cretaceous: Northwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 52). *Arickaree shales.*—Light-colored, olive, yellowish, and brownish fossiliferous gray shales referred to lower part of Fox Hills div. Overlie Lisbon shales.

Conflicts with better established name (Arikaree) for a Mio. fm. These beds belong to Pierre sh. No beds of Fox Hills age are known in Kans.

Named for *Arikaree* River, Cheyenne Co.

Arido sandstone.

Jurassic: Northeastern Arizona.

C. [R.]Keyes, May, 1936 (Pan-Am. Geol. vol. 65, No. 4, pp. 303, 306). *Zunian series* divided into (descending) McElmo shales, Lohali ss., Montezuma shales, and *Arido ss.* The latter 3 fms. correspond to LaPlata beds of Cross. The Arido replaces Gregory's preoccupied name *Navajo ss.*, and is named for Arido Creek, in N. part of Navajo Reservation.

This ss. appears to correspond to Wingate ss. of U. S. G. S. classification. (See A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U. S. G. S. P. P. 183, chart opp. p. 37.)

†Arietina bed.

A paleontologic name applied in some early Tex. repts. to the Lower Cret. beds later named *Del Rio clay.*

Arikaree sandstone.

Miocene: Western Nebraska, southeastern Wyoming, southern South Dakota, and northeastern Colorado.

N. H. Darton, 1899 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 732, 735, 742, 743–748, pls. 82, 83, 84, 85, 88). *Arikaree fm.*—Series of gray sands, everywhere characterized by layers of dark-gray concretions which often have a tubular form, underlying Ogallala fm. in western Nebr. with distinct erosional uncon. and overlap. Rests (usually conformably) on Gering fm., where that fm. is present; where Gering is absent, on Brule clay. There is possibility upper memb. of Gering fm. may be basal part of Arikaree fm. The Arikaree enters Nebr. from Wyo., and thins out beneath Ogallala fm. in E. part of Banner Co. Thickness 400 ft. in Scotts Bluff Co. and 500 ft. in Sioux and Dawes Counties, the thickness increasing as the Arikaree displaces the Ogallala fm. northward. Extensively exposed along Niobrara River, apparently to E. of Valentine, and occasionally seen along W. edge of sand-hill dist., but not yet distinctly recognized in region drained by Loup Forks or along Platte River E. of Cheyenne Co. In upper part are beds containing the large *Daemonelix* of Barbour. The fm. includes large amount of volcanic ash as a general admixture in its sediments as well as in beds of considerable extent and thickness. Also contains a number of channels filled with cgl. The name *Arikaree* is applied to the fm. because Arikaree Indians were at one time identified with area in which it is most largely developed.

N. H. Darton, 1903 (U. S. G. S. P. P. 17), mapped *Arikaree fm.* across western northern Nebr. up to S. Dak. line, but did not show any Ogallala above it in that area. In 1909 (U. S. G. S. W. S. P. 227) Darton mapped *Arikaree fm.* across southern S. Dak. from near Fall River Co. on W. to beyond Missouri River on E., did not show any younger fm., and did not mention presence of Ogallala fm. in S. Dak.

According to H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 65), the Arikaree of NW. Nebr. and SE. Wyo. is all of lower Mio. age, while the Arikaree of northern Nebr. and adjacent Little White River region, S. Dak., includes upper Mio. and late middle Mio. deposits equiv. to lower part of Ogallala fm. of SW. Nebr., and these late middle Mio. deposits are separated from beds equiv. to lower Mio. Arikaree of NW. Nebr. and SE. Wyo. by a big hiatus.

H. F. Osborn, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 247, 249), assigned Arikaree fm. of S. Dak. to Mio. and Olig. In 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 9, 12) he stated that Arikaree fm. includes some Plio., lower Mio., and possibly some upper Olig.

E. L. Troxell, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 210), stated that study of vertebrate fossils in Marsh collection leads to conclusion Arikaree fm. is upper Olig.

See also *Oak Creek fm.*, *Little White River beds*, and *Ogallala fm.*

H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5), stated that vertebrates of "Arikaree" fm. are Mio. and upper Olig. But G. E. Condra, preface to same book, stated that he believes the Gering (the equiv. of lower part of Arikaree) is Mio. and not Olig., as classified by H. J. and M. C. Cook. This would assign all of Arikaree to Mio., which is present age designation of U. S. Geol. Survey.

Arisaig series.

Silurian: Nova Scotia.

J. W. Dawson, 1860 (Canadian Nat., vol. 5, pp. 135–137).

†Arizona slates.

†Arizonan.

†Arizonian slate.

Pre-Cambrian: Southeastern Arizona.

W. P. Blake, 1883 (Eng. and Min. Jour., vol. 35, p. 254). *Arizonian sl.*—An extensively developed fine-grained mica sl. This fm. is very ancient, and is lithologically and to all appearance the equiv. of the Taconic slates of Berkshire, Mass., and the Vermont extensions. It is extensively developed in Ariz., and being one of the primal series of fms. and fundamental bedrocks of the territory, in and upon which such a variety of later fms. are grouped, it deserves the distinguishing name of *Arizonian sl.,* which I shall apply to it. It is extensively exposed to view along the sides of Queen Creek Valley, W. of town of Pinal, where it may be seen in a highly contorted, twisted condition traversed by innumerable veins of white quartz, also contorted, and often doubled back and forth upon themselves. This sl. extends to SW., flanking the granitic masses of Pinal Range, and is there much traversed and broken up by granitic intrusions. This rock finally disappears, westward, under the post-tertiary fms. of Gila plains.

Same as Pinal schist. Has also been spelled *Arizonan* and called "Arizona slates."

Arkadelphia marl. (In Navarro group in Texas.)

Upper Cretaceous (Gulf series): Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 53–56, 188). *Arkadelphia shales.*—Alternating bands of marine blue clay and white or orange-colored sands, 5 ft. thick. Uncon. overlies Washington or High Bluff (Cret.) greensands, and underlies Quat. gravels and clays. Basal fm. of Eocene Camden series.

A. C. Veatch, 1906 (U. S. G. S. P. P. 46, p. 28). The dark laminated clays which overlie Nacatoch sand and form the "blue dirt" of well drillers along line of Iron Mtn Ry from Arkadelphia to Texarkana were named by Hill in 1888 the Arkadelphia shales, from outcrops at Arkadelphia, Clark Co., Ark. These beds contain uppermost Cret. fossils for 100 to 200 ft. above Nacatoch sands, the fossil-bearing beds being well developed on Yellow Creek 3 to 4 mi. NW. of Fulton, 5 to 6 mi. N. of Hope, N. and NW. of Emmet, and at Arkadelphia. Thus far no fossils have been found in upper portion of this fm., which extends without any apparent break to the Eocene sand beds forming the sandy hills S. of Iron Mtn Ry. Thickness 200 to 300 ft. at Arkadelphia, 500 ft. at Lanesburg, 500 to 600 ft. at Hope and Spring Hill, and 500 ft. at Texarkana and Shreveport.

C. H. Dane, 1929 (Ark. Geol. Surv., Bull. 1). The outcrops near Arkadelphia are now known to be upper part of the Nacatoch, which is unusually well stratified and consists of alternating clay and sand in this vicinity. The outcrops along Mine Creek are part of the clay phase of Tokio fm. Exact location of outcrops cited [by Hill] in southern Hempstead Co. is not known to writer, but a locality about half way btw. Fulton and Washington might be either in uppermost Nacatoch or possibly in lowest part of marl now defined as Arkadelphia. The "dark laminated clays" which according to Veatch are well developed on Yellow Creek 3 to 4 mi. NW. of Fulton, 5 to 6 mi. N. of Hope, N. and NW. of Emmet, are not the "blue clay and yellow sand outcropping in vicinity of Arkadelphia" to which Hill first applied the name Arkadelphia, and a new name would have been desirable.

The name, however, has now become firmly entrenched in geologic literature, although somewhat modified from the sense in which it was used by Veatch; and it now seems best to retain it, although with the clear understanding that the fm. typically outcrops 2 to 3 mi. NW. of Fulton and at numerous localities 5 to 7 mi. N. and NW. of Hope. Thickness 120 to 160 ft. It is possible basal few ft. of fm. outcrops, though not typically, at Arkadelphia; and this is an additional reason for retention of the name.

Top fm. of Upper Cret. or *Gulf* series in SW. Ark. Uncon. overlies Nacatoch sand and uncon. underlies Midway fm. According to 1925 and 1926 studies of L. W. Stephenson and C. H. Dane, *marl* is more appropriate lithologic designation than either *shale* or *clay*, by both of which names it has been called.

Arkadelphia clay.

Same as Arkadelphia marl, the present adopted name.

†Arkansan series.

Pennsylvanian: Western Arkansas and eastern Oklahoma.

C. R. Keyes, 1901 (Iowa Acad. Sci. Proc., vol. 8, pp. 119–132). *Arkansan series.*—Series of coal measures, 0 to 18,000 ft. thick, representing practically uninterrupted deposition, and locally underlying Des Moines series and overlying Mississippian series. Limited above by base of Cherokee sh., or base of Grady coal in Okla., and limited below by top of Miss. Includes (descending) Sebastian, Spadra, Norristown, Boonville, Appleton, Danville, and Millstone grit terranes. Represents, locally, lower part of Penn. series. [In 1931 Keyes replaced this name with *Yellian series.*]

Named for valley of Arkansas River, Ark. and Okla.

†Arkansas marls.

Miocene (upper) and Pliocene: Central southern Colorado.

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 75–91). In valley of the Arkansas N. of Poncha Pass is a fine development of light-colored marls, doubtless of same age as Santa Fe marls, which I have designated by name of *Arkansas marls.* They occupy entire valley of the Arkansas, which is 40 mi. long and 5 to 10 mi. wide. Assigned to Plio.

Same as *Santa Fe fm.*, of upper Mio. and Plio. age.

†Arkansas sandstone.

Pennsylvanian and Permian: Central southern Colorado.

F. M. Endlich, 1874 (U. S. Geol. and Geog. Surv. Terr. 7th Ann. Rept., p. 312). *Arkansas ss.*—Red ss., 5,000± ft. thick. In Sangre de Cristo Range the sss. are interstratified with lss. and shales and rest directly on granite. Assigned to Carbf. Is overlain by gray and bluish lss. and underlain by gray saccharoidal ls. Named for proximity to Arkansas River.

F. M. Endlich, 1878 (U. S. Geol. and Geog. Surv. Terr. 10th Ann. Rept., p. 129). *Arkansas ss.* assigned to Upper Carbf. Thickness 2,400 to 4,000 ft. Consists of red sss. and shale. Occurs along Arkansas River and in Sangre de Cristo Range.

C. E. Siebenthal, 1910 (U. S. G. S. W. S. P. 240, p. 35). Looking up valley of Willow Creek Park, SE. of Crestone, is a ledge of cgl., here called puddingstone cgl., because many of the bowlders in it are themselves conglomeratic, which was called "Arkansas ss." by Endlich.

Arkansas novaculite.

Middle and Upper (?) Devonian: Southwestern Arkansas and southeastern Oklahoma.

L. S. Griswold, 1892 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 3, pp. 57–61, 69, 85, 87–113). *Arkansas stone* [also repeatedly called *Arkansas novaculite*].—True novaculite which occurs associated with shales into which it grades through opaque flinty layers. Resembles chert in structure, composition, and manner of occurrence. Thickness 500 or 600 ft., which generally includes some flinty shales and soft shales or sss. The novaculites proper are the prominent members, however, and occur in massive beds from few inches to 12 or 15 ft. thick. All highly siliceous rock except occasional sss. is novaculite or flinty sh.; there is no true chert or flint, although hard spots or masses are called flint by quarrymen. The Arkansas stone is a typical memb. of the novaculite fm., in which the two stones (Arkansas novaculite and Ouachita stone) occur.

A. H. Purdue, 1909 (Slates of Ark., Ark. Geol. Surv., pp. 30, 39–40). *Arkansas novaculite*.—Massive white and variegated novaculite with alternating flint and sh. layers in upper half. Lower 300 ft. wholly novaculite. Thickness 0 to 800 ft. Uncon. underlies Fork Mtn sl. and overlies Missouri Mtn sl.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 66). *Arkansas novaculite* consists of 3 lithologic divisions: A lower one made up almost entirely of massive white novaculite, at whose top is one of the two manganese horizons; a middle one consisting mainly of thin layers of dense dark-colored novaculite interbedded with sh. and having a cgl. of local distribution at its base; and an upper one consisting chiefly of massive, highly calc. novaculite which also yields manganese. Thickness 250 to 950 ft. Uncon. underlies Stanley sh. and overlies Missouri Mtn sl. Some sh. at base of Stanley sh. has in places been altered to sl., to which name "Fork Mtn sl." has been earlier applied.

The upper part of lower memb. contains Middle Dev. fossils; the lower part of middle memb. contains fossils that were identified by E. O. Ulrich as Upper Dev. (Genesee); the upper memb. may be post-Dev. (See H. D. Miser and A. H. Purdue, U. S. G. S. Bull. 808, 1929, pp. 57–59.)

C. L. Cooper, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 211). At Caddo Gap, Montgomery Co., west-central Ark., the *Arkansas novaculite* is 900 ft. thick and typical of the fm. in Ouachita Mtns. It is divisible into 3 lithologic units (descending): (1) Mostly massive calc. novaculite; (2) interbedded dark-colored dense novaculite and sh.; (3) almost entirely massive thick-bedded novaculite. Ulrich, on basis of fossils from novaculite beds near Ti, Okla., holds that the lower div. is of Onondagan age. Evidence furnished by conodonts indicates upper and middle divisions are Miss. Of 45 sp. in the novaculite, 27 occur in the Woodford, 13 in the Hardin, and 17 in the Chattanooga. The fm. therefore should be redefined. Writer suggests *Caddo Gap* for Miss. part when necessary detailed mapping has been done. [Proof that the beds referred to are Miss. is lacking. The U. S. Geol. Survey still classifies them as Dev. (?).]

Named for quarries in Ark. and for fact that the quarried rocks have long been known to the trade as *Arkansas novaculite*. It is the principal fm. of Ouachita Mtns.

Arkansas black marble.

Trade term for very fine-grained, even-textured, and uniformly shaded black marble occurring in large quantities in Fayetteville and Pitkin fms. (both of Miss. age) of northern Ark.

Arkona.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Arkona beds.

Devonian: Ontario.

A. W. Grabau, 1917 (Jour. Geol., vol. 25, p. 341).

Arlington formation.

Mississippian: Northern California (Taylorsville and Lassen Peak regions).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Arlington beds.*—Slates and sss. with traces of cgl.; 5,700 ft. thick. No fossils, but as they lie beneath Shoo Fly beds at one end and are associated with Sil. slates at the other, they are regarded as probably belonging to upper Paleozoic. Older than Shoo Fly beds and younger than Taylor[s]ville slates.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Arlington fm.*—Chiefly fine, gray, thin-bedded ss., with some sh. in part silicified and a few beds of cgl. In lower memb. yellowish shales prevail and grade up into the shaly and thin-bedded greenish gray ss. of middle memb., which is well exposed in bold escarpment of Arlington Heights. In upper memb., which is well exposed about Crystal Lake, slaty gray shales are most abundant, with local cgls. and highly silicified red jaspery portions near top. Measured thickness 5,700 ft. Is separated from overlying Shoo Fly fm. by great thickness of Taylor meta-andesite. Is younger than Taylorsville fm.

Named for Arlington Heights, Plumas Co., which is composed of the fm., and where middle memb. is well exposed.

Arlington lake beds.

Pleistocene and late Tertiary: Central northern Oregon.

E. T. Hodge, 1930 (Monthly Weather Rev., vol. 58, pp. 405–441). *Arlington lake beds.*—Lake beds and stream gravels of white ash, diatomaceous material, and gray silts, 200 ft. thick. Furnish evidence of period of extensive flooding of Cascade Range at a time contemp. with deposition of The Dalles and Madras fms. Underlie extensive morainal deposits and bear on their surface enormous glacial erratics. Occur on S. side and very close to Columbia River. Greatly eroded. Once extended as far S. as Willamette, as far W. as The Dalles beds, as far N. as N. side of Columbia River, and unknown distance to E. Conviction prevails that Dalles, Madras, and Arlington fms. represent a period of aggradation during first glacial stage.

E. T. Hodge, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, pp. 924–968). Early Pleist. fossils in gravels of *Arlington fm.* near Umatilla. Uncon. overlies Columbia River basalt (Mio.).

E. T. Hodge, 1932 (Univ. Oreg. Pub., Suppl. to Geol. Ser., vol. 1, No. 5). *Arlington lake beds.*—Pleist. fossils in older gravels. Perhaps part of fm. is Recent. The name is not wholly distinctive of this fm., and in later publications we propose to call it *Shutler fm.* On E. side of Deschutes River the fm. intergrades with Madras fm. Lies uncon. on Columbia River basalt. The lake beds and gravels occur as erosional remnant patches up to elev. of 1,750 ft.

The town of Arlington is near Shutler.

†Arlington traps.

Name applied by N. H. Darton (U. S. G. S. Bull. 67, 1890), to several small sheets of Palisade diabase (intrusive) near Arlington, Hudson Co., N. J.

Arlington moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. (See M. M. Leighton, 16th Int. Geol. Cong. Guidebook 26, 1932, pl 2.)

Arlington Heights moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. (See M. M. Leighton, 16th Int. Geol. Cong. Guidebook 26, 1932, p. 15.) See also *Tinley Park moraine.*

Armendaris limestone.

Ordovician: New Mexico.

C. R. Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 259, 260). *Armendaris lss.*—Lss., 300 ft. thick, underlying Montoyan series and uncon. overlying late Camb. qtzites (Lone terrane) in N. Mex. The main body of Early Ordovicic lss. well displayed in Sierra de los Caballos. [Derivation of name not stated.]

Armenia limestone lentil (of Oswayo formation).

Devonian or Carboniferous: Central northern Pennsylvania (Bradford County).

H. S. Williams and E. M. Kindle, 1905 (U. S. G. S. Bull. 244). *Armenia ls. lentil of Oswayo fm.*—Is No. 29 of Armenia Mtn section, Bradford Co. Contains probably not more than 25 per cent of lime, but since no other bed in section above the Chemung contains an appreciable quantity of lime, it is regarded as a ls. Thickness 10 to 26 ft. Lies 149 ft. below top of Oswayo fm. Contains Carbf. fish remains.

Armstrong member (of Cuyahoga formation).

Mississippian: North-central Ohio (Wayne County).

G. W. Conrey, 1921 (Ohio Geol. Surv., 4th ser., Bull. 24, p. 54). *Armstrong memb. of Cuyahoga fm.*—Greenish buff, fine-grained ss., 25 to 35 ft. thick. Upper part in layers 2 to 6 inches thick; lower 25 ft. massive, irregularly bedded, with marked tendency toward lenticular beds. Underlies Black Hand memb. and overlies Burbank memb. Named for exposure near village of Armstrong, Wayne Co.

Armuchee chert.

Lower and Middle Devonian: Northwestern Georgia.

C. W. Hayes, 1902 (U. S. G. S. Rome folio, No. 78, p. 3). *Armuchee chert.*—Rusty, sandy, bedded chert, at places grading into ferruginous ss. Thickness 0 to 50 ft. Underlies Chattanooga sh. and overlies Rockwood fm., on N. side of Coosa Valley, NW. of Coosa fault. Probably contemp. with Frog Mountain ss., of Oriskany age, which is present in only SW. corner of Rome quad.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221, p. 10). Typical *Frog Mtn ss.* is all of Onondaga age. It extends NE. into Ga., where it is present in Lavender Mtn and in Horseley Mtn, about 1 m. W. of Rome, and was mapped by Hayes in *Armuchee chert.* In both of these mtns this ss. is immediately underlain by fossiliferous chert which belongs to Armuchee chert of Hayes as described in Rome folio.

Named for exposures around Armuchee, Floyd Co.

Arnheim shale. (In Richmond group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and west central Kentucky and Tennessee.

A. F. Foerste, 1905 (Sci., n. s., vol. 22, p. 150). *Arnheim bed* introduced to replace preoccupied name *Warren.* Consists of sh. and clay, with nodular clay layer at top. Thickness 63 ft. Underlies Waynesville bed and overlies Mount Auburn bed [upper part of McMillan fm.].

Adopted to include at top beds called by A. F. Foerste *Fort Ancient div. of Waynesville,* which, because of fauna and strat. break at their top more properly belong to Arnheim than to overlying Waynesville, according to E. O. Ulrich and C. Butts. Foerste also originally stated that his Fort Ancient div. is more closely related faunally to Arnheim than to Waynesville. In Ohio the Arnheim is chiefly sh. and is called *Arnheim sh.;* in Ind. and Ky. it consists of clay and sh. with ls. layers and is called *Arnheim fm.;* in Tenn. it is wholly ls. and is called *Arnheim ls.* Basal fm. of Richmond group.

Named for Arnheim, Brown Co., Ohio.

Arnheim limestone.

Upper Ordovician: Western Tennessee. See under *Arnheim sh.*

Arnold amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Local name, in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is same as Ashbed amygdaloid. The mineralized part is the Arnold lode.

Named for occurrence in Arnold mine, Keweenaw Co.

Arnold flow.

Includes Arnold amygdaloid and underlying trap.

Arnold member (of Deese formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 15). *Arnold memb.,* near middle of Deese fm., N. of Ardmore, includes a fossiliferous ls. up to 50 ft. thick.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 46, pp. 36–38). *Arnold memb.*, near middle of Deese fm., consists of (descending): (1) Medium-grained massive buff ss., 50 ft.; (2) sh., 50± ft.; (3) ls. (fossiliferous, thin-bedded, more or less earthy and lumpy, interbedded with calc. sh., and carrying lenses of smoky chert), 50± ft.; (4) 100± foot interval; (5) richly fossiliferous shales associated with float or smoky chert. Named for Arnold's Reef, on Arnold farm, in sec. 33, T. 3 S., R. 1 E. [Columnar section on pl. 18 shows 1,900± ft. of strata btw. Arnold memb. and underlying Devil's Kitchen memb. of Deese fm.]

See also C. W. Tomlinson, A. A. P. G. Bull., vol. 18, No. 8, 1934, p. 1085.

Arnoldsburg sandstone. (In Monongahela formation.)

Pennsylvanian: Western West Virginia and eastern Ohio.

R. V. Hennen, 1911 (W. Va. Geol. Surv. Rept. Wirt, Roane, and Calhoun Counties, pp. 57, 202, 505). *Arnoldsburg ss.*—Coarse brown and gray ss. forming high pebbly cliffs. Thickness 25 to 45 ft. Lies 40 to 50 ft. below Uniontown ls. and overlies Lower Uniontown coal. Named for Arnoldsburg, Calhoun Co., W. Va.

Arnoldsburg limestone. (In Monongahela formation.)

Pennsylvanian: Eastern Ohio and northern West Virginia.

W. Stout, 1929 (W. Va. Acad. Sci. Proc., vol. 3, pp. 140, 143). *Arnoldsburg ls.* (new) is a buff hard stratum occupying most of interval btw. Fulton green sh. and Arnoldsburg ss. in northern pan-handle region of W. Va. and belonging just below horizon of Lower Uniontown coal. Thickness 0 to 15 feet. Named for association with Arnoldsburg ss.

R. E. Lamborn, 1930 (Ohio Geol. Surv., 4th ser., Bull. 35, pp. 181, 244–247). In many parts of W. Va. and eastern Ohio the ls. btw. Uniontown coal and Fulton green sh. is divided into 2 well-defined ls. horizons separated from each other by aren. sh. or ss. The lower part of this ls. lies in contact with or closely above Fulton sh., and upper part is usually a few ft. below Uniontown coal. D. B. Reger of W. Va. Geol. Surv. proposes to restrict *Uniontown ls.* to that part which lies closely below Uniontown coal and to use *Arnoldsburg* for the ls. which lies close above Fulton green sh. The term *Arnoldsburg* is hereby accepted by Ohio Geol. Surv. and will be used in this and subsequent repts on Monongahela series of this State. The Uniontown ls. formerly included Arnoldsburg ss. and Arnoldsburg ls. horizons. [Thicknesses of Arnoldsburg ls. given by Lamborn range from 3 to 12 ft. in Jefferson Co., Ohio, but in some sections the name *Uniontown ls.* is applied to all the lss. and shales overlying Fulton green sh.]

D. B. Reger, 1931 (Ill. Geol. Surv. Bull. 60, pp. 217–239), in generalized section of Monongahela fm. of W. Va., gave following downward succession: Uniontown coal, 0 to 2; gray or red sh., 0 to 10; Uniontown ls., 0 to 15; red or green sh. with thin sss. and lss., 44 to 59; Arnoldsburg ss., 25 to 30; sh., 0 to 5; Lower Uniontown coal, 0 to 1; *Arnoldsburg ls.*, yellow, fresh-water, 0 to 5; Fulton green sh., 0 to 5.

W. Stout, 1931 (Ill. Geol. Surv. Bull. 60, p. 212), in generalized section of Monongahela fm. of Ohio, gave following downward succession: Uniontown coal, 10 inches; Uniontown sh. and ls., 5 ft.; Arnoldsburg ss., 8 ft.; Arnoldsburg coal absent; Arnoldsburg ls. and calc. sh., 37 ft.; Fulton green sh., 4 ft.

Arnott moraine.

Pleistocene (Illinoian): North-central Wisconsin.

S. Weidman, 1907 (Wis. Geol. and Nat. Hist. Surv. Bull. 16). Named for Arnott, Portage Co.

Aroostook limestone.

Silurian: Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 44–45). Under name *Aroostook ls.* are grouped the calc. shales and slates covering large part of eastern twp of Aroostook Co. The Aroostook River cuts them from Wade Twp to its junction with the St. John. The few fossils indicate Clinton age. Is regarded as older than Sheridan ss. and Ashland sh. and ls. and as representing base of Sil. in this region.

Aroostook Falls diabase.

Age (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 115, 175–177). *Aroostook Falls diabase.*—Dark-gray rock, with characteristic lamprophyric appearance. Occurs in a number of dikes cutting the blue ls. of the region. Named for occurrence at Aroostook Falls, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the diabase of Aroostook Co. is mapped in block designated "mainly Sil., but some of Dev. age."

Arpin conglomerate and quartzite.

Pre-Cambrian (upper Huronian): Central northern Wisconsin (Wood County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 366). *Arpin cgl. and qtzite.*—Qtzite, probably 200 to 500 ft. thick, which resembles Baraboo qtzite. Exposed immediately S. of Arpin, Wood Co. Contains pebbles of Powers Bluff qtzite. Is either upper or middle Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to "Animikie group (upper Huronian)."

Arrastre quartzite.

Probably Lower Cambrian: Southern California (San Bernardino County).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 351, 352–365, and map). *Arrastre qtzite*—The oldest sedimentaries positively identified as such in the region. Qtzites and quartzose schists, chiefly thin bedded, in beds less than 6 inches thick. Differs from Saragossa qtzite in that it contains no beds up to 5 and 10 ft. thick, of pure qtzite, no pure saccharoidal qtzite, no coarse angular grits, pebble cgl., or cross bedding. No fossils found. Grades into Furnace ls. above. Floor on which it was laid down has been destroyed by granite intrusions.

Named for Arrastre Creek, San Bernardino Co.

Arriban series.

A time term applied by C. R. Keyes (Sci., n. s., vol. 23, p. 921, and Am. Jour. Sci., 4th, vol. 21, pp. 298–300; 1906) to 500 ft. of sss, said to underlie his Llano Estacadan series, to overlie his Wasatchan series in N. Mex., and to include Santa Fe fm. and Galisteo ss. Derivation of name not stated.

Arrowhead limestone member (of Monte Cristo limestone).

Mississippian (middle): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 9, 18, etc.). *Arrowhead ls. memb.*—Alternating layers of thin-bedded blue and gray ls. and gray sh.; highly fossiliferous; no chert. Thickness 10 to 20 ft. Underlies Yellowpine ls. and overlies Bullion dol., all members of Monte Cristo ls. Named for Arrowhead prospect, sec. 9, T. 24 S., R. 58 E., Goodsprings quad. Fossils (listed) are middle Miss., according to G. H. Girty.

†Arrowmink arkosic gneiss.

Pre-Cambrian: Southeastern Pennsylvania (Philadelphia region).

F. Bascom, 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143). *Arrowmink arkosic gneiss* correlated with Baltimore gneiss. [In U. S. G. S. Philadelphia folio, No. 162, 1909, Baltimore gneiss was used, and Miss Bascom states (Dec. 5, 1936) that later work has not changed this identification.]

Arroyo formation. (In Clear Fork group.)

Permian: Central Texas (Taylor and Runnels Counties region).

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 45–46). [See 1918 entry under *Abilene fm.*]

Most geologists (including U. S. Geol. Survey and Tex. Geol. Survey, Sellards, 1933) now include Arroyo fm. in Clear Fork group, but some geologists have included it in Wichita group.

Arroyo Seco gravel.

Pleistocene: Northern California (Mokelumne River Basin).

A. M. Piper, H. S. Gale, and H. E. Thomas (U. S. G. S. W. S. P. 780, in press). *Arroyo Seco gravel*—Water-worn cobbles, gravel, and sand derived chiefly from pre-Cret. crystalline rocks. Is a pediment gravel that mantles the dissected Arroyo Seco pediment in Arroyo Seco Land Grant, along W. front of Sierra Nevada. Thickness 0 to 19 ft. Contemp. sediments presumably exist to much greater thickness beneath cover in axis of California trough. Underlies Victor fm. and uncon. overlies Laguna fm. (Plio. ?).

Artemisa limestone.

Cretaceous: Cuba.

J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 537). [Assigned to Jurassic or Cret.]

Artemisia gravel.

Pleistocene: Great Lakes region (Ontario and Michigan).

W. E. Logan, 1863 (Canada Geol. Surv. Repts 1843–63, pp. 887, 908–909). *Artemisia gravel.*—A belt of loose gravel, stretching southward across the peninsula of western Canada from near Owen Sound to Brantford, a distance of 100 mi. Average breadth of belt 23 mi. Covers total area of more than 2,000 sq. mi. The gravel is all well rounded and generally coarse; often constitutes what might properly be called shingle, being loose and free from any admixture of clay; and it is distinctly stratified. After forming a northward spur in Euphrasia Twp it reaches Beaver River in the N. of Artemisia. Relations to Algoma sand and to Saugeen clay not fully determined. [In table on p. 887 it is placed btw. Saugeen clay below and Algoma sand above.] Near Brantford it rests on Erie blue clay.

J. W. Spencer, 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 85–86). *Artemisia gravel* of Canadian Survey includes sand, gravel, and even till deposits of all kinds and ages. The term should be restricted to the ridges occupying position of the very high-level beaches. Named for Artemisia Twp, Ontario.

Artesia sand.

Subsurface sand, of Perm. (probably Capitan) age, in Artesia field, Eddy Co., N. Mex.

Arthrodiran sandstone.

Upper Devonian: Central Arizona.

See *Sycamore Creek ss.*, also *Jerome fm.* Paleontologic name, based on content of fishes of group *Arthrodira.*

Artibonite group.

Miocene: Haiti.

W. P. Woodring, 1922 (Haiti Geol. Surv., Strat. and structure of central plain, Washington). Includes Las Cahobas fm., Thomonde fm. and Maïsade tongue, and Madame Joie fm.

Arundel formation. (Of Potomac group.)

Lower Cretaceous: Eastern Maryland.

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 156, 190). *Arundel fm.*—Series of large and small lenses of iron-ore bearing clays which occupy ancient depressions in surface of Patuxent fm. The largest lenses nearly 125 ft. thick. The clays are highly carbonaceous. Lignitized trunks of trees are often found in upright position with their roots still intact. Vast quantities of nodules of iron carbonate are scattered through the tough dark clays. In upper part of fm. the carbonate ores have changed to hydrous oxides of iron. Fossils mainly dinosaurian remains. Uncon. underlies Patapsco fm. Included in Potomac group. Named for Anne Arundel Co.

Arvonia slate.

Upper Ordovician: Central Virginia (James River region).

T. L. Watson and S. L. Powell, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 36–43). West of Blue Ridge the Martinsburg sh. [Upper and Middle Ord.] was laid down at about same time as *Quantico and Arvonia belts of sl.*

T. L. Watson, 1916 (Va. Geol. Surv. geol. map of Va.). [Map explanation states that the Ord. (Cincinnatian) block "Includes the Arvonia and Quantico slates of the Piedmont Plateau province."]

A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 119, abstract). At the James River, in Va., *Arvonia slates*, of Chazyan age, are infolded in a continuation of the Peach Bottom syncline.

A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 841–842). *Arvonia sl.*—Blue slates which uncon. overlie Peters Creek fm. and Precambrian granite, with a basal cgl. present in part of area. Have been previously mapped and described but not named. Writer proposes name *Arvonia slates* for these beds. Bassler classifies fossils as probably of Chazy [Lower Ord.] age. Exposed at Arvonia.

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, p. 25). Fossils have been found in *Arvonia sl.* by Darton (Am. Jour. Sci., 3d, vol. 44, pp. 50–52, 1892) and others in an old quarry E. of Arvonia Station. They include crinoids, brachiopods and trilobites of late Ord. (Maysville) age, according to personal communication from C. Schuchert and R. S. Bassler. Sl. of same age occurs near Quantico [Quantico sl.] and Dumfries, in NE. Va. The Arvonia sl. is similar in character to Peach Bottom sl. of Md. and Pa., whose age is not known because no fossils have been found in it.

†Arvonian.

A term applied in some early repts to the felsites and quartz porphyries of lower part of Huronian series. The name was imported from Wales. (See J. D. Whitney and M. E. Wadsworth, 1884, Harvard Coll. Mus. Comp. Zool. Bull., vol. 7, geol. ser. vol. 1, No. XI, pp. 561, 562; also C. R. Van Hise and C. K. Leith, 1909, U. S. G. S. Bull. 360, p. 88 and index.)

Asbury clay.

Miocene (upper): Eastern New Jersey (Monmouth County).

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 145). *Asbury clay.*—Dark clay with thin laminæ of sand. Thickness 0 to 12 ft. Believed to lie below the great mass of "fluffy sand," which underlies Alloway clay in Gloucester and Salem Counties. Present in Monmouth Co., but absent in Burlington Co. and SW. to Salem Co. Not certainly known whether Asbury clay forms a single well-defined bed of wide extent and varying thickness, or is a series of overlapping lenses, some thin, some thick, separated by beds of fine, loose, light sand, all occupying about same general horizon. Evidence seems most to favor latter view. Rests uncon. on Eocene marl. Named for development just W. of Asbury Park.

Is a part of Kirkwood fm.

Ashawa till.

A term employed by C. [R.] Keyes to cover the Wisconsin till of Iowa, also (Pan-Am. Geol., vol. 58, p. 203, 1932) to a single till sheet of Wisconsin stage.

Ashawan.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 45, pp. 150–151, 1926) to replace *Wisconsin*, as applied to the late Pleist. till of Keewatin glacier, with suggestion that Wisconsin be restricted to the late Pleist. till of the Labradoran glacier.

Ashbed amygdaloid. (In Ashbed group.)

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 56, 58, 102, 116, 129, and chart). Scoriaceous amygdaloids called "Ash-bed." Probably = Hancock or South Pewabic bed of Houghton Co. Thickness about 180 ft.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, p. 173). The amygdaloid of bed 65 is the layer so well known as the Ashbed, though the name is certainly a misnomer so far as it means to indicate an origin in the condition of volcanic ash.

Belongs to Ashbed group and has been worked in old Ashbed mine, Keweenaw Co. The mineralized part is Ashbed lode.

Ashbed flow.

Includes Ashbed amygdaloid and underlying trap.

Ashbed group.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 172–173, 178, 186, pls. 17 and 18). A series of diabase and diabase amygdaloid flows, including cgls., underlying Marvine's group C and overlying the Greenstone group. Thickness 618 ft.

According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, 1911) the Ashbed group is 1,239 to 2,400 ft. thick.

It underlies Eagle River group and overlies Central Mine group, the top fm. of which is the Greenstone flow.

Apparently named by Irving for fact it includes the Ashbed amygdaloid, but according to A. C. Lane (1911) it occurs in old Ashbed mine, Keweenaw Co., so that it has a geographic significance.

Ashcroft rhyolite porphyry.

Tertiary (Oligocene?): British Columbia.

C. W. Drysdale, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 141), and 1916 (Summ. Rept. 1915, p. 87).

Asher formation.

Permian: Central and central southern Oklahoma.

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 141–142, pls. 3, 27, and map). *Asher fm.*—Typical red beds. Basal 30 ft. consists of a series of coarse, red and brownish-red sss. that cap N. bluff of Canadian River from bridge S. of Asher to northern edge of Stonewall quad. Contains no arkosic material, but arkose is characteristic of underlying Pontotoc terrane [group]. The portion of fm. present in NW. corner of quad. is 250 ft. thick. No upper limit is here defined. No fossils found, but upon evidence afforded by color and position in section is referred to lower Perm. Next younger fm. is Guertie sand, of Pleist. age.

The top of Asher fm. as defined by H. D. Miser (geol. map of Okla., 1926) is base of Enid fm. as first defined.

Named for development at and W. of Asher, Pottawatomie Co.

Ashland limestone.

Silurian: Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 51, 52–54). *Ashland ls.*—Mainly pure gray ls., much fractured. The fragmental, brecciated condition is common to it wherever seen. Contains fauna correlated with Niagara of N. Y. Appears to be younger than Ashland shales and older than Square Lake ls. Named for exposures in Ashland village (in a ledge opposite Ashland Hotel), Aroostook Co.

Ashland shale.

Silurian: Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 45, 49–51). *Ashland shales.*—In Ashland village, along road opposite the hotel, and southward toward Masardis, are several outcrops of lss., calc. shales, and sss, which present strat. relationship to one another, but on account of shear planes and semislated structure, as well as intervals unexposed, some doubt must be held regarding accuracy of interpretation. The irregular, block-like masses of ls. opposite the hotel are met on S. side by yellowish, weathered shales. There is an interval of several hundred ft. showing no rock exposures. On E. side of road there is a rock cut about 400 ft. S. of hotel. The rocks in this exposure are calc., thin-bedded shales, somewhat nodular and weathering yellowish from iron oxide. Some layers contain nearly pure argill. shales, others are calc. The calc. layers are all somewhat aren., showing pebbles of quartz, jaspers, and siliceous slates, mingled with broken calc. shells, and an approach to the conditions of Sheridan ss. Writer's interpretation, with his present knowledge of facts, is that the shales are older than the lss., and that Sheridan sss. are of same age as [or older, p. 21] the shales. Fauna correlated with Niagara of N. Y. Regarded as younger than Aroostook ls.

Ashland mica schist.

Pre-Cambrian: Eastern Alabama.

E. A. Smith and H. McCalley, 1904 (Ala. Geol. Surv. Bull. 9, p. 8). ***Ashland mica schists.***—Metamorphic sediments of undet. age, probably Paleozoic. Older than Talladega slates and younger than the older (probably pre-Camb.) mica schists.

G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 32–33). ***Ashland mica schist.***—Schists, chiefly garnetiferous biotite schist and siliceous, more or less graphitic, muscovite schist, the two types intergrading. Contains some qtzite. Is penetrated by both basic and acid intrusives, not separable on map. Thickness probably 10,000 ft. Assigned to Algonkian, but without definite proof.

In view of fact that "Archean system" and "Algonkian system" have been discarded, this fm. is now classified by U. S. Geol. Survey as pre-Camb.

Named for development around Ashland, Clay Co.

†Ashland Leptostrophia zone.

Term applied by H. S. Williams (Sci., n. s., vol. 24, pp. 365–372, 1906) to *Leptostrophia* zone at top of Wellsburg ss. memb. of Chemung fm. in Ithaca region, N. Y., because of outcrops in Ashland Hills.

The U. S. Geol. Survey does not apply geographic names to faunal zones.

Ashland limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 24). *Ashland ls.*—Main body light gray, massive, hard. Basal 3½ ft. interbedded lss. and shales. Thickness 12 ft. Lies 16 to 18 ft. above South Bend ls. Is top memb. of Braddyville fm. in Nebr. Named for town.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). *Ashland ls.* abandoned, as another name has priority. The Ashland ls. is the Weepingwater ls.

†Ashley marl.

†Ashley River beds.

†Ashley River marl.

†Ashley-Cooper beds.

†Ashley-Cooper phase.

†Ashley-Cooper marl.

†Ashley and Cooper beds.

†Ashley phosphate beds.

Eocene (upper): Southern South Carolina (Dorchester County).

M. Tuomey, 1848 (Agric. Surv. S. C. 1st Rept., pp. 162–169, 190, 211). [See quotation under *Cooper marl.*]

All of the above names, used in foregoing and subsequent repts., are replaced by *Cooper marl*, which is of Jackson age. The Ashley marl of E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2), which he defined as younger than Cooper marl, is interpreted by C. W. Cooke (U. S. G. S. Bull. 867, 1936) as including in part Hawthorn fm. (lower Miocene) and in part Cooper marl (upper Eocene).

Named for exposures along Ashley River, Dorchester Co.

Ashley Hill limestone.

Cambrian: Eastern New York (Columbia County).

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, p. 312). *Ashley Hill Camb. ls.* [in heading].—Another ls. belt associated with grits and shales occurs at Ashley Hill, in NE. corner of Chatham Twp, Columbia Co., about 1 mi. N. of Rayville or Rider's Mills Station on Lebanon Springs R. R., and 2 mi. S. of Brainard, in Nassau. This ls. belt cannot be connected with other ls. belts in this region, as they trend differently and are separated by masses of grit.

Ashnola gabbro.

Carboniferous (?): Southwestern British Columbia and central northern Washington.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). *Ashnola gabbro.*—A long slab of gabbro, ranging with Cathedral Fork of Ashnola River. Is a roof pendant to Remmel batholith, and older than Remmel granodiorite. Extends for 5 mi. May be contemp. with Kruger schists (probably late Carbf.), or may be Triassic.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 13). [The mass mapped as Ashnola gabbro lies 2 mi. E. of Ashnola River, B. C. and Wash.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 435).

Ashokan beds.

Middle Devonian: Eastern New York (Ulster and Greene Counties).

A. W. Grabau, 1917 (Geol. Soc. Am. Bull., vol. 28, p. 954). *Ashokan beds.*—Nonmarine terminal phase of Hamilton in Ulster Co. region. Shales and sands 500 to 600 ft. thick. No fossils except plants. Form principal bluestone fm. of Ulster Co. Prosser erroneously called these beds Sherburne in his monograph on Hamilton and Portage beds of eastern N. Y. Overlie *Mount Marion beds,* the lower fossiliferous Hamilton beds of Ulster Co. region.

A. W. Grabau, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 468–470). *Ashokan fm.*—The so-called Sherburne ss. of the Helderbergs. Shales and flags 500± ft. thick. Underlies Oneonta fm. in Ulster and Greene Counties. No fossils. I am satisfied this fm. is a continental phase of Upper Hamilton and therefore beneath base of typical Sherburne ss. Rests on Mount Marion beds without strat. break. Named for exposures in Ashokan dist., W. of Kingston.

G. H. Chadwick (1932) has named the beds overlying *Ashokan bluestone* in Catskill area the *Kiskatom red beds.*

Ashtabula moraine.

Pleistocene (late Wisconsin): Northern Ohio and northwestern Pennsylvania. Included in Lake Escarpment morainic system. Named for Ashtabula, Ohio. (See U. S. G. S. Mon. 41.)

†Ashton schists.

Pre-Cambrian: Northeastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 106, 107). *Ashton schists.*—Argill. rocks of Blackstone series, which succeeded the deposition and partial erosion of Cumberland qtzites. Characterized as a whole by greenish color. Some of rocks included in the schists are probably of igneous origin. Occur at Ashton, Providence Co.

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, p. 11). "Ashton schists" of Woodworth included Marlboro fm. and Albion schist memb. of Westboro qtzite, of present classification. [Woodworth also called these rocks "Ashton series."]

Ashton zone.

A zone in lower part of Fernando group in Huntington Beach oil field of Orange Co., southern Calif. Consists of 1,200 to 2,000 or more ft. of sticky brown sh., sandy shales, sands, and hard shells. Some producing wells have penetrated it to depth of at least 1,750 ft., according to S. H. Gester. H. S. Gale (A. A. P. G. Bull., vol. 18, No. 3, 1933, p. 330) assigned it to Repetto siltstone (lower Plio.).

Ashville beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 117).

†Aspalaga clay.

†Aspalaga marl.

†Aspalaga phase of †Waldo formation.

†Aspalaga phase of †Chattahoochee formation, or lower layer.

Miocene (lower): Florida and southern Georgia.

L. C. Johnson, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 128–132). ***Aspalaga clays.***—Tough calc. clays or altered marls, brown and dark-colored, including residuum after lime of shells is leached away. Thickness 60 ft. at Aspalaga [Liberty Co.], Fla. (where they underlie Lafayette fm.). Overlie 40 ft. of ls., the upper layers of which are full of fossils, corals, and lamellibranchs, and *Orbitulites floridana*, and which for sake of distinction we may call the ***Aspalaga phase of Waldo fm.*** On Sweetwater Creek, Fla., the ***Aspalaga marl,*** 20 to 40 ft. thick, is overlain by Alum Bluff or Chipola marl and underlain by ***Aspalaga phase*** or upper layer (30 ft. thick) of Chattahoochee fm.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 41–54). ***Aspallaga clays*** (marl), 67 ft. thick, not seen at type loc., but well exposed at Rock Bluff [Liberty Co., Fla.?]. Whether they belong to Chattahoochee or Chipola will no doubt be settled as investigations go on. I am inclined to consider them as top of the Chattahoochee [Tampa ls.]. Overlie Griffin bed.

W. H. Dall and J. Stanley-Brown, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 154). "***Aspalaga marl***" of Johnson is physically continuous with the sands of Alum Bluff beds. "***Aspalaga clays***" of Johnson are 20 ft. thick and belong to Chipola marl.

C. J. Maury, 1902 (Bulls. Am. Pal., vol. 3, No. 15, p. 70). No real discrimination could be made btw. so-called "Aspalaga clays" of Johnson and the Chattahoochee ls. The clays appear to be merely argill. beds of ls.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept.) and G. C. Matson, 1913 (U. S. G. S. W. S. P. 319). "Aspalaga marl" is a part of Chattahoochee fm.

Aspen shale.

Upper Cretaceous: Southwestern Wyoming.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). ***Aspen fm.***—Black and gray shales containing abundant fish scales. Often weathers silvery gray. Thickness 1,500 to 2,000 ft. Underlies Frontier fm. and overlies Bear River fm. Is of Benton age. Named for exposures near Aspen Station [Uinta Co.].

Aspermont dolomite.

Permian: Central northern Texas (Stonewall County).

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol 1, sec. opp. p. 96). ***Aspermont dol.***, 1 ft. thick, lies 105± ft. below top of Greer fm.

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, pl. 1). ***Aspermont dol.*** is older than Royston fm. and younger than McCaulley dol.; all included in Double Mtn group.

G. H. Norton, 1929 (A. A. P. G. Bull., vol. 13, pp. 955–956). Some geologists correlate Guthrie dol. with Aspermont dol.; others believe Guthrie is older than Aspermont.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). ***Aspermont dol.*** is same as Guthrie dol. and is discarded, Guthrie having been more commonly used. It is in Blaine fm.

Probably named for Aspermont, Stonewall Co.

Asphalto lake bed.

Pliocene: Southern California (northwestern part of Kern County).

J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 168). ***Asphalto lake bed.***—A small fresh-water deposit of fossiliferous blackish marl, about 40 mi. SE. from Kettleman lake bed, 18 mi. NW. of Buena Vista Lake, and 1,100 ft. above sea level.

Probably named for exposures at or near Asphalto, a village near McKittrick, Kern Co.

Asphaltum sandstone.

Pennsylvanian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 10+). ***Asphaltum ss.***—A series of gray to buff, yellow, calc. sss., generally massive, friable, and medium-grained, but locally laminated and thin-bedded, separated by sh. beds. Thickness 20 to 50+ ft. Underlies Claypool fm. [On cross section lies 200± ft. higher than Oscar ss.] Is exposed in vicinity of town of Asphaltum, Jefferson Co.

Aspidella slate.

Pre-Cambrian: Newfoundland.

A. Murray, 1881 (Geol. of Newfoundland, pp. 280–288).

Aspinwall limestone. (In Admire shale.)

Aspinwall shale. (In Admire shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol, 9, No. 2, pp. 9, 17, 29). *Aspinwall ls.*—Usually in 1 bed; massive, light brown, mottled. Thickness 1–2 ft. Type loc. is at Aspinwall. Separated from underlying Brownville ls. by 10 to 25 ft. of bluish calc. sh. and from overlying Falls City ls. by 18 to 37 ft. of bluish calc. sh. Included in Admire (?) fm.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 73, 82, 89), applied *Aspinwall sh.* to all beds (25 ft. thick in Nebr. and greater in Kans.) btw. Falls City ls. and Brownville ls., thus including Aspinwall ls. of 1915 rept., which, however, he did not mention and appears to have discarded. Named for Aspinwall (now abandoned), SE. of Nemaha City, Nemaha Co. Included in Admire sh.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), divided the rocks underlying Falls City ls. and overlying Brownville ls. into (descending) Hawxby sh., *Aspinwall ls.*, and Towle sh., thus discarding Aspinwall sh. and restoring Aspinwall ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Aspinwall ls. fm.* underlies Hawxby sh. fm. and overlies Towle sh. fm. [This classification was followed by R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), but Moore transferred all beds above Brownville ls. to Perm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)]

Assiniboian series.

Name suggested by C. [R.] Keyes (Pan-Am. Geol., vol. 43, pp. 287–302, 1925) to cover post-Dakota and pre-Fox Hills Cret. rocks of Western States. Derived from Canadian province of Assiniboia.

Assiniboine series.

A term employed by C. [R.] Keyes to cover the post-Dakota Cret. rocks of Iowa.

Astoria shale.

Miocene: Northwestern Oregon and southwestern Washington.

E. D. Cope, 1880 (Am. Nat., vol. 14, pp. 457–458, and Am. Phil. Soc. Proc., vol. 19, p. 62). The unpublished notes of Prof. Condon, formerly State Geologist, state that backbone of Coast Range consists of argill. shales, which contain invertebrate and vertebrate fossils, frequently in concretions. To this fm. Dr. Condon gives the name *Astoria shales*. Fossils are Mio.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 223–227). *Astoria shales.*—Clayey or sandy shales of various colors and degrees of consolidation. Weather soft and clayey, and so appear along banks of river at Astoria. Most prominent on left or S. bank. Included in Astoria group (Mio.). Overlies Aturia bed (Eocene). [See under *Astoria group.*]

W. H. Dall, 1909 (U. S. G. S. P. P. 59), assigned *Aturia* zone to Olig. and excluded it from Astoria sh.

C. W. Washburne, 1914 (U. S. G. S. Bull. 590), included *Aturia* zone in Astoria sh., and assigned a thickness of 400 ft. to the zone (which he assigned to the Olig.) and a thickness of 1,000± ft. to the overlying part of Astoria sh., which he assigned to Mio.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 259–260). Recently Howe (unpublished thesis Leland Stanford Univ., 1922) investigated Astoria locality and states that the 2 sss. present there (one underlying Astoria shales and one overlying the shales) have been confused by several writers. He states that by careful mapping the beds containing ***Aturia*** and the places from which Dall lists his fossils are middle Mio. and not Olig. as thought by Dall. Also that 54 per cent of the species present in the shales are also present in the sss., and that 43 per cent of the species at Astoria are also found in Monterey-Temblor (middle Mio.) of Calif.

H. V. Howe, 1926 (Pan-Am. Geol., vol. 45, pp. 295–306), assigned Astoria sh. and *Aturia* zone to middle Mio., and listed fossils.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, p. 269), assigned Astoria sh. and *Aturia* zone to Mio.

The U. S. Geol. Survey now classifies Astoria sh., including ***Aturia*** zone at base, as Mio.

†Astoria sandstone.

Miocene: Northwestern Oregon and southwestern Washington.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 223–227). *Astoria sss.*—Series of sss. on both sides of river above Astoria, though best developed on N. or right bank. The sss. are granular, brittle, or friable, sometimes very compact and hard, usually brownish. Included in Astoria group. Dana regards the sss. as more recent than Astoria shales, which is strengthened by fact that fissures in shales are filled with sand resembling that of which the sss. are composed. [See also under †*Astoria group.*]

†Astoria group.

Miocene: Northwestern Oregon and southwestern Washington.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 223–227). *Astoria group.*—The *Astoria shales* and *Astoria sss.* appear to form part of a single series varying in character according to fluctuations in sedimentation, the shales being more argill., the sss. more aren., neither possessing an exclusive character, the fossils appearing to be the same Mio. species in both, with tendency to form concretions around them in the sh. and to be represented by casts in the sss. The name *Astoria group* (from Astoria, Clatsop Co.) is proposed to include them both, but not the subjacent Eocene Aturia bed. Dana regards the sss. more recent than the shales, and this is strengthened by fact that fissures in the shales are filled with sand resembling that of which the sss. are composed.

Has been discarded, because *Astoria sh.* has priority and is more useful name. The *Aturia* zone is now considered to be Mio., and is included in Astoria sh.

Atane beds.

A name long in use for Upper Cret. rocks in Greenland that underlie Patoot beds (also Upper Cret.) and overlie Kome beds (Lower Cret.).

†Atascadero formation.

Upper Cretaceous: Southern California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Atascadero fm.*—Thick and thin-bedded ss. with small amount of cgl. and sh. Thickness 3,000 to 4,000 ft. Is local representative of Chico group. Represents all of Chico deposits present in the area. Uncon. underlies Vaquero[s] ss. and uncon. overlies Knoxville. Named for exposures along Atascadero Creek, San Luis Obispo Co.

Replaced by Chico fm.

†Atchison shale.

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and southeastern Nebraska.

C. R. Keyes, 1899 (Am. Geol., vol. 23, p. 309). *Atchison shales,* 500 ft. thick, extend from top of Forbes ls. to base of Cottonwood ls.

Includes Wabaunsee fm. and large part of underlying Shawnee fm. Named for Atchison Co., Mo.

Athabasca sandstone.

Pre-Cambrian: Canada.

R. G. McConnell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, p. 51D). [Assigned to Camb., but for many years this ss. has been assigned to pre-Camb. in Canada repts.]

Athelstane granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated).

Athens marble.

Silurian: Central western Illinois (Menard County).

A. H. Worthen, 1882 (Econ. Geol. Ill., vol. 1, pp. 102–103). Compact gray ls., quarried at Athens and generally known as *Athens marble.* Included in Niagara ls.

Athens shale. (In Blount group.)

Lower Ordovician: Eastern Tennessee, northern Alabama, western North Carolina, and western Virginia.

C. W. Hayes, 1894 (U. S. G. S. Kingston folio, No. 4, p. 2). *Athens sh.*—East of Tennessee River the upper part of Chickamauga ls. is replaced by calc. shales weathering yellow, from 300 to 500 ft. thick. Eastward beyond edge of this sheet this fm. increases to several thousand ft., where the strata represent the rapid and variable accumulation of sediment near the shore. Underlies Rockwood fm. and rests on a part of Chickamauga ls. [The area here described adjoins type loc.]

C. W. Hayes, 1895 (U. S. G. S. Cleveland folio, No. 20, p. 3). In belt extending from NE. corner of Cleveland tract toward SW., across Hiwassee River, a part of Chickamauga ls. is replaced by Athens sh., from 850 to 1,100 ft. thick, in some places sandy, but generally calc., dark blue when fresh, but weathering yellow. Increases in thickness to 2,500 or 3,000 ft. along E. side of valley, and includes a bed of calc. ss. 250 to 700 ft. thick about 500 ft. above base. [In columnar section of this folio this ss. is called *Athens ss.*] Underlies Tellico ss. and overlies part of Chickamauga ls. [This area includes type loc.]

The commonly accepted definition of Athens sh. in Tenn. applies to beds underlying Tellico ss. and overlying Holston marble, but Ulrich (1929) defined it as overlying his newly proposed Whitesburg ls., which he stated in places intervenes btw. Athens sh. and Holston marble. Fauna is considered to be of Normanskill age. In northern Ala. C. Butts (Ala. Geol. Surv. Spec. Rept. No. 14, 1926) identified Athens sh. as underlying Little Oak ls. and overlying Lenoir ls. Based upon work of C. Butts in Appalachian Valley of Va., the U. S. Geol. Survey now uses *Athens sh.* (or *Athens ls.*, where the fm. becomes so calc. as to be a ls.) across Appalachian Valley of Va., from Tenn. to W. Va. line. This use of *Athens ls.* displaces the local name *Liberty Hall ls.*

Named for exposures at Athens, McMinn Co., Tenn.

Athens group.

Pennsylvanian: Appalachian Basin.

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, p. 178). *Athens* and *Wheeling* proposed for groups of the Pennsylvanian lying btw. Dunkard group and Pottsville group [but no limits were assigned to either group]. The term "Athens" refers to the county of that name in Ohio, and "Wheeling" to the stream which flows through W. portions of Greene and Washington Counties of Pa. and Marshall and Ohio Counties of W. Va., localities in which the respective columns are shown in their full extent.

†Athens sandstone.

See under *Athens sh.*

Atherton clay.

Mississippian: Northwestern Kentucky and southern Indiana.

A. F. Foerste, 1910 (Ky. Geol. Surv. Rept. Prog. 1908 and 1909, pp. 76, 83, 84). *Atherton bed.*—Chiefly fossiliferous clay [thickness not stated] underlying St. Louis ls. in southern Ind. In northern Ky. overlies Harrodsburg ls., the Salem ls. not being recognized. Carries about same fauna as Salem ls. Thins out before reaching central Ind. [On p. 84 he stated his *Atherton bed* may be represented in part by the darker rock, 105 ft. thick, in bottom part of St. Louis ls. Derivation of name not stated.]

Athol shale.

Middle Devonian: Western New York (Eighteen-Mile Creek).

A. W. Grabau, 1930 (Sci. Quart. Nat. Univ. Peking, China, vol. 1, No. 4, pp. 322–326). *Athol shales.*—Separated from underlying black Marcellus sh. by 8½ ft. of Stafford ls. Underlie Avery shales. Thickness 45 ft. Appear to be 26 ft. thick in Livonia salt shaft, 70 mi. to E. Exposed on the Lake shore (18-Mile Creek region) at Athol Springs and Bay View. Are not black, like Marcellus sh., but fauna of Marcellus sh. continues up into Athol shales. [Fossils listed.]

According to G. A. Cooper (personal communication Jan. 1934) Grabau's Athol sh. is same as Levanna sh. of Cooper.

Atic Oban series.

Pre-Cambrian: Ontario.

W. H. C. Smith, 1893 (Geol. Soc. Am. Bull., vol. 4, p. 334).

Same as *Atikokan series*, the commonly accepted spelling.

†Atikokan series.

Pre-Cambrian (Keewatin): Ontario.

A. C. Lawson, 1912 (Canada Geol. Surv. Mem. 28, p. 14).

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360), spelled the river, dist., range, and rocks *Atikokan*, and stated that the spellings *Aticokan* and *Atic Oban* have also been used.

†Atkinson limestone.

A shortened form of *Fort Atkinson ls.* employed by C. [R.] Keyes.

Atlantic period.

Atlantic system.

Pre-Cambrian: New Hampshire.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, p. 522), divided his *†Eozoic era* into (descending): Huronian period; Labrador period; uncon.; *Atlantic period;* and Laurentian period. His Atlantic period was divided into (descending): Franconia breccia group; Montalban or White Mtn gneiss; Winnipiseogee gneiss; and Bethlehem group.

Some authors attribute this name to Featherstonhaugh, 1835, but as it has fallen into disuse the compiler has not searched for the original usage. The terms *Atlantic group, Atlantic series*, and *Atlantic gneiss* have also been used by Hitchcock for rocks in N. H., which he assigned to "Archean."

Atlantic amygdaloid. (In Ashbed group.)

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is same as Ashbed amygdaloid. The mineralized part is the Atlantic lode.

Named for occurrence in Atlantic mine, Houghton Co.

Atlantic flow.

Includes Atlantic amygdaloid and underlying trap.

Atlantic oil sand.

Subsurface sand in midst of Penn. section in Graham field, NW. part of Carter Co., Okla., 75 to 244 ft. below Johnson oil and gas zone and 78 to 125 ft. above Ricketts oil sand.

†Atlantic group.

Tertiary: Atlantic Coastal Plain.

O. Meyer, 1888 (Am. Geol., vol. 2, pp. 88–89, 93–94). The marine Tert. is extensively developed along the coast from N. Y. to Tex. The eastern Tert. may be divided into two groups, one the *Atlantic group*, comprising the Atlantic States proper from N. J. to Fla., the other the *Gulf group*, including the states from Ala. to Tex. In the first group the younger Tert. fms. are extensively developed. It comprises mostly younger Tert. strata. The Gulf group comprises the old Tert. strata.

Atlantic Coast series.

Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 195).

†Atlantosaurus beds.

A paleontologic term applied in early repts to Morrison fm. and also to lower part only of the Morrison.

Atlas formation.

Quaternary (?): Southern California (Kern County).

A. C. Lawson, 1906 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 431–462). *Atlas fm.*—Ancient alluvium, made up of angular fragments of rocks of bed-rock complex, including schists, quartz diorite, granite, quartz, and arkose, well cemented. Older than Tank volcanics.

Derivation of name not stated and not known.

Atoka formation.

Pennsylvanian (Pottsville): Eastern Oklahoma, western Arkansas coal field, and southwestern Arkansas.

J. A. Taff and G. I. Adams, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 273). *Atoka fm.*—Alternating sss. and shales, 7,000 ft. thick, with, at intervals of 1,000 to 1,200 ft., four groups of ss. strata each nearly 100 ft. thick. Underlies Hartshorne ss. Is basal fm. of Coal Measures.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Atoka fm.*, 3,100 ft. thick, underlies Hartshorne ss. and overlies Wapanucka ls.

The fm. (of Penn. age) underlying Atoka fm. in area S. and E. of Ti Valley-Choctaw belt of Ouachita Mtns, Okla., and extending into Scott Co., Ark., is now known as *Johns Valley sh.*, and the fm. underlying it in parts of the Ti Valley-Choctaw belt of Ouachita Mtns, Okla., is Wapanucka ls., but in other places the Wapanucka ls. and underlying Springer fm. are absent, and the Atoka appears to rest on the older Caney sh. (now restricted to beds of Miss. age). The fm. that underlies it in Arkansas Valley of Ark. is Jackfork ss. (See H. D. Miser, A. A. P. G. Bull., vol. 18, No. 8, 1934.)

Named for Atoka, Atoka Co., Okla., which is situated on outcrop of fm.

Atolia quartz monzonite.

Jurassic (?): Southern California (Randsburg quadrangle, Kern and San Bernardino Counties).

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95, pp. 33–42, map). Intrudes Rand schist and the undiff. Paleozoic series of El Paso Mtns, which may be in part Carbf. Uncon. underlies middle Mio. sediments (Rosamond series). Is undoubted correlative of plutonic rocks of Sierra Nevada and is probably of late Jurassic age. Named for exposures at and around Atolia, San Bernardino Co.

Atrypa limestone.

Upper Devonian: Eureka district, Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 78). *Atrypa ls.*, 2,000 ft. thick, underlies Woodpecker lss. and overlies Lamoureaux shales. Lithologically embraces the massively bedded portion of the local Dev. section. Included in Nevadan series [Nevada ls.]. Name derived from Atrypa Peak, in Eureka dist.

Attalla chert conglomerate member (of Chickamauga limestone).

Lower Ordovician (early Chazy): Northern central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175). *Attalla cgl. memb.*—Medium-grained ss. to coarse cgl. or breccia; in general composed mostly of rather small angular fragments of chert embedded in a siliceous matrix composed of comminuted chert or quartz. Thickness 20 to 40 ft. Basal memb. of Chickamauga ls. in central and NE. Ala.

At request of C. Butts the name was in 1926 changed to *Attalla chert cgl. memb.*

Named for exposures at Attalla, Etowah Co.

Attawapiskat coral reef.

Silurian: Canada.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 341, 356, 363, 368).

Attawapiskat limestone.

Silurian: Ontario.

A. F. Foerste and T. E. Savage, 1927 (Denison Univ. Bull., Sci. Lab. Jour., vol. 22, pp. 5, 16).

Attica shale.

Upper Devonian: Western New York.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157), and 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [Showed (in tables) that the sh. of Lake Erie section that has been called *Rhinestreet sh.* includes at top the Hatch sh. of Genesee River section, and is therefore a larger unit than typical Rhinestreet sh. (which lies btw. Cashaqua sh. below and Hatch sh. above). He therefore (1923 citation) named the so-called Rhinestreet of Lake Erie region *Attica sh.*, probably from exposure at Attica, Wyoming Co.]

Attleboro sandstone.

Carboniferous: Southeastern Massachusetts and Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 144, 151–152). *Attleboro ss.*—Fine-grained massive ss., green to brown, the latter color evidently due to oxidation. Named for exposures in town of North Attleboro; also exposed in vicinity of Deantown, in Attleboro Twp. Is embedded in Wamsutta red beds.

Attwood series.

Carboniferous (?): Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 10, 118° 30′ to 119°). *Attwood series.*—Argillite, qtzite, ls. Overlies Anarchist series. [Mapped at and around Attwood Mtn, B. C.]

O. E. LeRoy, 1912 (Canada Geol. Surv. Mem. 21, pp. 19, 26, 32).

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 382).

Aturia bed.

Aturia formation.

Paleontologic names applied in early repts to the *Aturia* zone, composing lower 400 ft. of Astoria sh. (Mio.) of Oreg., which is characterized by the genus *Aturia*. In some early repts excluded from Astoria sh. and assigned to Eocene, also to Olig. W. H. Dall repeatedly assigned it to Olig., but B. L. Clark (1918) and recent writers assign it to Mio. (See under *Astoria sh.* and †*Astoria group.*)

Atwater Creek shale.

Upper Ordovician: Eastern New York (Black River Valley).

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 124–126, 130). [See under *Deer River sh.*]

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 51, 60, 62, 63, 76, 147, 148, 150). The northern Frankfort [sh.] is thus not younger than the typical Frankfort, but older, and either of later Utica or early Frankfort age. We will for that reason distinguish it as *Atwater Creek sh.* Is the zone of *Glossograptus quadrimucronatus, forma typica.* Consists of black and gray shales. Overlies Deer River sh. (of basal Lorraine age and=basal part of Frankfort sh.), and on charts is correlated with a part of Frankfort sh. [In some parts of this rept *Atwater Creek sh.* is applied to beds below Whetstone Gulf sh. and in other parts of rept the Atwater Creek is included in Whetstone Gulf fm.]

Atwell sand.

Upper Devonian: Central northern Pennsylvania (Tioga County).

M. L. Fuller, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, p. 591). *Atwell sand.*—Fine-grained, very dark brown or almost black ss. called by driller black sand. Thickness 12 to 24 ft. Included in Chemung fm. of Gaines oil region, Tioga Co., lying 700 ft. below top of Chemung. Named in honor of owner of first producing well, on Atwell farm, E. of Watrous.

Aubrey group.

Permian and Pennsylvanian: Northern Arizona, southern Utah, and southeastern Nevada.

G. K. Gilbert, 1875 (U. S. Geog. and Geol. Surv. W. 100th Mer., vol. 3, pp. 176–185, 197). *Aubrey group.*—Consists of (descending): (1) Cherty lss., 200 to 820 ft. (*Aubrey ls.*); (2) massive, cross-bedded yellow sss. 300 to 1,000 ft. (*Aubrey sss.*); (3) red and white shales and sss. 800 ft. Overlies Red Wall ls. group and underlies Lower Triassic marls [now called Moenkopi fm.]. The Aubrey ls. and sss. constitute Aubrey Cliff, which faces Aubrey Valley, in northern Ariz. and stretches SE. nearly to Camp Apache.

N. H. Darton, 1910 (U. S. G. S. Bull. 435, pp. 21–30). The 3 fms. included in *Aubrey group* in Ariz. require individual names according to present methods of nomenclature, so that I shall here introduce the terms *Kaibab ls.* (to replace "Aubrey" ls. of early repts); *Coconino ss.* (for the cross-bedded gray to white ss. of Aubrey group, which is so conspicuous in walls of Grand Canyon); and *Supai fm.* (for the red sss. and shales constituting lower part of Aubrey group in northern Ariz. In previous literature the Supai fm. and Coconino ss. have usually been referred to as "Aubrey ss. series."

L. F. Noble, 1922 (U. S. G. S. P. P. 131B). The upper 235± ft. of thin-bedded lss. which form top memb. of Redwall ls. and are said to contain Penn. fossils, are here included in Supai fm., and *Redwall* is restricted to Miss. part of original Redwall.

Aubrey group is now generally divided into (descending) Kaibab ls., Coconino ss., Hermit sh., and Supai fm.

†Aubrey limestone.

Permian: Northern Arizona, southern Utah, and southeastern Nevada.

G. K. Gilbert, 1875 (U. S. G. S. and G. S. W. 100th M., vol. 3, pp. 171–187, figs. 81, 82). [See under *Aubrey group.*]

Replaced by *Kaibab ls.*

†Aubrey sandstones.

Permian: Northern Arizona, southern Utah, and southeastern Nevada.

G. K. Gilbert, 1875 (U. S. G. S. and G. S. W. 100th M., vol. 3, pp. 171–187, figs. 81, 82). [See under *Aubrey group.*]

Replaced by *Coconino ss.* and *Supai fm.*

Aubreyan series.

A term employed by C. R. Keyes instead of *Aubrey group.*

Auburn shale. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 30). *Auburn sh.*—Fossiliferous olive-colored sh., 8 to 20 ft. thick, included in Upper Coal Measures of Shawnee Co. [From statement on p. 28 appears to underlie Elmont ls. and overlie Wakarusa ls.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 66). *Auburn sh.* is 20 ft. thick in Nebr. It overlies Wakarusa ls. and underlies Emporia ls. Is top bed of Humphrey sh. memb. of Wabaunsee fm. The name was free at time it was used by Beede and should be retained for this unit.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). *Auburn sh. fm.*—Gray, red, and bluish gray zones, quite calc. and fossiliferous near top, 18 to 30 ft. thick. Underlies Reading ls. (older than Elmont ls.) and overlies Wakarusa ls. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 222). Condra (1927) has used *Auburn sh.* for a lower bed than Beede's Wakarusa ls. Because greater importance is attached to usage in recent literature than to priority in the case of a term that has been unused except in original rather obscure paper, we follow Condra's placement of Auburn sh. Type loc. not designated, but undoubtedly it is in vicinity of Auburn, Shawnee Co., Kans. Good exposures along Wakarusa Creek near NE. cor. sec. 26, T. 13 S., R. 14 E., SW. of Auburn. Thickness 20 to 70 ft. Continuous from SE. Nebr. across Kans. into Okla.

Auburn chert.

Middle Ordovician: Central-eastern Missouri.

R. R. Rowley, 1908 (Mo. Bur. Geol. and Mines vol. 8, 2d ser., pp. 14, 16). *Auburn chert.*—Intensely hard bluish ls., with soft chert bands full of fossils, forming surface stone of Auburn, Lincoln Co. Included in Trenton ls.

A. F. Foerste, 1920 (Denison Univ. Bull., Sci. Lab. Jour., vol. 19, pp. 175–194), correlated *Auburn chert* with Decorah sh., and stated that it "apparently lies at about same horizon as Bryant ls."

J. H. Bradley, Jr., 1925 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 66), stated that *Auburn chert* is included in Plattin fm.

C. L. Fenton (1928) and S. Weller and S. St. Clair (1928). See under *Plattin ls.*

J. Bridge, March 1937 (personal note). *Auburn chert* is = Decorah or possibly is slightly younger.

Auburn moraine.

A Pleist. moraine in central N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627+, 1932.)

†Aucella beds.

A paleontologic term that has been applied to Lower Cret. and Jurassic rocks of Oreg., because of profusion in them of species of the genus *Aucella.*

Auger conglomerate lentil (of Wichita formation).

Permian: Southwestern Oklahoma (Tillman County).

M. J. Munn, 1914 (U. S. G. S. Bull. 547, pp. 23–26). *Auger cgl. lentil.*—Clay-ls. cgl. and associated beds, consisting of clay, ss., and cgl., forming basal memb. of Wichita fm. Thickness 20 to 78 ft.

Named for Old Fort Auger and Auger Creek, Tillman Co.

Auger limestone member.

A name applied by geologists of mining companies, in their company repts, to basal 100 ft. of Lake Valley ls. (Miss.) in Santa Rita dist., SW. N. Mex.

†Augusta limestone.
†Augusta group.
†Augusta stage.

Mississippian: Iowa, Missouri, and Illinois.

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 59–71). *Augusta ls.* introduced to include rocks btw. Kinderhook group below and St. Louis ls. [broad usage] above. Includes what has been called Warsaw shales and ls., Geode bed, Keokuk ls., Upper Burlington ls., and Lower Burlington ls. Uncon. underlies St. Louis ls. [In subsequent repts Keyes and others called these rocks "Augusta stage" and "Augusta group." *Augusta ls.* has also been applied to *Burlington ls.*]

Includes all of Osage group except Fern Glen ls., and part of overlying Meramec group.

Named for Augusta, Des Moines Co., Iowa.

†Auriferous slates.

Term in common use by Whitney (Geol. Surv. of Calif.) and subsequent writers for undiff. Paleozoic and Mesozoic strata in Sierra Nevada.

†Auriferous slate series.

A descriptive term used in folios and other early repts on Gold Belt region of northern Calif., to include Mariposa sl. and Calaveras fm., in contradistinction to †Superjacent series, a descriptive term applied to the Cret., Tert., and Quat. deposits of the region.

Auriferous gravels.

A descriptive term that has had considerable usage in northern Calif. for gravels of Cret., Eocene, and Pleist. age. (See under *Weaverville fm.*)

Aurora formation.

Cretaceous (Lower): Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 324), and 1910 (Soc. Geol. Mexicana, Bol., t. 7, p. 96).

Aurora sandstone member (of Orangeville shale).

Mississippian: Northeastern Ohio.

C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 123, 209, 211). *Aurora ss. memb.*—Blue, fine-grained ss. with some thin sh. partings, forming middle memb. of Orangeville fm. in Cuyahoga and Chagrin valleys, NE. Ohio. Underlain by black Sunbury sh. memb. of Orangeville and overlain by Brecksville sh. memb. of Orangeville.

The Sunbury sh. is now excluded from Orangeville sh., so that Aurora ss. is basal memb. of the Orangeville.

Named for exposures on Aurora Creek, in NW. part of Portage Co.

†Auroral series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 105, 123–124, 208–245, 251–257, 261; and vol. 2, p. 752). Divided into (descending): (1) *Auroral mag. ls.* 2,500 to 5,500 ft. ("The Chazy and Black River lss. of N. Y. are parts of this formation."); (2) *Auroral calc. ss.* (*Calciferous ss.* of N. Y.), which occurs chiefly in Northampton, Centre, and Huntingdon Counties, and is 60 ft. thick at Easton.

Later the Auroral ls. of Rogers was replaced by *Shenandoah ls.*, which is now subdivided in most areas into several named units.

†Auroral limestone.
†Auroral sandstone.

See under †*Auroral series.*

†Ausable granite.

Pre-Cambrian: Northeastern New York (Essex County).

J. F. Kemp, 1894 (N. Y. State Mus. 47th Ann. Rept.). The anorthosite quarried near Keeseville [Essex Co.] is called "Ausable granite." Probably to be classed in Algonkian of U. S. G. S. geologists.

H. P. Cushing, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, p. 546). The more feldspathic portions of the anorthosite are quarried near Keeseville and placed on market under name of "Keeseville granite."

J. F. Kemp, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, p. 583). The great quarries at Keeseville have made this anorthosite widely known as "Ausable granite."

Ausable sandstone.

Upper Cambrian: Eastern New York.

H. I. Alling, 1919 (N. Y. State Mus. Bull. 207, 208, pp. 113-145). "Au Sable ss." is applied by some authors to coarse cgl. known as *Potsdam basement bed* and underlying the so-called "white Potsdam" ss., which recent work seems to indicate is not same as Potsdam ss.

Ausable syenyte.

Pre-Cambrian: Eastern New York (Adirondack Mountains).

See under *Adirondack anorthosyte.*

Austin chalk.

Upper Cretaceous (Gulf series): Eastern Texas.

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, pp. 583, 585). ***Austin ls.***—Fossiliferous cream-colored and bluish earthy ls.; 100 ft. exposed in vicinity of Austin. Some beds soft and crumble on exposure, other beds moderately hard and furnish handsome building rock. At base shaly layers of fossiliferous dark bluish gray calc. ss. Overlies *Exogyra arietina* marl [Del Rio clay] and underlies Comanche Peak group.

C. A. White and R. T. Hill, 1887 (Phila. Acad. Nat. Sci. Proc. 1887, p. 40). *Austin ls.*—Includes strata named Austin ls. by B. F. Shumard in 1860, but true relations not then recognized. Underlies Navarro beds [as here used included at base the Taylor marl] and overlies Eagle Ford shales.

The present generally recognized definition of *Austin chalk* applies to the beds below Taylor marl and above Eagle Ford clay. But to NE. the upper part of the chalk (Gober tongue) overlies Brownstown marl, and basal part of the chalk (Ector tongue) underlies Bonham clay (formerly erroneously included in Eagle Ford clay). (See L. W. Stephenson, U. S. G. S. P. P. 186G, 1937.)

†Austin marble.

Lower Cretaceous (Comanche series): Southeastern Texas.

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, p. xxii). *Austin marble.*—Massive ls., often metamorphosed into marble, composed almost exclusively of calcified shells of *Requienia* (*Caprotina*), *Nerinea*, etc. Thickness 20 ft. Overlies 10 ft. of flagstones. Assigned to Washita div. but may represent close of Fredericksburg div.

Conflicts with Austin chalk. Is a bed at top of Edwards ls., the top fm. of Fredericksburg group.

Named for occurrence at Austin.

†Austin rock.

Trade term for a fine-grained sandrock or shaly sandrock, of Dev. age, quarried at Austin, Mower Co., Minn.

Austin Brook quartz porphyry.

Post-Ordovician: New Brunswick.

G. A. Young, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 219).

Austinburg sand.

A subsurface sand in NE. Ohio (Austinburg pool, Ashtabula Co.) that has been correlated with both Sylvania ss. of Ohio and with Oriskany ss. of N. Y.

Autocene.

Recent: New England.

J. B. Perry, 1872 (Boston Soc. Nat. Hist. Proc., vol. 15, pp. 55–56). "Autocene" is introduced into the table, in place of "Recent" or "Present," merely for sake of uniformity. *Autocene* means *emphatically new,* thus appropriately designating the latest times.

Aux Sable limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

J. R. C. Evans, 1926 (Chicago Univ., Abstracts of Theses, Sci. ser., vol. 2, pp. 199–200). The Richmond of NE. Ill. may be subdivided into 3 main members: (1) A lower sh. memb.; (2) a middle dominantly ls. memb.; and (3) an upper dominantly sh. memb. The lower and upper members are nonfossiliferous. The middle memb. contains abundant fossils. In it 6 horizons can be recognized, which are named (ascending order): (1) *Aux Sable ls.*, which corresponds faunally to lower part of the Waynesville of Ind.; (2) *Millsdale ls.,* which contains a few poorly preserved fossils representatives of which occur in the Waynesville and lower Liberty of Ind.; (3) *Treat ls.*, practically unfossiliferous; (4) *Du Page ls.*, fossils, poorly preserved, occur in Waynesville and lower Liberty; (5) *Rock Run ls.*, fossils, poorly preserved, occur in Waynesville and lower Liberty; (6) *Wilmington ls.*, highly fossiliferous, and fossils very similar to upper Waynesville and Liberty of Ind. [Lithology and type localities of these named faunal zones not stated.]

Aux Vases sandstone. (Of Chester group.)

Mississippian: Eastern Missouri and southwestern Illinois.

C. R. Keyes, 1892 (Geol. Soc. Am. Bull., vol. 3, p. 295). *Aux Vases* ss.—Fine-grained ferruginous ss., 10 to 100 ft. thick, the "ferruginous ss." of Shumard and others. Overlies Ste. Genevieve ls. and underlies Kaskaskia ls.

The fm. overlying Aux Vases ss. is now known as *Renault fm.*, and Aux Vases rests uncon. on Ste. Genevieve ls. (See also under *Ste. Genevieve ls.*)

Named for exposures on Aux Vases River, Ste. Genevieve Co., Mo.

Auxvasse Creek sandstone member (of Callaway limestone).

Devonian: East central Missouri (Callaway County).

F. B. Conselman, 1935? (Mo. Acad. Sci. Proc., vol. 1, pp. 105, 108–113, 119). *Auxvasse Creek ss. memb.*—Basal memb. of Callaway ls. (Dev.) in Auxvasse Creek quad., Callaway Co. The uncon. btw. Callaway ls. and underlying Mineola ls. is evidenced by the thinning or absence in places of the Mineola and by presence of Auxvasse Creek ss. memb. in S. part of quad. The Auxvasse ss. is white, friable, calc. ss.; rarely fossiliferous; 16 in. to 5 ft. thick. On E. side of Auxvasse Creek it reaches thickness of nearly 5 ft. and is well exposed a short distance N of the gravel road in NE. 1/4 sec. 8, T. 46 N., R. 8 W. and in NW. 1/4 sec. 9 of same twp., E. of where it apparently disappears. Is also absent in central part of area. Some early workers mistook this ss. for St. Peter ss., but it is St. Peter reworked by Dev. seas.

Ava shale. (In Pottsville formation.)

Pennsylvanian: Southwestern Illinois.

T. B. Root, 1928 (Ill. Geol. Surv. Rept. Invest. No. 16, pp. 9, 10, pls. 1, 2). In upper part of Pottsville fm. [110± ft. below top on pl. 1] is a fairly persistent and extensive sh. bed, which for convenience is called *Ava sh.* Can be identified in many outcrops and well records. Throughout greater part of area (Ava-Campbell Hill area, in parts of Randolph, Perry, and Jackson Counties) the Ava sh. has been used as key horizon for contour map which shows structure of Penn. beds. Although Ava sh. is irregular in thickness and locally is missing in both outcrops and well logs, it was found to be best horizon to use over so large an area. [Contour map shows it surrounding village of Ava, Jackson Co.]

Avalon group.

A term applied to ancient rocks of Newfoundland. Assigned to "Algonkian" by C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 218) and C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 43). For Walcott's original definition see under *Terranovan*. Type loc. is on Avalon Peninsula.

Avalonian formation.

Pre-Cambrian (Huronian): Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Avalonian fm.*—Slates, tuffs, aggls., cgls., and lavas. Fossil worms (?). Basal fm. of Huronian. Underlies Signal Hill fm. (Huronian). [Derivation of name not stated.]

Avant limestone member (of Ochelata formation).

Pennsylvanian: Central northern, northeastern, and northern central Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, pp. 31, 37). *Avant ls. lentil*.—Bluish semicrystalline ls., often thin-bedded, from a few ft. to 40 ft. thick. Stratigraphically about 85 ft. above Dewey ls. along 96th meridian S. of Bartlesville. Included in Copan memb. of Wann fm. in northern area and in Ramona fm. in southern area.

In northern Okla. is now treated as a memb. of Ochelata fm.; in Bristow quad. is treated as a memb. of Copan fm.

Named for Avant, Osage Co.

Avenal sandstone.

Eocene: Southern California (Diablo Range).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 164–168). *Avenal sss.*—A great thickness of ss. exposed in canyon of Canoas Creek, with a thin basal bed of cgl., 6 to 10 ft. thick, resting on Lower Cret. shales. Upper 400 ft. consists of very fossiliferous concretionary sss., below which occur thin-bedded ss. The Avenal wells at Tar Springs are drilled to penetrate these sands, which are exposed at Tar Springs on E. and at Sulphur Springs on Zapato Chino Creek to W. Underlie Kreyenhagen shales.

F. E. von Estorff, 1930 (A. A. P. G. Bull., vol. 14, No. 10, pp. 1321–1336). The 500 ft. of ss. underlying Kreyenhagen sh. in canyon of Canoas Creek is Domengine ss., of upper middle Eo. age. The type loc. of Domengine is N. of Coalinga.

Averill granite.

Age (?): Northeastern Vermont (Essex County).

R. A. Schroeder, 1921 (Vt. State Geol. Rept. 1919–20, pp. 39–42). *Averill granite*.—Pink, two-mica granite of medium grain, with subporphyritic texture. Intrudes a muscovite-biotite schist; the contact being well exposed on summit of Averill Mtn and in bed of Averill Stream 100 yds below the granite bridge of Norton Mills road. Underlies and surrounds Big Averill Lake and all but a small part of Little Averill Lake.

Avery shale.

Middle Devonian: Western New York (Eighteen-Mile Creek).

A. W. Grabau, 1930 (Sci. Quart. Nat. Univ. Peking, China, vol. 1, No. 4, pp. 323–326). *Avery shales*.—Do not differ markedly from underlying Athol shales, on which they rest. On 18-Mile Creek are 30 to 40 ft. thick and underlie Wanakah sh. In Livonia salt shaft, 70 mi. to E., they appear to be 147 ft. thick. Contain pronounced Hamilton fauna, but many typical Marcellus species continue. [Derivation of name not stated.]

According to G. A. Cooper (personal communication Jan. 1934) Grabau's Avery sh. is same as Ledyard memb. of Cooper.

Avilton conglomerate.

Upper Devonian: Western Maryland.

C. K. Swartz et al., 1913 (Md. Geol. Surv. Middle and Upper Devonian vol., pp. 352, 383–385). The flat-pebble jasper cgl. in Chemung ss. memb. of Jennings fm. of northern Garrett Co., Md., is named *Avilton cgl.* because of its occurrence in immediate vicinity of post office of that name on Pea Ridge. It is possibly same as Stevenson's Upper Chemung cgl. of Pa. Is overlain by the upper sh. and ss. beds of Chemung memb. and underlain by the middle sh. and ss. beds of that memb.

Avis sandstone memb. (of Thrifty formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31). *Avis ss.*, basal memb. of Thrifty fm. in May-Coleman and Strawn-Baird sections. Lies discon. on Graham fm.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 125, 131–136, 152–158). *Avis ss. memb. of Thrifty fm.*—Persistent but variable deposit of coarse-grained ss., grit, or cgl., ranging in thickness from 5 to 40+ ft. Basal memb. of Thrifty fm. in Brazos River valley. Lies 35 to 80 ft. below Ivan ls. memb. In places rests on Wayland sh. memb. of Graham fm.; in other places on underlying Gunsight ls. memb. of Graham. Correlated by Plummer with Trickham bed of Drake, in Colorado River valley. Named for town of Avis, Jack Co. Typically developed in Jack, Young, and Stephens Counties.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated Avis ss. as basal memb. of Thrifty fm.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, p. 232), used *Avis ss.* for the beds underlying Breckenridge ls. and overlying Speck Mtn ls. in Colorado River Valley (McCulloch Co.), and stated that Parks Mtn cgl. of Drake (the type loc. of which is in adjoining Coleman Co.) is a conglomeratic phase of Avis ss.

The U. S. Geol. Survey at present treats Avis ss. as basal memb. of Thrifty fm. in Brazos River region, and Parks Mtn ss. memb. of Colorado River region as much younger, lying immediately below Chaffin ls. and resting on Lohn sh. memb. of Thrifty.

Avis limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 347). *Avis ls.*—Steel gray, hard, with shaly streak near middle; marine fossils. Thickness 20 to 45 ft. Name introduced to replace *Hinton ls.* of Krebs, because of conflict with Hinton group [fm.]. Type loc. in vicinity of Avis and Hinton, Summers Co.

Avis shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 346–352). *Upper Avis sh.*—Green or yellow, calc., usually fissile, 20 to 100 ft. thick, abundant marine fossils. Underlies Avis ss. and overlies Avis ls. *Lower Avis sh.*—Yellow, calc., 15 to 30 ft. thick; marine fossils; underlies Avis ls. and overlies Payne Branch ss. All members of Hinton group [fm.]. Type loc., region around Avis, Hinton, and Bellepoint, Summers Co. Also observed in Mercer Co.

Avis sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 345). *Avis ss.*—Greenish gray, micaceous, massive or shaly, persistent, 10 to 35 ft. thick. Underlies Low Gap sh. and overlies Upper Avis sh., all members of Hinton group [fm.]. Type loc. high up sides of mtns in vicinity of Hinton and Avis, Summers Co. Also observed in Mercer Co.

Avoca limestone. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 45, 47). *Avoca ls.*—Top unit in Lecompton ls. Dense bluish ls. in 2 or 3 beds. Thickness 2 to 9 ft. in Nebr.; 1+ ft. in Mo. and Kans. Overlies King Hill sh. (in Lecompton ls.). Named for exposure in South Fork Weeping Water Creek about 3 mi. E. of Avoca, Otoe Co., Nebr.

Avon shale and limestone. (In Pottsville formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Avon sh. and ls.* to beds underlying Colchester (No. 2) coal and overlying his Bernadotte ss. He included these beds in Carbondale fm., as he proposed to expand that name; but they belong to Pottsville fm. of U. S. Geol. Survey and other authors. Thickness and derivation of name not stated, but probably named for Avon, Fulton Co.

†Avondale limestone.

Pre-Cambrian: Southeastern Pennsylvania (Chester County).

P. Frazer, 1883 (2d Pa. Geol. Surv. Rept. C_4, pp. 307, 321, 322), casually alludes to *Avondale ls.*, and accompanying map (of Chester Co.) shows a belt of "Siluro-Cambrian ls." running through Avondale, Kennett Square, and other places in Chester Co.

A quarry rock in Cockeysville marble is now locally known as "Avondale ls."

Avondale volcanics.

Pre-Cambrian: Newfoundland.

A. F. Buddington, 1919 (Jour. Geol., vol. 27, p. 456).

†Avondale series.

A name used by A. C. Hawkins (Am. Jour. Sci., 5th, vol. 7, pp. 355–364, 1924) to denote Glenarm series in vicinity of Avondale, Chester Co., Pa.

Avon River limestone.

Mississippian: Nova Scotia.

W. A. Bell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 166).

Aweres formation.

Pre-Cambrian: Ontario.

R. G. McConnell, 1926 (Ont. Dept. Mines, 35th Ann. Rept., vol. 35, pt. 2, p. 16).

Axemann limestone. (In Beekmantown group.)

Lower Ordovician: Central Pennsylvania (Center and Blair Counties).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 552, 653, 657, 660, 674, pl. 27). *Axeman* [*n*] *ls.*—Thick and thin-bedded, nearly pure ls., of dark color, frequently stained with iron oxide, and ranging from compact to distinctly crystalline. Thickness 158 ft. Underlies Bellefonte dol. and overlies Nittany dol.

The ls. at Axemann, Center Co., is Stonehenge ls., which underlies Nittany dol., but the ls. named *Axemann* crops out 1 mi. E. of Axemann. The Bellefonte, Axemann, Nittany, and Stonehenge compose Beekmantown group of central Pa.

Ayer granite.

Carboniferous or post-Carboniferous: Eastern Massachusetts, southeastern New Hampshire, and northeastern Connecticut.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 86, 223–228 and map). *Ayer granite.*—Biotite-muscovite granite of moderately coarse grain. In many places coarsely porphyritic, containing feldspar phenocrysts 1 to 3 inches long or blotched with large patches of feldspar crystals. Extends through Ayer, Mass.

Aylesworth limestone member. (In Pottsville formation.)

Pennsylvanian: Northwestern Illinois (McDonough County).

T. E. Savage, 1930 (Ill. Acad. Sci. Trans., vol. 22, p. 498). [Columnar section of Macomb region shows *Aylesworth ls. memb.* located about midway in *Avon sh. and ls.*, the upper part of Pottsville fm. Derivation of name not stated.]

Aylmer formation.

Ordovician (Lower): Ottawa Valley, Canada.

P. E. Raymond, 1905 (Carnegie Mus. Annals, vol. 3, p. 380, and Am. Jour. Sci., 4th, vol. 20, p. 364, etc.). *Aylmer fm.*—Name proposed for the Chazy of Ottawa Valley, which is very late Chazy, and differs in lithology and fauna from typical Chazy.

†Azoic era.

In its earlier and in some of its later usages this term was applied to all pre-Paleozoic time. In other later usages it was applied (1) to all pre-Potsdam time; (2) to Huronian epoch of †Algonkian period plus the †Archean period; (3) to †Archean period only; and (4) to a hypothetical interval preceding all known rocks. (For full definition see U. S. G. S. Bull. 769, pp. 20–26, 1925.)

Azotea tongue (of Carlsbad limestone).

Permian: Southeastern New Mexico (Pecos Valley).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). The part of Carlsbad ls. that caps western Azotea Mesa and overlies Seven Rivers gypsiferous memb. of Chalk Bluff fm. is here named *Azotea tongue*.

Aztec sandstone.

Jurassic(?): Southeastern Nevada (Goodsprings quadrangle).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 9, 35, etc.). *Aztec ss.*—Massive ledge of reddish or buff ss., minutely cross bedded. Is made up of many lenses, mostly 10 to 25 ft. thick, each lens in turn made up of smaller laminae ½ to 2 inches thick. Thickness 2,100 ft. Rests on Chinle fm. and is overlain by Quat. deposits. Name is derived from Aztec Tank, a natural depression in the ss. several hundred ft. E. of Contact mine, in which water accumulates at times of heavy rain.

Aztecan series.

A term introduced by C. [R.] Keyes and applied by him in Colo., N. Mex., and Ariz., to cover "a thick, post-Laramian succession of Cretacic sediments in the San Juan region." (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 5.)

Azuero formation.

Pre-Pleistocene: Panama.

O. H. Hershey, 1901 (Univ. Calif. Dept. Geol. Bull., vol. 2, p. 237).

Azure River series.

Pre-Cambrian(?): British Columbia.

N. F. G. Davis, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, p. 285).

Baby sand.

A subsurface sand near top of Rico fm. (Perm.) in southern San Juan Co., SE. Utah.

Babylon cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to basal part of Pottsville fm. (Penn.) of central-western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated, but there is a village of that name in Fulton Co.

Bachelor Creek limestone.

Pennsylvanian: Southern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). Members of Howard ls. have been assigned names as follows, ascending: *Bachelor Creek ls., Aarde sh.* (containing Nodaway coal), *Church ls., Winzeler sh.*, and *Utopia ls.* [Derivation of names not stated. On p. 21 *Bachelor Creek ls.* is described as consisting of 1.35 ft. of blue ls. weathering brown and shaly.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 205–207). *Bachelor Creek ls.*, lowest memb. of Howard ls., is developed in southern Kans. from Greenwood Co. southward. It is hard, somewhat sandy, impure, bluish gray ls. ranging in thickness up to 3± ft. Occurs below Aarde sh. memb., in which Nodaway coal lies near base. Type loc., Bachelor Creek, sec. 33, T. 25 S., R. 11 E., about 5 mi. E. of Eureka, Kans.

Backbone limestone.

Lower Devonian: Southwestern Illinois (Jackson County).

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Back-bone ls.*—Rather thick-bedded coarsely crystalline lss., 0 to 70± ft. thick, uncon. underlying Clear Creek chert in SW. Ill. and uncon. overlying Bailey ls., of New Scotland age. Fauna appears to be closely related to that of Becraft ls. of N. Y. No separate name was applied by Worthen to this ls. Is well exposed near S. end of Devil's Back-bone Ridge, a short distance N. of Grand Tower, Jackson Co.

T. E. Savage, 1925 (Am. Jour. Sci., 5th, vol. 10, pp. 139–144), replaced his *Back-bone ls.* (of supposed Helderberg age) with Weller's *Little Saline ls.* (of known Oriskany age), being satisfied of Oriskany age of his Backbone ls. and its equiv. to Little Saline ls.

†Bad limestone.

See 1st entry under *Bad River ls.*

Bad Axe member (of Franconia sandstone).

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., figs. 1, 2, pp. 81, 92, 134, 140, 159, 431, 446, 449, etc.). *Bad Axe memb. of Franconia fm.*—Greensand and siltstone, 21 to 25± ft. thick, underlying St. Lawrence memb. of Trempealeau fm. and overlying Hudson memb. of Franconia fm. at Victory, Trempealeau Mtn, Skillet Falls, Goodenough Hill, Hudson, Afton, and other places in western Wis. Named for Bad Axe River, near Franconia, Chisago Co., Minn. [On p. 309 of this book G. O. Raasch stated that *Bad Axe memb.* is lower *Dikelocephalus* zone. *St. Lawrence memb.* as used in above definition of *Bad Axe memb.* included not only St. Lawrence ls. (dol.) memb. of Ulrich but the underlying basal greensand and cgl. memb. as well.]

Above definition was repeated and somewhat amplified by W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, Nov. 30, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1702, etc.), who, however, treated the basal cgl. and greensand memb. overlying Bad Axe memb. as distinct from their St. Lawrence dol. memb. They gave thickness of Bad Axe memb. as ranging btw. 20 and 50 ft.

Baden sandstone.

Pennsylvanian: Central eastern Missouri (St. Louis County).

H. A. Wheeler, 1895 (St. Louis Acad. Sci. Trans., vol. 7, p. 125). *Baden ss.*—Gray to drab ss., 2 to 10 ft. thick, coarse-grained, porous, cross-bedded. Occurs near base of Coal Measures at Baden, North St. Louis. Equiv. of "Ferruginous" ss. Underlain by 3 to 5 ft. of shales which rest uncon. on St. Louis ls.

Named for exposures at Baden, St. Louis Co.

Bader formation. (In Council Grove group.)

Permian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 4, 7). *Bader ls. fm.*, about 24½ ft. thick, includes (descending) Middleburg ls., Hooser sh., and Eiss ls. of Council Grove group. [Derivation of name not stated.]

Badger Creek formation.

Cambrian or pre-Cambrian: British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 76).

Bad Heart sandstone member.

Cretaceous: Alberta.

F. H. McLearn, 1926 (Canada Geol. Surv. Bull. 42, p. 119). Included in Smoky River fm.

Bad Hole sand.

A subsurface sand of early Penn. (Cherokee) age in central eastern Okla., which is reported to correspond to one of sands of Dutcher sand series. In Timber Ridge pool, Muskogee Co., it lies at a depth of 1,385 to 1,407 ft. and the Muskogee sand lies at 1,480 to 1,510 ft. C. W. Wilson, Jr., says (A. A. P. G. Bull., vol. 19, No. 4, 1935, pp. 505, 515) this sand corresponds to Georges Fork ss. memb. of Atoka fm., and that it is one of the Dutcher sands.

Badito formation.

Pennsylvanian: Central southern Colorado (Walsenburg region).

R. C. Hills, 1900 (U. S. G. S. Walsenburg folio, No. 68). *Badito fm.*—Upper part consists of 100 ft. of brick-red ss., massive or thick bedded but sometimes shaly on weathered surface. This ss. probably corresponds to some part of Fountain fm. Lower part consists of coarse brownish red cgl. that is=Sangre de Cristo fm. [See also 1900 entry under *Sangre de Cristo fm.*]

Probably named for Badito Peak or town of Badito, just W. of Walsenburg quad. and in Huerfano Park quad.

†Bad River sandstone.

Pre-Cambrian (Keweenawan): Northwestern Wisconsin (Ashland County).

E. T. Sweet, 1876 (Wis. Acad. Sci., Arts., and Lett. Trans., vol. 3, pp. 40–55). *Bad River ss.*—Sss. and shales forming upper beds of Copper-bearing series [Keweenawan]. Largely represented on Bad River.

†Bad River gabbro.

Pre-Cambrian (Keweenawan): Northwestern Wisconsin (Ashland County) and northern peninsula of Michigan.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pp. 115, 134, 135, 186; also U. S. G. S. Mon. 5, pp. 40–41, 144, 155, 377, 435). Very coarse gabbro, largely developed in Bad River region, Ashland Co., Wis., and exposed on Bad River, Iron Co., Wis. Forms base of Keweenawan series.

Bad River dolomite.

Pre-Cambrian (lower Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic district).

C. R. Van Hise, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, p. 338). *Bad ls.*—Cherty ls., of Lower Huronian age. Uncon. underlies Palms fm. and uncon. overlies Archean granite and gneiss in Penokee-Gogebic dist.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, btw. pp. 680–695). *Bad River fm.* of Gogebic Range is=Kona dol. and Randville dol.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 225, 228). *Bad River ls.*—Chiefly ls., heavily mag., in places approaching dol., intermingled and interstratified with chert. Thickness 200 to 300 ft. Grades into underlying Sunday qtzite. Top eroded. Overlain by Palms fm.

Named for occurrence at Bad River, in Penokee Gap section.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), adopted *Bad River dol.* as the name of this fm.

Badshot formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. A, p. 126).

Bad Vermilion Lake granite.

Pre-Cambrian: Ontario.

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 51).

Baffin till.

C. [R.] Keyes, 1926 (Pan-Am. Geol., vol. 45, p. 151). The Greenlandian ice-center of today and the Patrician ice-center of Hudson Bay may both prove to be parts of what we call the Labradoran glacier. If the first is really a distinct polarine ice-cap its deposits should be distinguished by some such title as *Baffin till*. In either case the Greenland glacier is a hold-over remnant of Wisconsin glaciation.

Bagley andesite.

Lower (?) Jurassic: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Bagley andesite.*—Includes the lavas and pyroclastics of a succession of volcanic eruptions of similar general character. Commonly filled with an abundance of small phenocrysts of plagioclase, and rarely also with dark grains in a greenish groundmass. Composed chiefly of andesitic tuff, sometimes coarse, almost agglomeratic, but generally fine and stratified, with occasional traces of marine fossils. More than three-fourths of Bagley Mtn area is occupied by tuff. The lavas are most abundant near summit and whole mass has thickness of about 1,000 ft. Both areas [Bagley Mtn and along Pit River] of Bagley andesite lie practically on border btw. Potem and Modin fms., but do not necessarily indicate an uncon. These areas represent centers of greater accumulation of volcanic material near points of eruption during beginning of Potem epoch. Between the two points the contemp. sediments contain some detritus from both centers, but apparently the greater portion comes from a different source. For this reason the intermediate sediments were included in the Potem.

Bagnell till.

Name introduced by C. [R.] Keyes for a very old sheet of glacial till (pre-Nebraskan) in Mo. "that has been called Nebraskan till by Leverett." (See Pan-Am. Geol., vol. 58, pp. 203, 208, 217, 1932.)

Bailey limestone.

Lower Devonian (Helderberg): Eastern Missouri and southwestern Illinois.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Bailey ls.*—Argill. lss. and shales containing New Scotland Helderbergian faunas at Red Rock landing and above. Overlies Bainbridge ls. and underlies Clear Creek ls. [restricted]. Thickness 100± ft.

Named for exposure at former Bailey's Landing, on Mississippi River, Perry Co., Mo., a short distance above present Red Rock Landing.

Bailey Spring limestone.

Pennsylvanian (early) and Mississippian (late): Eastern Nevada (Pioche district).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171, pp. 7, 21, etc.). *Bailey Spring ls.*—Gray, medium-bedded ls., some cherty layers; basal beds consist of olive-brown fossiliferous ls. weathering to reddish debris, which passes up into gray-black fossiliferous ls. that weathers to mottled red and yellow. These basal beds are probably not very thick. Thickness of fm. 2,275 ft. Overlies Scotty Wash qtzite. Is youngest Carbf. fm. in Pioche dist. Top is eroded. Is overlain by igneous rocks of Tert. (?) age. Fossils are lower Penn. and late Miss., according to G. H. Girty. The fm. occurs in several large areas SE. of Bailey Spring, on W. side of Bristol Range, Pioche dist.

†Bainbridge marl.

Eocene (upper): Southwestern Georgia.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 41-54). *Bainbridge marl.*—Very calc. bed containing many fossils, chiefly Orbitoides. Exposed at water level

E. and W. of Steamboat landing at Bainbridge. Lies 150 ft. below top of Vicksburg group, in which it is included.

According to later studies of C. W. Cooke this marl is part of Ocala ls. of Jackson (upper Eocene) age, which name has priority.

Named for exposures at Bainbridge, Decatur Co.

†Bainbridge residual beds.

Miocene and Oligocene: Southwestern Georgia.

W. H. Dall and J. Stanley Brown, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 170). The *Bainbridge residual beds* correlate with Chipola marl and with upper part of underlying Chattahoochee beds. [Not defined.]

C. J. Maury, 1902 (Bulls. Am. Pal., vol. 3, No. 15, pp. 67-69, 81). The upper part of *Bainbridge residual beds* correlates with Alum Bluff beds, the middle part with Chipola marl, and lower part with Chattahoochee clays and lss. [Not defined.]

Conflicts with another fm. The lower bed belongs to Flint River fm. and upper bed to Alum Bluff group, according to recent studies of C. W. Cooke.

Named, apparently, for exposures at or in vicinity of Bainbridge, Decatur Co.

Bainbridge limestone.

Silurian (Niagaran): Eastern Missouri and southwestern Illinois.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Bainbridge ls.* proposed to embrace all Sil. lss. beneath Bailey ls. in river bluffs for some miles above and below Bainbridge, Mo., also above and below Thebes, Ill. [For next older fm. Ulrich adopted Girardeau ls. in above rept.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28), restricted *Bainbridge ls.* to beds of late Niagaran age, lying uncon. below Bailey ls. (Helderbergian) and uncon. above Brassfield ls. This is present generally accepted definition.

Named for Bainbridge, Cape Girardeau Co., Mo.

Baird shale.

Mississippian: Northern California (Redding region).

H. W. Fairbanks, July 1894 (Am. Geol., vol. 14, p. 28). *Baird sh.*—Black siliceous sh., probably 500 ft. thick, the lowest horizon recognized at United States fisheries on McCloud River. Fauna considered by J. P. Smith to be analogous to the Waverly, but strat. position is higher. The shales outcrop most prominently on W. side of river just above Baird P. O., where they are in places highly metamorphosed by dikes of diabase and diabase porphyrite.

J. P. Smith, Sept.-Oct. 1894 (Jour. Geol., vol. 2, pp. 588-612). *Baird sh.*—Black siliceous shales 500 ft. thick. Older than McCloud ls. and younger than Sacramento fm. [Kennett fm.].

According to J. S. Diller (U. S. G. S. Redding folio, No. 138, 1906) the Baird sh. overlies Bragdon fm. and underlies McCloud ls.

Baitoa formation.

Miocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219)

†Baker limestone.

Silurian (early); Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402). *Baker ls.*—White crinoidal ls., 0 to 25 ft. thick in Tenn. Same as Clinton ls. of Ind. and Ky. Basal Sil. fm. in W. Tenn. Underlies South Tunnel bed (Osgood shaly clay). Included in Clifton ls.

Replaced by Brassfield ls., better established though later name. Is considered to be of Albion age.

Named for Baker, Davidson Co.

Baker gabbro.

Cretaceous (?): Southern British Columbia.

R. A. Daly, 1914 (Canada Geol. Surv. Dept. Mines Mem. 38, map 9, 118° to 118°30'). *Baker gabbro, Cret.* (?). [Mass lies just N. of Baker Creek (which empties into Christina Lake) and at headwaters of the creek.]

Baker sand.

A subsurface sand in Pottsville group of eastern Ky.

Baker member (of Richfield formation).

Pre-Cambrian: British Columbia (Cariboo district).

G. Hanson, 1935 (Canada Dept. Mines, Geol. Ser., Bur. Econ. Geol. Mem. 181, No. 2396, p. 4).

Bakerstown sandstone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Allegheny County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. xix (preface) and 305–308, index). *Bakerstown ss.*—Underlies Bakerstown coal and overlies Lower Barren Measure red shales, which rest on Pine Creek coal. [Only recorded use of name.]

Bakerstown clay.

A term that has been applied to clay underlying Bakerstown coal in Conemaugh fm. of W. Va.

Bakersville gabbro.

Triassic (?): Western North Carolina.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 5). *Bakersville gabbro.*—Unmetamorphosed massive gabbro, of black and brown color. Intrusive into Roan gneiss and Carolina gneiss. [Named for Bakersville, Mitchell Co.]

W. S. Bayley, 1923 (Tenn. Div. Geol. Bull. 29, p. 41), assigned this gabbro to pre-Camb.

Bakoven shale.

Middle Devonian: Eastern New York (Catskill Mountains).

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 16, pp. 480, 483). The black sh. heretofore passing as "Marcellus," below Mount Marion fm., since it remains unidentified by Dr. Cooper with any of his Hamilton units, is here called *Bakoven sh.* (bok-o-fen), from local Dutch name of valley it produces, with its type section (partial) where Catskill-Palenville road crosses Kaaters Kill.

†Balaklala rhyolite.

Jurassic (?): Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Balaklala rhyolite.*—A succession of irregular lava flows and tuffs which have been so compressed and folded as to render very obscure the original layered arrangement of the mass. Thickness about 500 ft. Clearly underlies Kennett ls. and sh. and penetrates and overlies Copley meta-andesite. Named for fact it forms the hills about Balaklala mine.

Later work by L. C. Graton (U. S. G. S. Bull. 430, pp. 81–85, 1910) proved these rocks to be intrusive alaskite porphyry and same as so-called †Bully Hill rhyolite. Both geographic names have therefore been discarded as unnecessary. This porphyry cuts rocks as young as Pit sh (Middle and Upper Triassic).

†Bald Eagle conglomerate.

Upper Ordovician: Central Pennsylvania (Blair County).

A. W. Grabau, 1909 (Jour. Geol., vol. 17, p. 235). *Bald Eagle cgl.*—Gray to white, rarely red, cgl. and quartz ss., 550 to 1319 ft. thick. Characterized by extensive cross bedding. Generally called Oneida by Pa. geologists. Is of Lorraine age. Underlies Juniata fm. and overlies Eden ss. Was originally named "Tyrone," but that name is preoccupied. Named for Bald Eagle Mtn at Tyrone, Blair Co.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). *Oswego (Bald Eagle)* underlies Juniata ss. in central Pa. and rests on Reedsville sh., the upper part of which is of Eden age.

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 408-410). *Bald Eagle cgl.*—The Oswego ss. must represent upper part of the Bald Eagle. Ulrich makes Bald Eagle exact equiv. of Oswego ss. without giving reasons for this correlation. To E. the ss. begins earlier and rests on lower beds than to NW. In Bald Eagle Mtn it rests on lowest Pulaski if not Frankfort; in Buffalo and Pulaski region it is post-Lorraine.

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 533, 536). *Bald Eagle ss.* of Grabau and Oneida cgl. of 2d Pa. Geol. Surv. replaced by Oswego ss.

Baldface phase.

See 1928 entry under *Conway granite*.

M. Billings, 1935 (letter dated July 19). Type loc. for *Baldface phase of Conway granite* is South Baldface Mtn, in NE. corner of North Conway quad., White Mtns region, N. H.

Bald Hill granite gneiss.

Pre-Cambrian: Southeastern New York (Poughkeepsie region).

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148, pp. 11, 14-16, 20-21, 32, 34, 40). *Bald Hill granite gneiss* is of igneous origin and certainly Precambric. Covers about 11 sq. mi. E. of the Hudson. Composes Bald Hill. Remarkably homogeneous. In outcrops it is commonly drab colored and granitelike.

Bald Hill shale. (In Henshaw formation.)

Pennsylvanian: Western Kentucky (Webster County).

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 118). *Bald Hill shales.*—Shales, dominantly argill. and marly and usually leaden or green, with a hint of purplish mottling in some places. Several thin coals in upper part. Thickness 60 to 125 ft. Underlies Vanderburg ss. and overlies Dixon ss., all included in Dixon [Henshaw] fm. Named for Bald Hill, just E. of Dixon.

Bald Hill limestone. (In Tradewater formation.)

Pennsylvanian: Southeastern Illinois (Saline County).

G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, p. 263). *Bald Hill ls.* lies in interval btw. Bald Hill coal and Bald Hill ss. Is exposed in railroad cut E. of Stonefort as a discontinuous layer a few inches thick, but is more typically developed at Bald Hill, about 2 mi. SE. of Stonefort on N. side of Big Four R. R.

Bald Hill sandstone. (In Tradewater formation.)

Pennsylvanian: Southeastern Illinois (Saline County).

G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 258, 263). Bald Hill ss. occurs along crest of hill N. of Stonefort, that is, Stonefort Hill, and is exposed on low knoll upon which Mitchellville is located. It lies 100 ft. or more above Curlew ls.

Baldie granite.

Jurassic (?): British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 81).

Bald Knob shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1915 (W. Va. Geol. Surv. Rept. Boone Co., p. 497). *Bald Knob sh.*—Dark gray, slaty sh. containing small marine fossils. Thickness 1 to 8 ft. Lies 25 to 34 ft. below Stockton ls. and 0 to 3 ft. above Matewan coal. Named for Bald Knob P. O., Boone Co.

Bald Mountain limestone.

Lower Ordovician (Beekmantown): Eastern New York (Mohawk Valley).

W. W. Mather, 1843 (Geol. N. Y., vol. 1, p. 367). *Bald Mountain ls.* is synonym of Black River ls.

A. Fitch, 1850 (Historical, topographical, and agricultural survey of county of Washington [N. Y.], pt. 3, pp. 841-852). *Bald Mtn ls.*—Blue ls., composing most of Bald Mtn, which rises 600 or 700 ft. above level of surrounding county. At Bald Mtn and its immediate vicinity we have both the Sparry ls. and the stratum beneath it.

J. M. Clarke, 1912 (N. Y. State Mus. Bull. 158, p. 21). *Bald Mtn ls.*, of Beekmantown beds; provisionally named because so distinct from Beekmantown beds of Champlain Valley. Underlies "Trenton" lss. Field work by R. Ruedemann.

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 66–99). *Bald Mtn ls.*—Fine-grained, light bluish gray ls. with many white crystalline spots; aren. bands in lower part. Top fm. of Beekmantown age in eastern trough at Saratoga Springs and vicinity. Fauna distinct from Fort Cassin fauna, and indicates this ls. is older than Normanskill sh. and that it overlies Deep Kill sh., but it may come from an entirely different trough or basin that was originally E. of Levis trough. Thickness 100 ft. [In chart on p. 140 he shows it uncon. beneath Normanskill sh. Map shows that it occurs on Bald Mtn, Washington Co. This definition was repeated by Ruedemann in 1929 (Geol. Soc. Am. Bull., vol. 40, No. 2, p. 414) and 1930 (N. Y. State Mus. Bull. 285, p. 27).]

Bald Mountain dacite.

Tertiary: Central southern Colorado (Custer County).

W. Cross, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 295). *Bald Mtn dacite.*—Named for Bald Mtn. Clearly later than Rosita andesite and is cut by rhyolite, but relations to other igneous rocks of Silver Cliff-Rosita Hills dist. not known.

Bald Mountain gneiss.

Pre-Cambrian: Northeastern Oregon.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, p. 105; Jour. Geol., vol. 27, p. 105). *Bald Mtn gneiss*, Archean(?), eastern Oreg. [Oldest fm. given in table of eastern Oreg. fms.]

Bald Mountain lake beds member (of Esmeralda formation).

Miocene (upper): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Bald Mtn lake-beds memb.*—Cgls., tuffaceous sss., and shales; at top a few ft. of fangl. Sediments twice broken by volcanic activity, as two members of rhyolitic tuff are included. Thickness 500± ft. Lies 700+ ft. below top of Esmeralda fm., the intervening beds consisting of a quartz latite memb. Overlies Diamond King memb. Composes upper part of Bald Mtn to within 400± ft. of its top.

Bald Peak basalt.

Pliocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, map at end). *Bald Peak basalt.*—Top fm. of Berkeleyan series [Berkeley group]. Forms large part of Bald Knob, E. of Berkeley.

Bald Rock conglomerate member (of Lee formation).

Pennsylvanian: Southwestern Virginia (Wise County).

J. B. Eby, 1923 (Va. Geol. Surv. Bull. 24, p. 65). *Bald Rock cgl. memb.*—Middle memb. of Lee fm. in Wise Co., SW. Va. Thickness 15 to 200 ft. Is 70 ft. thick at Bald Rock, in vicinity of Miller Yards, about 4 mi. W. of Dungannon, Wise Co. Underlies Starns coal and overlies Burton Ford coal.

Baldwinsville limestone. (In McLeansboro formation.)

Pennsylvanian: Central eastern Illinois (Edgar County).

See 1934 entry under *La Salle ls. memb.*, where is cited only known use of name. Derivation unknown.

Ballard.

Cretaceous: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

Ballard Harmon sandstone.

Mississippian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 244). *Ballard Harmon ss.*—Massive, hard, fine-grained, gray; 15 ft. thick. Lies about 500 ft. below Pocahontas No. 3 coal. Included in Mauch Chunk series. Has been quarried on SW. side of Tug Fork, just below mouth of Ballard Harmon Branch, McDowell Co.

†Ballast Point silex bed.

Miocene (lower): Central Florida.

Term used in some early repts of W. H. Dall to designate the very fossiliferous siliceous bed (4 to 10 ft. thick) in Tampa ls. that has also been called "Tampa silex bed" and "Orthaulax bed."

Named for exposures at Ballast Point, Tampa.

Ballena gravel.

Eocene: Southwestern California (San Diego County).

W. J. Miller, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 10, pp. 1556–1561). *Ballena gravel* (*or cgl.*) has been cause of considerable discussion and has been differently interpreted. It has an important bearing on geomorphologic history of Peninsular Range. Was first described [but not named] by H. W. Fairbanks (Calif. State Min. Bur. 11th Ann. Rept., 1893, pp. 91–92). [Fairbanks named the whaleback-shaped hill but not the deposit.] Occurs in 10 or more areas, extending SW. from near Witch Creek (at 3,000 ft.) to SW. of Ballena (at 2,400 ft.), and W. to San Vicente Valley (at 2,000 ft.) in Ramona quad. to W. and NW. of Padre Barona Valley (at 1,800± ft.) in Cuyamaca quad. The largest area, several mi. long, is SW. of Ballena, where the gravel caps ridges 300 to 500 ft. high. This may be regarded as type loc. All the areas were doubtless once continuous. Consists largely of pebbles and boulders of red and gray porphyritic lava, considerable qtzite, and some schist. Thickness 100 ft. or more. Striking similarity btw. the pebbles and boulders of Ballena gravel and Poway cgl. (marine) strongly indicates their former continuity. Assigned to late Eocene. Deposited locally. Probably = Poway cgl.

Ballou clay. (In Allegheny formation.)

A name applied in some early Ohio repts to the clay underlying Upper Freeport coal and overlying Upper Freeport ls. in Muskingum Co., Ohio.

Balltown oil sand.

Drillers' term for a sand in NW. Pa.; probably = Cherry Grove oil sand and of Chemung age. Lies lower than Tiona sand and higher than Sheffield sand, and is said to correspond to Gartland and Garfield sands.

Balmville limestone member (of Wappinger limestone).

Middle Ordovician: Southeastern New York (Orange County).

F. Holzwasser, 1926 (N. Y. State Mus. Bull. 270, pp. 38–41, 43). *Balmville ls.*, uppermost memb. of Wappinger ls. in Newburgh quad., underlies Hudson River slates and overlies typical Wappinger ls. of this area. Consists of more than 50 ft. of dark bluish gray coarsely crystalline ls., in places changing below into a conglomeratic facies consisting of about 20 ft. of fossiliferous cgl. crowded with pebbles. Outcrops N. of Balmville, Orange Co. Has been called Trenton ls. Is of either uppermost Black River or early Trenton age.

Balsora limestone. (In Palo Pinto formation.)

Pennsylvanian: North-central Texas.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 24). *Balsora ls.*, in Palo Pinto fm., lies 70± ft. below Bridgeport coal and 7 to 10 ft. above Sanders Bridge ls. Thickness 0 to 4± ft. Named for outcrop in valley of a small stream 1 mi. W. of Balsora, Wise Co. Also occurs along Boone Creek. To NE. it lenses out into shales. Not present in section exposed at Martin Lake.

Baltic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 135, 136). The Baltic mine is in an amygdaloid bed [called by Hubbard *Baltic amygdaloid*], whose strike, according to Mr. Theodore Dengler, Mining Engineer of the Atlantic and Baltic mines, is N. 60°30′ E. (magn.). This bed crosses the line btw. secs. 20 and 21, T. 54, R. 34, about 200 ft. N. of the quarter post.

A. C. Lane, 1906 (Mines and Minerals, vol. 27, pp. 204–206). The Baltic lode occurs a short distance above Baltic (No. 3) cgl. on Keweenaw Point, Mich.

Belongs to Bohemian Range group. Is younger than Baltic cgl. and older than Baltic West amygdaloid. The mineralized part is Baltic lode.

Named for occurrence in Baltic mine, Houghton Co.

Baltic flow.

Includes Baltic amygdaloid and underlying trap.

Baltic conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1906 (Mines and Minerals, vol. 27, pp. 204–206). Baltic cgl. (No. 3) lies a short distance below Baltic lode.

Belongs to Bohemian Range group.

Named for occurrence in Baltic mine, Houghton Co.

Baltic sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 495, 499, fig. 47). "*Baltic sandstone,*" an amygdaloid cgl. with much red sandy matrix, which I am inclined to identify with Marvine's cgl. No. 5.

Belongs in Bohemian Range group.

Probably named for its occurrence near Baltic mine or at or near town of Baltic, Houghton Co.

Baltic West amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use for many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is younger than Baltic amygdaloid. Belongs in Bohemian Range group. The mineralized part is the Baltic West lode. Named because it is usually the first amygdaloid W. of Baltic lode.

Baltic West flow.

Includes Baltic West amygdaloid and underlying trap.

Baltimore gneiss.

Pre-Cambrian: Northern Maryland and southeastern Pennsylvania.

G. H. Williams and N. H. Darton, 1892 (U. S. G. S. map of Baltimore and vicinity, to accompany "Guide to Baltimore," prepared for Baltimore meeting Am. Inst. Min. Engrs. Feb. 1892, pp. 88–139). [*Baltimore gneisses,* also *Baltimore gneiss,* here used to include gneiss overlying Cockeysville marble and the hornblende gneiss underlying Setters quartz schist, and text says *Baltimore gneisses* embrace a great variety of types. The gneiss that overlies Cockeysville marble is in Wissahickon fm.]

G. H. Williams and W. B. Clark, 1893 (Maryland, its resources and institutions, chap. III, pp. 55–88). *No certain traces of clastic origin have ever been detected in Baltimore gneisses,* although their sed. character may be inferred from their rapid alternations of beds of different composition, and from nature of other rocks intercalated in them, like the marbles and quartz schists.

W. B. Clark, 1904 (Md. Geol. Surv. Harford Co. Atlas, geol. map). *Pre-Cambrian (Baltimore).*—Highly crystalline gneisses with bands varying from micaceous qtzite to biotite and hornblende schists. Includes metamorphosed sediments and igneous masses. [Placed beneath Setters qtzite. Columnar section on map reads:

"*Baltimore gneiss* 5,000 (?) ft. Banded mica and hornblende gneiss with intruded aplite, pegmatite, and granite."]

E. B. Mathews, 1904 (Am. Jour. Sci., 4th, vol. 17, pp. 141–159). *Baltimore gneiss.*—Banded gneiss, highly crystalline. All agree that it is pre-Camb. Usually in eastern Md. it is separated from other metamorphosed sed. rocks by igneous masses, but in vicinity of Baltimore and in Phila. area, as shown by Dr. Bascom, these banded gneisses immediately underlie the qtzite (Chickies qtzite or Setters quartz schist). Apparently of sed. origin.

E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 40–62). *Baltimore gneiss* is restricted to sed. gneiss, and the intrusive gneiss is here named *Hartley augen gneiss.* The Baltimore uncon. underlies Setters fm.

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 105, 140–152). *Baltimore gneiss* (early pre-Camb.) consists of biotite and hornblende gneiss that shows some cataclastic deformation. Varies in appearance from a heavily bedded, granitoid gneiss of white or gray color to a thinly layered ribbon gneiss of alternating light and dark bands. Named for fine outcrops in city of Baltimore, along banks of Jones Falls and Gwynns Falls.

F. Bascom, 1932 (U. S. G. S. West Chester-Coatesville, Pa., folio, No. 223). *Baltimore gneiss* includes a nongraphitic facies and a graphitic facies. Latter was formerly treated as distinct fm. and called "Pickering gneiss," but this name is now abandoned, as the rocks are only a graphitic facies of Baltimore gneiss. Assigned to Archean.

In 1934 the U. S. Geol. Survey decided to adopt *Pickering gneiss* for the pre-Camb. sed. rocks associated with Franklin ls. (a white coarsely crystalline ls. or marble, more or less contemp. with Pickering gneiss), with which it is found interbedded as well as apparently overlying. For description of Pickering gneiss see last entry under *Pickering gneiss.*

The Baltimore gneiss was formerly classified by U. S. Geol. Survey as "Archean," but that term having been discarded as a time term the fm. is now classified as *pre-Camb.*

†Baltimorean formation.

Lower Cretaceous: Eastern Maryland.

P. R. Uhler, 1888 (Am. Phil. Soc. Proc., vol. 25, p. 48). *Baltimorean fm.*—Gravels, sands, and clays, 500+ ft. thick. Is probably lowest alluvial fm. discovered in Md. Rests on Archean rocks. Underlies Albirupean fm. Well developed in city of Baltimore.

B. L. Miller, 1917 (U. S. G. S. Tolchester folio, No. 204). "Baltimorean" of Uhler included Patuxent, Arundel, and Patapsco fms., which compose Potomac group.

Banbury volcanics.

Pliocene (upper): Southern Idaho (Twin Falls County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Banbury volcanics.*—Massive dark-brown weathered basalt flows and fragmental tuff beds, 360± ft. thick. Older than Hagerman lake beds and younger than Raft lake beds. There are thick exposures of fm. near Banbury Hot Spring, sec. 33, T. 8 S., R. 14 E., Twin Falls Co. At old Riverside Ferry there is a cone from which the tuffs issued.

Bandbox Mountain type.

Name applied by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 543–546, 1900) to dikes of analcite basalt on Bandbox Mtn, Little Belt Mtns, Mont.

Bandera shale.

Pennsylvanian: Southeastern Kansas and northeastern Oklahoma.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 32). *Bandera sh.*—Shales, 100 ft. thick, carrying considerable thin-bedded ss. and some coal, overlying Pawnee ls. and underlying Parsons ls.

Adopted by U. S. Geol. Survey many years ago as a fm. of Pleasanton group in Kans., overlying Pawnee ls. and underlying Altamont ls., basal memb. of Parsons fm. But R. C. Moore has recently abandoned Parsons fm., and now treats Bandera sh. of Kans. as a distinct fm. in his Marmaton group. This changed classification has not yet been considered by U. S. Geol. Survey for its publications.

Named for Bandera, Bourbon Co., Kans., near which it is quarried.

Banff series.

Carboniferous and Devonian(?): Alberta.

R. G. McConnell, 1887 (Canada Geol. Surv., n. s., vol. 2, pp. 15D, 17D, 19D). [Assigned to Carbf.]

Later repts assign these rocks to Dev., to Miss., to Miss. and Dev., and to Penn. and Miss.

Banffian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, pp. 285, 288). *Banffian series.*—Lss., 1,400 ft. thick, composing all of Late Devonic of Banff, Alberta. Underlie Banff shales, of Early Carbonic (Kinderhookian) age. The title *Banff* should be restricted to the Late Devonic beds, or some part of them in case it is found that this is not a single series.

Bangor limestone. (Of Chester group.)

Mississippian: Alabama, central and eastern Tennessee, and northwestern Georgia.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, pp. 155–157 and map). The Sub-Carbf. of Ala. is divided into "Upper or Calc. memb. (named Oxmoor ss. and shales and Bangor ls.)" and "Lower or Siliceous memb. (named Fort Payne chert)." The upper calc. member is variable in composition. In North Ala. it is chiefly a ls., called Mountain ls., from fact it forms flanks of most mtns in that section that are capped by Coal Measures. Within this ls. there is interbedded a layer of ss. [Hartselle] of variable thickness, perhaps 100 ft. max. in Tenn. Valley, while the over and underlying lss. are many times that. As we come southward the ss. (which we have often called La Grange ss., but that name is preoccupied, which has caused us to replace it by name *Oxmoor,* where the rocks are well exposed and where the shales are more conspicuous than at La Grange) becomes more important; and lower section of the ls. appears to give way to, or to be replaced by, a series of black shales [Floyd sh.] closely resembling those of the Dev. but many times more massive. In many places in the anticlinal valleys, and especially the further S. we go, the upper ls. also appears to be wanting or to be replaced by the shales and sss. above named. The ls. which comes next below the Coal Measures is well exposed at many places, as at Bangor, Blount Springs, and Trussville, where it is extensively quarried, but S. of latitude of Birmingham it is very rarely seen, and in its stead we find the black shales mentioned. These shales are often interstratified with dark-colored lss. and sometimes with tolerably pure lss., but these are unimportant in thickness as compared with the shales and sss. The greater part of Shades Valley is based upon these sss. and shales, though the ls. appears in several places.

Later mapping by C. Butts resulted in restriction (Ala. Geol. Surv. Spec. Rept. No. 14, 1926) of *Bangor* to the ls. above Hartselle ss. and below Pennington sh. In Shades Valley the Bangor restricted is overlain by an upper tongue of Floyd sh. In the broad sense in which Bangor ls. was originally defined and subsequently used it included all Miss. rocks above Fort Payne chert. In some early repts it was used to include the rocks later named *Tuscumbia ls.*, while in some other repts these rocks were included in Fort Payne chert. A name became necessary for the ls. above Hartselle ss., for which the name *Bangor* is especially appropriate, while the use of the name in the broad sense became unnecessary, the rocks having been subdivided. The Bangor restricted belongs to Chester group. (See also under *Hartselle ss.*)

Named for development at Bangor, Blount Co., Ala.

Bangor beds. (In Martinsburg shale.)

Upper Ordovician: Southeastern Pennsylvania (Northampton County).

C. H. Behre, Jr., 1926 (Jour. Geol., vol. 34, pp. 485–487) and 1927 (Pa. Geol. Surv., 4th ser., Bull. M9, pp. 33, 104–107, and maps). [See under *Pen Argyl beds.*]

Bankston Creek limestone.

See under *Bankston Fork ls.*

Bankston Fork limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Saline County) and southwestern Illinois (Perry County).

G. H. Cady. 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 257, 261, 262). [*Bankston Creek ls.* in columnar section on p. 257; *Bankston Fork ls.* elsewhere in rept.].—The ls. which I have chosen to call *Bankston Fork ls.* lies in lower part of McLeansboro fm., about 40 ft. above Herrin No. 6 coal, top memb. of underlying Carbondale fm, It is a fairly pure, slightly brownish or pinkish, hard, dense ls., which commonly breaks with a fracture somewhat concnoidal, Contains fossils. Thickness 0 to 15± ft. Is discontinuous, possibly because locally displaced by Anvil Rock. The strat. relation of these two strata is not very certain in mind of writer. One of best exposures is along S. side of valley of *Bankston Creek,* just E. of Saline Co. line.

A. H. Bell, C. Ball, and L. McCabe, 1931 (Ill. Geol. Surv. Press Bull. No. 19). *Bankston Fork ls. memb.*—Argill., dark blue, massive, fossiliferous ls.; weathers brown. Thickness 2½ to 7 ft. in Perry Co. Top lies 5 to 7 ft. below Galum ls. memb. Base lies 25± ft. above Herrin (No. 6) coal. Named by G. H. Cady (Trans. Ill. Acad. Sci., vol. 19, p. 261).

Bannock volcanic formation.

Cambrian (?): Southeastern Idaho (Pocatello).

A. L. Anderson, 1928 (Idaho Bur. Mines and Geol. Pam. 28, p. 3). *Bannock volcanic fm.*—Ancient volcanic rocks, including several flows of lava of probable andesitic composition, tuff beds, and breccias, thin beds of impure ls., calc. sh., ss., qtzite, and cgl., all so highly sheared, mashed, and altered that they may be pre-Camb., but writer has tentatively left them at base of Camb. until further study. Thickness 1,200+ ft.; base not exposed, Top has been taken to include the sh. beneath Black Rock ls. No definite fossils found. Named because its only known occurrence is in Bannock Range. The lavas are purplish, greenish, and reddish, and best described as greenstones.

†Baptanodon beds.

A paleontologic name applied by O. C. Marsh (1891) to beds underlying †Atlantosaurus beds (Morrison fm.) in the West. Is same as *Sundance fm.*, according to J. B. Reeside, Jr.

Baraboo quartzite.

Pre-Cambrian (middle? Huronian): Central southern Wisconsin (Sauk and Columbia Counties).

R. D. Irving, 1877 (Geol. Wis., vol. 2, pp. 504–519, 539, 542). *Baraboo qtzite ranges.*—The rock constituting the great body of the Baraboo ranges is a qtzite of nongranular, usually flaky, texture, and of color from nearly white, through gray, pink, and amethyst, to purplish red and even brick-red, the gray and deep red being most common, the white the least common. Very rarely a distinct granular texture is seen. The qtzite is very distinctly laminated, the lamination contorted. Next in abundance to the qtzite, and merging into it, are heavy beds of a fine metamorphic cgl., usually of grayish to amethystine color; the matrix and pebbles of qtzite are not always well defined from one another. A peculiar greasy-surfaced quartz schist forms thin layers btw. the thick layers of qtzite. Other quartz schists of different character form the lowest layers of the north qtzite range.

R. D. Irving, 1892 (U. S. G. S. Mon. 19, pl. 1), mapped *Baraboo qtzites.*

C. R. Van Hise, 1892 (U. S. G. S. Bull. 86, p. 195), referred *Baraboo qtzites* to upper Huronian.

S. Weidman, 1904 (Wis. Geol. Nat. Hist. Surv. Bull. 13). Thickness of *Baraboo qtzite* is 3,000 to 5,000 ft. Rests on floor of rhyolite, granite, and diorite. Underlies Seeley sl., without evidence of uncon. Is mainly qtzite, but contains small amount of quartz porphyry cgl. at base, and in several places is accompanied by red sl., hardened and semi-metamorphosed, making the well-known catlinyte of Pipestone and Baraboo Counties.

S. Weidman and A. R. Schultz, 1915 (Wis. Geol. Nat. Hist. Surv. Bull. 35, pp. 274–275). *Baraboo qtzite* forms E. end of Baraboo bluffs in W. part of Columbia Co.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 720), stated that Baraboo qtzite, Seeley sl., and Freedom dol. might be middle Huronian.

Baraboo series.

Pre-Cambrian: Central southern Wisconsin (Sauk County).

S. Weidman, 1904 (Wis. Geol. and Nat. Hist. Surv. Bull. 13, Econ. ser. No. 8, pp. 4, 22, 161, 162, 169–171), used *Baraboo series* to include (descending) Freedom fm., Seeley sl., and Baraboo qtzite in Baraboo region.

A. Leith, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 216, pp. 329–331), used *Upper Baraboo series* to include, in Baraboo dist., Rowley Creek sl. and Dake qtzite, and *Lower Baraboo series* to include Freedom fm., Seeley sl., and *Baraboo qtzite.*

Barachois slate.

Cambrian: Nova Scotia.

H. Fletcher, 1900 (Canada Geol. Surv., Descriptive note on Sydney coal fields, p. 5).

Barberie andesite.

Devonian: New Brunswick,

W. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 479).

Barbican formation.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

†Barclay limestone.

Pennsylvanian: Eastern Kansas.

J. W. Beede, 1902 (Kans. Univ. Sci. Bull., vol. 1, p. 175). *Barclay ls.*—Proposed by G. I. Adams, in unpublished ms., for lss. interbedded with shales, about 70 ft. thick, intimately connected faunally. Overlies Burlingame [Scranton] shales and underlies Willard shales.

This name fell into disuse years ago. As defined it included several lss. According to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 215), Barclay ls. of Beede extended from top of Scranton sh. up to base of Willard sh. (just as defined by Beede), but Moore's Willard sh. is a younger sh. than the Willard of current literature. Moore discarded this name.

Probably named for Barclay, Osage Co.

Bardstown coral reef. (In Liberty formation.)

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, p. 280). *Bardstown coral reef.*—Coral horizon forming base of Liberty bed of Richmond fm. in Ohio and Ky.

Named for Bardstown, Nelson Co., Ky.

Bar Harbor series.

Silurian and pre-Cambrian: Southeastern Maine (Mount Desert Island).

N. S. Shaler, 1889 (U. S. G. S. 8th Ann. Rept., pt. 2, pp. 1037, 1047–1052, 1060 and map). *Bar Harbor series.*—Thick-bedded flaggy slates and associated bedded qtzites and felsites with very numerous injections of various igneous rocks. In main quartzose and argill. slates, shales, and flags. Near Rodick's Cove and in some other places they consist in the main of bluish green and purple shales; at some points the beds are crowded with siliceous concretions. Found on N. and E. shores of Mount Desert from Rodick's Cove to the Ovens. No trace of fossils. I am disposed to think this small series represents beds deposited at a later period than any other on the island. The greater part of Mount Desert rocks are probably Camb. or older.

F. Bascom, 1919 (Geog. Soc. Phila. Bull., vol. 17, No. 4, pp. 117–122). *Bar Harbor series.*—Chiefly qtzites, slates, and flagstones, red, purple, and green; 700 to 1,000 ft. thick. Not very highly metamorphosed, but no organic remains have been found. Some of them may prove to be volcanics. Well exposed at Bar Harbor landing, whence the name. Skirt N. and E. shores of Mount Desert Island from Thomas Bay (east side) to Cromwell Cove at SE. end of Bar Harbor. Are perhaps next younger than Bartlett Island series. Are Lower Camb. or earlier.

On 1933 geol. map of Maine, by A. Keith, the rocks extending along shore of Mount Desert Island from E. side of Thomas Bay to S. of Bar Harbor are included in block of igneous rocks labeled "mainly Sil. but some Dev.;" and the rocks on SW. side of Thomas Bay are mapped as pre-Camb. sediments.

F. W. Toppan, 1932 (Geol. of Maine, Dept. Geol. Union Coll., Schenectady, p. 50), assigned these rocks to Camb.

†Barker formation.

Upper and Middle Cambrian: Central northern Montana (Fort Benton region).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Barker fm.*—The oldest sed. rocks of quad. Comprise all of Camb. Subdivisions can not be mapped separately on scale of map. Consist of (descending): (1) Yogo ls., 100 ft.; (2) Dry Creek sh. (brick-red sh. and lss.); (3) Pilgrim ls. (massively bedded), 140 ft.; (4) Park shales and ls. cgls., several hundred ft.; (5) Meagher lss., 110 ft.; (6) Wolsey sh. (purple and green micaceous sh. containing small ls. nodules bearing fossils), 125 ft.; and (7) Flathead ss. (coarse ss. composed of small pebbles and coarse grains of quartz and feldspar and occasional pebbles of gneiss, grading into hard sss. which often form a true qtzite. The rocks are well exposed near Barker, also in broad valley of Pilgrim Creek and in cliffs to N. Rest on Archean gneiss and schist. Overlain by Monarch fm. (Sil.? and Dev.).

The subdivisions mentioned above are now treated as fms., and the inclusive unit "Barker fm." has been discarded.

Barker porphyry.

Post-Cretaceous: Central Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Barker porphyry.*—Granite porphyry, usually gray or pale brown, weathering reddish. Forms Big Baldy Mtn, to S. of Barker. Assigned to post-Cret. [Also forms Barker Mtn, in Fort Benton quad.]

Barker syenite.

A name applied by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 465–468, 1900) to the rock that forms the intrusive mass N. of Barker, Cascade Co., Mont.

Barker sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Elwren ss. of Malott.

Barker quartzite.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 401). *Barker qtzite.*—One of key rocks of Taconic sequence, being readily identifiable and making sharp hills and ridges. Is generally of light or white color on weathered surfaces, but usually is more or less green when freshly broken. Varies from dense rock with very fine grains of quartz to coarse qtzite and locally a fine cgl. The coarser facies contain pebbles of various slates, qtzites, and a little ls., probably derived from older Camb. fms. Thickness varies from 100± ft. at Barker Hill (4 mi. E of N. from Castleton) and nearby Wallace Ledge down to thinness that is barely recognizable. Underlies Bull sl. and overlies Hubbardton sl.

Barker shale.

Cambrian: Alberta.

C. E. Michener, 1934 (Jour Geol., vol. 42, No. 1, p. 47).

Barkerian series.

A term applied by C. [R.] Keyes to all Camb. fms. of Mont. (See Pan-Am. Geol., vol. 46, 1926.) Corresponds to Barker fm. of Weed, a term long ago discarded by U. S. Geol. Survey.

Barkerville formation.

Pre-Cambrian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 14).

Barkley quartzites.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38). *Barkley qtzites.*—Qtzites, 1,400 ft. thick, composing upper fm. of Panamintan series (Early Cambric) in Utah. [Derivation of name not stated.]

Barlow sand.

A subsurface oil sand of Miss. age in western Ky. that has been identified as Bethel or Sample ss. by D. B. Chisholm (Ky. Geol. Surv., ser. 6, vol. 41, p. 220, 1931) and W. L. Russell (A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932).

Barlow lime.

A subsurface oil zone of Miss. age in western Ky. that has been identified as basal part of Paint Creek ls., of Chester group. (See D. B. Chisholm, Ky. Geol. Surv., ser. 6, vol. 41, p. 220, 1931; and W. L. Russell, A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932.)

Barlow.

Name applied to a glacial lake, of Pleist. age, in Canada, north of Great Lakes region.

Barnard gneiss.

Cambrian: Southeastern Vermont (Windsor County).

C. H. Richardson, 1924 (Vt. State Geol. Rept. 1923–24, pp. 91–92). *Barnard gneiss.*—Acid intrusive gneiss forming continuous outcrop for several mi. in Barnard Twp. Composes prominent ridge on W. side of Locust Creek N. of village of Barnard, but before it enters Bethel, on N., it forms prominent ridge on both sides of Locust Creek. Is light gray, tinged with green from presence of a little chlorite and epidote. Of gneissoid structure and medium to coarse grained texture. Exact age unknown. That it is pre-Ord. seems certain, and it may be pre-Camb.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this fm. to Upper Camb., but without discussion.

Barnegat limestone. (Has also been spelled *Barnegate.*)

Middle Ordovician to Lower Cambrian: Southeastern New York.

W. W. Mather, 1838 (N. Y. Geol. Surv. 2d Rept., pp. 168–169). The first continuous range of ls. of much magnitude that is seen in Columbia and Dutchess Counties, in passing from W. to E., is that which crosses the Hudson at Barnegat [now called Stoneco]. It extends from Barnegat up Wappingers' Creek, by Pleasant Valley and Pine Plains into Columbia Co., and on S. it passes from Milton to Newburgh; on the W. down the great valley through N. J.

into Pa. Varies in character from sandy, granular, subcrystalline texture, to perfect compact ls. with conchoidal fracture. Is usually gray, granular, and subcrystalline. Is said to contain fossils, but no fossils were found. Is sometimes distinctly stratified, and even slaty near its junction with the sl. rocks. Essentially synonymous with "Wappinger ls."

J. D. Dana, 1879 (Am. Jour. Sci., 3d, vol. 17). The ***Barnegat or Wappinger Valley ls.*** contains Trenton fossils and is a southward extension of Copake ls.

W. B. Dwight, 1883 (Am. Ass. Adv. Sci. Proc., vol. 31, pp. 384–387). The ***Wappinger*** *(or Barnegat) lss.* of Dutchess and neighboring counties, N. Y., contain Trenton and Calciferous fossils at several places.

W. B. Dwight, 1886 (Am. Jour. Sci., 3d, vol. 31, pp. 125–133). The ***Wappinger Valley*** *(or "Barnegat") lss.* at Fishkill and Stissing Mtns include lss. now known to be Trenton and Calciferous. In outskirts of Poughkeepsie a ledge of rock in Wappinger Valley ls. proved rich in Potsdam fossils. It must be over 300 ft. thick. Is exceedingly variable, but everywhere calc. and more or less aren. [In some places he called it *Potsdam ls.*] Rests on calc. qtzite of Potsdam group.

W. B. Dwight, 1887 (Vassar Bros. Inst. Trans. Sci. Sec., vol. 4, pt. 2). The ***Wappinger Valley*** *(or "Barnegat") lss.* of Dutchess Co. include Trenton ls. resting conformably on Rochdale group (the rocks which in previous papers I have called Calciferous).

E. C. Eckel, 1902 (N. Y. State Geol. 20th Ann. Rept., pp. r144–r150). Though there seems to be little doubt of essential equiv. of Barnegat and Stockbridge lss., it seems best to retain both names, as the Stockbridge probably includes Trenton beds, which in the less metamorphosed area of Orange Co. and N. J. can be differentiated from the Barnegat.

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83), used ***Stockbridge ls.*** for supposedly Ord. and Camb. lss. underlying Hudson [Manhattan] schist and overlying Poughquag [Lowerre] qtzite. The ls. of this area is now considered to be pre-Camb. and is known by local name ***Inwood ls.***

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). ***Wappinger ls.***—Fine-grained blue and white banded ls. 1,000 ft. thick. Contains Lower Siluric [Ord.] and Cambric fossils. Conformably underlies Hudson River slates in Highlands of SE. N. Y. and rests conformably on Poughquag qtzite.

J. M. Clarke, 1909 (N. Y. State Mus. Bull. 133, pp. 14–17). *Wappinger ls.*—First called "Barnegate ls." by Mather, but now named for Wappinger Creek, Dutchess Co. Hard, blue, medium bedded lss., carrying brachiopods with an occasional trilobite, all of apparent Trenton affinities. [The belt of ls. that runs through town of Fishkill was in this rept. named *Fishkill ls.* and excluded by Clarke from Wappinger ls.] The belt can be traced beyond the road from Fishkill Village to Wappingers Falls.

C. E. Gordon, 1910 (N. Y. State Mus. Bull. 140, pp. 16–20). *Wappinger ls.*—Occurs in two well-defined masses in Poughkeepsie quad. the composite Wappinger Creek belt and the Fishkill ls. Is older than Beekmantown ("Calciferous," Rochdale group), but whether Cambric or Canadian could not be determined. [Gives reason for thinking much of the ls. is older than Trenton and perhaps Camb. or early Ord.]

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 32–57). *Wappinger ls.*—Compact, fine texture, dark gray, either massive or strongly bedded ls., 1,000 ft. thick in area of N. Y. City aqueduct. Assigned to Cambro-Ordovicic. Generally supposed = Inwood ls. (or dol.) S. of the Highlands.

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148). *Wappinger (Barnegate) ls.*—In Poughkeepsie quad. is conglomeratic, aren., lutaceous, siliceous, and dolomitic lss. The western belt is Barnegate ls. of Mather, but now commonly referred to as Wappinger Creek or New Hamburg belt. It includes Trenton, Beekmantown (Calciferous-Rochdale group), Potsdam, and Georgian. The eastern belt of Wappinger ls. is known as ***Fishkill ls.***, as it lies chiefly in town of Old Fishkill. It includes Trenton, Beekmantown, and Lower Cambric (Georgian) fossils. Overlies Poughquag qtzite and underlies Hudson River sl. group.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 29). ***Barnegat ls.*** = Wappinger (Valley) ls. The name was from Barnegat, now called Stoneco, Dutchess Co. The Fishkill ls. is in part = Wappinger ls.

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 66–99). ***Wappinger ls.*** includes ls. of Hoyt, Beekmantown, and Mohawkian ages.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226). *Wappinger ls.* is about 1,000 ft. thick in West Point quad. Is finely crystalline ls. Conformably underlies Hudson River series and conformably overlies Poughquag qtzite. Belongs to Cambro-Ord. series.

E. B. Knopf, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 429–458). The Ord. and Camb. rocks of E. part of Dutchess Co. ("Wappinger ls." of Dwight and Dana) are divided as follows: (1) Lss. of early Trenton and Black River age; (2) Copake ls. (of Beekmantown age), 0 to 400 ft.; (3) Rochdale ls. (of Beekmantown age), 600 ft. in Wappinger Valley; (4) Hoyt dol., 300 ft. (the "Potsdam ls" of Dwight); (5) Stissing dol., 200 ft. (Middle ? and Lower Camb.); (6) Lower Camb. ("Poughquag") qtzite.

Has also been called *Newburgh ls.*

See also under *Stockbridge ls.*

Barnes conglomerate. (Of Apache group.)

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Barnes cgl.*—Cgl., 10 to 15 ft. thick, composed of well-rounded pebbles of hard white or pink qtzite with some reddish jasper and white vein quartz. Overlies Pioneer sh. and underlies Dripping Spring qtzite. Forms a conspicuous strat. girdle about Barnes Peak, Globe dist. Included in Apache group.

Barneston formation. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 41). *Barneston fm.* is erected to include Florence flint and Fort Riley ls., *which are in contact, except at a few places where a thin sh. intervenes.* The Florence or lower memb. is distinguished from the Fort Riley by its abundant chert content. The members are usually mapped together as *Fort Riley-Florence*. Their average combined thickness from southern Kans. to Nebr. is 50 ft. or more. They constitute a strong fm. which produces bold rounded escarpments. Type loc. of Barneston fm. is in bluffs W. and SW. of Barneston, Gage Co., Nebr.

Barnett shale.

Mississippian: Central Texas (mineral region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25–26). *Barnett sh.*—Yellowish gray to black bituminous sh., 0 to 50 ft. thick. Underlies Marble Falls ls. and overlies Ellenburger ls. Absent at type loc. of Marble Falls ls. Sharp faunal change btw. Barnett sh. and Marble Falls ls. Named for Barnett Springs, E. of San Saba [San Saba Co.].

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132). *Barnett sh.*, 0 to 150 ft. thick, consists chiefly of black petroliferous, fissile sh., overlain by thin layers of brownish, concretionary, petroliferous ls., and with distinctly conglomeratic beds at base, where it rests on Ellenburger ls. Previously called "Lower Bend" sh. Is basal fm. of Bend group. Overlain by massive beds of Marble Falls ls. The thin lss. at top contain fossils of Miss. aspect. [See also under †*Bend series.*]

Barnett sand.

A subsurface sand correlated with upper part of Cherokee sh. (Penn.) of Ponca City field, Kay Co., Okla. Is older than Markham sand and younger than Bartlesville sand.

†Barnstable series.

Pleistocene: Southeastern Massachusetts (Barnstable County).

N. S. Shaler, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 503–593). *Barnstable series.*—Dark-colored clays, in part at least laid down in salt water. Appears to have been laid down after Nashaquitsa series and before Truro series.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). Shaler's "Barnstable series" included clays, boulder clays, sands, and gravels, and represents several Pleist. fms. of Long Island.

Named for occurrence at Barnstable, Barnstable Co.

Barnwell sand. (In South Carolina.)
Barnwell formation. (In Georgia.)

Eocene (upper): Coastal Plain of western South Carolina and eastern Georgia (Savannah drainage).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 12, 17). [*Barnwell buhr sands* in table; *Barnwell phase* in heading.] The littoral line of Barnwell phase irregularly overlaps upper margin of Santee marls, which extend from Shell Bluff easterly by Tinkers Creek, Orangeburg, Keitt Ravine and thence southerly along E. ridge of Santee River; along some ridges this littoral line extends almost to the fall line. The area along Savannah River extends southerly to Johnson's Landing, where it passes under King's Creek Silex, which near Cohens Bluff passes under Brier Creek marl (explored on Ga. side along Brier Creek by Lyell and by Vaughan). From Johnson's Landing the line of southerly exposures of this fm. passes near Fairfax, and thence probably curves, in obscurity of surface sands, towards Scotchmans Bluff; but it has been conclusively discriminated nowhere near St. Georges anticline S. of Orangeburg. The materials consist of silicified shells and decomposed glaucenite sands, partly indurated to ss.

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2), showed *Barnwell buhr-sands* and *Barnwell phase* as overlying his Santee marl and as separated from his Cooper marl by Mount Hope phase, but stated that position of the Barnwell was uncertain.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, p. 285). *Barnwell sand.*—Sloan has used name Barnwell "buhr sands" or Barnwell "phase" for red, ferruginous sands that immediately overlie McBean fm. as defined in this rept. Type area is in Barnwell Co., S. C., where its strat. position is as stated. Sloan, who has also studied the area in Ga. adjacent to Savannah River, states that Barnwell "phase" is represented by the sands that overlie the fossiliferous marls of Shell Bluff [*Ostrea georgiana* zone]. The Barnwell sand directly overlies McBean fm. and is in contact with both the marls and the Congaree clay, the basal memb. of McBean fm. and of Claiborne group (p. 268).

C. W. Cooke and H. K. Shearer, 1918 (U. S. G. S. P. P. 120C), modified the definitions of Barnwell sand and of McBean fm. as explained in 1918 entry under *McBean fm.* They showed Ocala ls. and Barnwell fm. as contemp., but stated that they are very different in lithology and present different faunal facies; also that they interfinger and merge laterally into each other. They stated: Barnwell fm. as here defined applies to a less homogeneous composite of materials than Barnwell sand of Veatch and Stephenson, including, in addition to Barnwell sand of Veatch and Stephenson, their so-called "Congaree clay" and the *Ostrea georgiana* zone of their McBean fm.; and it extends in a broad belt from Savannah River nearly to Flint River, but in W. half of this belt, the area lying W. of Oconee River, the fm. is intermediate in character btw. the typical Barnwell and the Ocala ls., merging into Ocala ls. to the S., or seaward, and toward the SW.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867, on Coastal Plain of S. C.). Study of fossils has shown that many of the localities specifically referred by Sloan to the Barnwell really belong to McBean fm., and it is difficult to specify any particular locality in S. C. that can be considered as the original type. However, *Barnwell* has been adopted in this rept. in what is deemed to be its original significance, namely, an Eocene fm. composed chiefly of sand that overlies uncon. the McBean fm. This usage is same as that followed by Cooke and Shearer in their description of the deposits of Claiborne and Jackson age in Ga. [As mapped by Cooke in this rept the fm. covers N. half of Barnwell Co.]

Barrack Mountain granite gneiss.

Pre-Cambrian (?): Northwestern Connecticut.

W. M. Agar, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 204, 211+). *Barrack Mtn granite gneiss.*—Coarse, irregularly banded granite gneiss with variably spaced foliation planes due to discontinuous bands of biotite. It is a cataclastic gneiss with frequently a well-developed mortar texture. The minerals are quartz, microcline, microperthite, a little oligoclase, brown pleochroic biotite, much less muscovite, usually a little epidote, and a good deal of a second generation of quartz in larger elongated crystals. Feldspars characteristically poikilitic; the potash feldspar usually white but when present in large crystals it shades towards pink. The rock forms Barrack Mtn, 1 mi. S. of Falls Village, Litchfield Co. The Grenville schists and gneisses and the Barrack Mountain gneiss are so intimately intermingled over large areas that it is necessary to map the resulting gneiss separately as a mixture of the two and disregard the many minor variations. *Intrudes all older rocks. Assigned to pre-Camb.*

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, p. 362). Writer previously (this Jour., 17, p. 211, 1929) called the most granitic type of this latter rock [mixed gneisses] the *Barrack Mtn granite gneiss* and regarded it as an older intrusive forming the igneous component of the widespread mixed gneiss series. He has abandoned that view at present and regards the Becket magma as a widespread impregnating agent.

Barranca division.

A term applied by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, pp. 122–152, 1900) to a series of shales, slates, sss., and cgl. or breccia, with beds of graphite and coal, in Sonora, Mexico. Assigned by him to Triassic, and said to overlie Carbf. lss. and dolomites.

R. E. King, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 89, 101), assigned these rocks to Upper Triassic and Liassic. (The latter is included in Lower Jurassic by U. S. Geol. Survey.)

Barranquitas shaly limestones.

Early Cretaceous (?): Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

Barre granite.

Devonian: Northeastern Vermont (Washington County).

C. H. Richardson, 1902 (3d Rept. Vt. State Geol., btw. pp. 61 and 98). Of the eruptives in Washington ls. [Waits River ls. of current literature] the *Barre granite* plays most important part. The area is about 8 mi. long and 4 mi. wide, *mostly in Barre but with a small area in Williamstown. It is a fine granite,* composed of quartz, feldspar, and mica, and of lower Trenton age.

C. H. Richardson, 1908 (6th Rept. Vt. State Geol.). *Barre granite,* Dev., intrudes Waits River ls.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned *Barre granite* to Dev.

Barre moraine.

Pleistocene (Wisconsin stage): Western New York and southern Ontario. Named for South Barre, Orleans Co., N. Y. Replaces †Lockport moraine. Is shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Barré limestone.

Devonian: Quebec.

J. M. Clarke, 1915 (N. Y. State Mus. Bull. 177, p. 150).

Barree limestone.

Silurian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, pp. 132–133). *Barree lss.*—Thin beds of light-gray bluish gray ls. streaked with calcite, with some greenish gray sh. partings. Thickness 175 ft. Underlie Clinton upper shales and overlie Barree shales. Outcrop belt crosses Little Juniata River at Barree forge, and it is quarried for flux at Barree furnace [Huntingdon Co.].

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 825–827), called the shales above *Barree ls. group* the *Barree Upper shales* and the shales below that ls. the *Barree Lower shales.*

These ls. beds are basal part of McKenzie fm., as identified by C. Butts in U. S. G. S. Hollidaysburg-Huntingdon folio (No. 227).

Barree shales.

Silurian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, p. 133). *Barree shales.*—Green shales; 60 to 75 ft. thick, with thin, limy, fossiliferous layers. Underlie Barree lss. and rest on 10 ft. of ore ss. [Keefer ss. memb.]. Included in Clinton fm. [Form upper part of Clinton fm. as identified in U. S. G. S. Hollidaysburg-Huntingdon folio (No. 227).]

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 826–827). *Barree Upper shales*, top memb. of Clinton fm., 60 ft. thick, overlie Barree ls. group (175 ft. thick), which rests on *Barree Lower shales* (75 ft. thick, green in color, with thin limy fossiliferous layers almost entirely confined to upper half, and exposed along river bank below Barree furnace, Huntingdon Co.). All included in upper part of Clinton fm. [The Barree Upper shales and Barree ls. of this rept form basal part of McKenzie fm. of U. S. G. S. Hollidaysburg-Huntingdon folio (No. 227), and the Barree Lower shales form upper part of Clinton fm. of that folio.]

Barrelian series.

Cambrian: California.

C. [R.] Keyes, 1931 (Pan-Am. Geol., vol. 56, p. 76).

Barrel Spring formation.

Middle Ordovician: Central eastern California (Inyo Range).

F. B. Phleger, Jr., 1933 (Southern Calif. Acad. Sci. Bull., vol. 32, pt. 1, pp. 1–6). *Barrel Spring fm.*—A succession of qtzites, impure lss., and argill. shales of Middle Ord. age. The fm. is well exposed in Barrel Spring Canyon and in each of next 4 canyons to N. Consists of (descending): (1) Argill. sh., dark gray to black, weathers reddish brown, highly fossiliferous at certain localities, 64 ft.; (2) nonfossiliferous dark-gray impure ls. that weathers lighter gray, 25 ft.; (3) basal qtzite, white, nonfossiliferous, 41 ft. Conformably overlies Mazourka fm. (of Chazy age) and conformably underlies Dev. qtzite that weathers white to buff. Five of the 7 forms that are present in fauna of Barrel Spring fm. are either identical with or are closely related to species of Trenton age.

†Barren Measures.

A descriptive term used in early repts (see J. P. Lesley, Manual of coal, 1856 ed.; H. D. Rogers, Geol. Pa., vol. 2, pt. 1, pp. 474–477, 1858) to include the rocks of western Pa. above the Mahoning ss. Subsequently "Upper Barren Measures" was applied to the rocks later named *Dunkard group*, and "Lower Barren Measures" was applied to the rocks later named *Conemaugh fm.* The coordinate descriptive term "Upper Productive Coal Measures" was applied to the intervening Monongahela fm., and the term "Lower Productive Coal Measures" to the Allegheny fm.

Barrett shale.

Lower Cretaceous: Northeastern Wyoming and western South Dakota (Black Hills).

W. P. Jenney, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, p. 593, fig. 122, and map). *Barrett shales (Lower Cret.)*.—Shales and massive sss., uncon. underlying Oak Creek beds and overlying (without positive evidence of uncon.) Hay Creek coal fm. in Black Hills. Formerly included in Dakota ss. (Upper Cret.). Thickness 45 to 75 ft. [Mapped at and around Barrett, Crook Co., Wyo.]

Barrett sand.

A subsurface sand, of Upper Dev. (Chemung?) age, in NW. Pa., which is believed to lie lower than Bayard sand and higher than Elizabeth sand.

Barrière formation.

Cambrian or pre-Cambrian: British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 78).

Barrington clays.

Pleistocene (Wisconsin stage): Rhode Island (Barrington).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 987–988, chart opp. p. 988, and pl. 62). *Barrington clays.*—Grayish to bluish clays present in town of Barrington, R. I. Are more sandy in upper than in lower part. Used for making brick. Underlain by glacial gravel and sands and overlain by glacial sands. Thickness 60 to 65 ft.

Is a local deposit of clay of Wisconsin age.

Barron quartzite.

Pre-Cambrian (Keweenawan): Northwestern Wisconsin (Barron County).

N. H. Winchell, 1895 (Am. Geol., vol. 16, pp. 150–162). The Sioux qtzite, New Ulm qtzite, Baraboo qtzite, and *Barron County qtzites* are of same age, and are pre-Keweenawan and post-Mesabi.

S. Weidman and A. R. Schultz, 1915 (Wis. Geol. Nat. Hist. Surv. Bull. 35, pp. 234, 235), mentioned *Barron qtzite* as present in E. part of Barron Co., resting on pre-Camb. granite.

W. O. Hotchkiss et al., 1915 (Wis. Geol. Nat. Hist. Surv. Bull. 44, econ. ser. 19, p. 85 and map). *Barron qtzite.*—The three main phases are the purplish pink, well-cemented qtzite, the yellowish somewhat less well-cemented qtzite, and the striped or stain-banded phase. A very minor phase widely famed, however, because of its use by the Indians, is the pipestone or catlinite, which occurs in thin shaly beds. It includes at least two separate uncon. qtzite fms., trap rocks, and probably both acid and basic intrusives. Thickness 600 ft. Assigned to Keweenawan. Rests uncon. on Huronian slates.

Barron County quartzite.

See under *Barron qtzite*.

Barryville member.

Upper Devonian: Southeastern New York and northeastern Pennsylvania (Wayne and Pike Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 586–587). *Barryville memb.*—Lower memb. of Shohola fm. Underlies Paupack ss. (upper memb. of Shohola fm.) and overlies Delaware River flags. Consists of 700 ft. of olive and gray shales and sss., cross bedded, weathering often to deeply pitted surfaces, and containing red interbeds and glomerate layers of mud chips and fish fragments. Evidently this memb. corresponds to, and is a thickened continuation of, the beds below Paupack ss. which so puzzled I. C. White [but to which he applied the name *Paupack shales and ss.*]. Exposed on Delaware River in Pike Co., but better displayed on N. Y. side of the river, in vicinity of Barryville, Sullivan Co. Is continental correlate of marine Chemung. Is not recognized beyond central Monroe Co., along Brodhead Creek.

Barstow formation.

Miocene (upper): Southern California (San Bernardino County).

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 360–370). *Barstow series.*—A thin valley fm. made under arid conditions. Occurs at several points in Mohave River valley, notably along railroad about 1½ mi. E. of Barstow [San Bernardino Co.]. Type section near Barstow consists of:

1. Stratified, hard brown material due to arid condition but composition not determined. Persistent over considerable area, 20 ft.
2. Yellow and light gray silt, 4 ft.
3. Stratified, fine gravel and sand of dull red color and containing red lava fragments, 15 ft.
4. Structureless bed of white tuff with angular and subangular fragments of various other rock species embedded in it, 20 ft.

Is extensively developed on low hills on N. side of valley btw. Barstow and Daggett. Uncon. overlies Rosamond and Escondido series. Extensively eroded. Overlain uncon. by Quat.

J. C. Merriam, 1915 (Pop. Sci. Monthly, vol. 86, pp. 252–254). The term *Barstow fm.* is used for the beds containing the Upper Mio. vertebrate fauna.

J. C. Merriam, 1919 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, No. 5, pp. 441–448). *Barstow fm. or group.*—Mainly bluish gray to yellowish brown, slightly indurated strata, composed largely of fine arkose with considerable percentage of volcanic ash. In an earlier publication (Calif. Univ. Pub., Dept. Geol. Bull., vol. 6, p. 168, 1911) writer referred to fauna of Barstow syncline as the *Mohave fauna,* this name being considered mainly as a geographic designation. Later, in order to avoid confusion with other Tert. faunas occurring in Mohave area, the name *Barstow* has been used for this faunal assemblage, and *Barstow fm.* for the beds containing the Upper Mio. or Barstow fauna. This fm. comprises the uppermost of the five divisions [of Rosamond series] in Barstow syncline, described by Baker [Calif. Univ. Pub., Dept. Geol. Bull., vol. 6, 1911] as fossiliferous tuff memb., and any other beds which may be recognized as representing the horizontal or vertical extension of the same depositional unit. The limits of Barstow fm. may be found to correspond with those of the fossiliferous tuff memb., or they may include a greater range of sediments above and below. It is possible the Barstow fauna occurs in all strata of Barstow syncline. It is also possible the lowest strata of that section will be discovered to contain a faunal assemblage much older than the particular Upper Mio. assemblage known as the fossiliferous tuff. The resistant breccia memb. immediately below the fossiliferous tuff in Baker's Barstow syncline section seems to contain a representation of Barstow fauna, and may ultimately be included in Barstow fm. Should the resistant breccia be recognized as a distinct fm. the name *Barstow group* may be used for the sequence of fms. Excepting marine deposits of Eocene age, the oldest Tert. rocks in Mohave area of which the age is certainly known are included in Barstow fm. Fauna [listed] is distinctly older than Ricardo fauna. Assigned to Upper Mio.

Bartlesville sand.

Name that has been applied to one and to several productive sands in lower part of Cherokee sh. of eastern part of Osage Co., NE. Okla., some of which have been correlated with Bluejacket ss. memb. of Cherokee sh. (Penn.). The name has been used to include Red Fork sand at top and Glenn sand at base, with intervening beds, the whole aggregating 200 or more ft. in thickness; and it has also been applied to the lower sand only, the upper sand being called *Burbank (Red Fork) sand.* According to N. W. Bass, the lower sand, which lies 50 to 100 ft. below the higher sand, is now regarded as true Bartlesville, which is the producing sand near town of Bartlesville, Washington Co., Okla., and is separated from Mississippi lime by a small thickness of sh. The sand formerly called *Bartlesville sand* in Kans. is now designated *Burbank sand.*

Bartlett barren member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup-Zuni Basin).

J. D. Sears, 1925 (U. S. G. S. Bull. 767). *Bartlett barren memb.*—Light-gray to white lenticular ss., light-gray clay sh., and thin irregular coal beds, but none of commercial importance. Thickness 330 to 400 ft. Underlies Gibson coal memb. and overlies Dilco coal memb., all belonging to Mesaverde fm. Named for excellent exposures near old Bartlett shaft mine, which penetrates lower half of the memb.

Bartlett Island series.

Pre-Cambrian and later: Southeastern Maine (west of Mount Desert Island).

N. S. Shaler, 1889 (U. S. G. S. 8th Ann. Rept., pt. 2, pp. 1037, 1038–1041, 1060). *Bartletts Island series.*—Thick layer of micaceous, chloritic, and sometimes gneissoid schists, which lie on W. side of island, extending from Thomas Bay, on N. side of island, to Nutter's Point, the extremity of SW. shore. A series of schists, qtzites and sss.; no lss. Consists of contorted schist, aren. and argill., with frequent bed of qtzite, a material often assuming a gneissoid aspect with the associated injections of igneous rocks. Thickness not less than 2,000 ft. and may be twice as much. Rocks lie low in Paleozoic. It may be found that a portion or whole of Bartlett's Island series is to be placed with that found about Bar Harbor [which he named *Bar Harbor series*].

F. W. Toppan, 1932 (Geol. of Maine, Dept. Geol. Union Coll., Schenectady, p. 48). *Bartlett's Island series* is Camb. or possibly pre-Camb.

On 1933 geol. map of Maine, by A. Keith, the rocks of Bartlett Island are mapped as pre-Camb. gneisses and schists, Sil. or Dev. igneous rocks, and Carbf. granite.

Named for development on Bartlett Island, off W. coast of Mount Desert Island.

Barton group. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania.

J. J. Stevenson, 1877 (2d Pa. Geol. Surv. Rept. K_2, p. 67). *Barton group.*—Includes Morgantown ss. at top and Crinoidal or Green Fossiliferous ls. [Ames] at base. This portion of section is so constant and shows such slight variation in general character that it deserves to be especially distinguished.

Barton gneiss.

Pre-Cambrian: Northeastern New York (Essex County).

J. F. Kemp, 1898 (Am. Inst. Min. Engrs. Trans., vol. 27, p. 178, map and cross sections). *Barton gneiss forms summit of* Barton Hill; is darker than underlying Orchard gneiss. Both occur near Port Henry [Essex Co.].

Barton beds.

Silurian: Ontario (Hamilton).

M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. 1913, pp. 179–188). *"Barton beds."*—Thin to thick-bedded dol. with interbedded sh. (in part bituminous), occurring in upper part of Lockport memb. of Niagara fm. Locally known in vicinity of Hamilton, Ont., as "Barton beds." At Ancaster about 10 ft. thick, and rest on 15 ft. of chert beds, which in turn rest on Gasport ls. memb. of the Lockport. [Derivation of name not stated.]

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser.). *"Barton beds."*—The 80 to 90 ft. of the Lockport overlying the chert beds and underlying Guelph dol. in vicinity of Hamilton are decidedly argill. and contain sh. beds at some horizons. Spencer and Grant called these beds "Barton beds," after the name of township in which Hamilton is situated. The name "Barton" has never been recognized to any extent in geological literature as it was preoccupied in Tertiary of England; it has, however, considerable local significance. As will be seen later, the upper 35 ft. of "Barton beds" belong to Erasmosa dol. [Name applied in this rept. to upper 12 to 50 ft. of Lockport dol., exclusive of Guelph.] The lower part is well defined by its argill. character from Mount Albion to Ancaster.

Barton sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Barton ss.*—Underlies Barton rider coal and overlies Barton coal; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied *Barton ss.* to sss. both overlying and underlying Barton rider coal, but on p. 65 he stated: "A thick ss. is found locally over the Barton coal at Barton and elsewhere which is named the Barton ss. from its position." On p. 114 he showed 30 ft. of *Barton ss. and sh.* underlying Wellersburg ls. and fire clay and overlying Barton rider coal in Castleman Basin.

Barton limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Barton ls.*—Underlies Barton coal and overlies Upper Grafton ss.; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 115), gave thickness of *Barton* ls. in Castleman Basin as 5 ft. and in Georges Creek Basin as 1 ft.

Barton red shale. (In Conemaugh formation.)

Pennsylvanian: Western Maryland.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 65). *Barton red sh.*—Red sh. found above Barton coal in drill holes in Potomac basin.

Barton clay. (In Conemaugh formation.)

Pennsylvanian: Central eastern Ohio (Jefferson County).

R. E. Lamborn, 1930 (Ohio Geol. Surv. Bull. 35, pp. 137–138). *Barton clay*, 3' 2" thick, underlies Barton coal, which in Jefferson Co. is represented by 2 in. of black carbonaceous clay.

Named for association with Barton coal.

†Barton Creek limestone.

Lower Cretaceous (Comanche series): Central Texas (Travis County).

R. T. Hill and R. A. F. Penrose, Jr., 1889 (Am. Jour. Sci., 3d, vol. 38, p. 470). *Barton Creek or Caprina ls.*—Estimated thickness 1,000 ft. Exposed on Barton Creek [near Austin] above the ford, also in high bluffs of the Colorado at and opposite Johnson's quarry; also in W. bluff of Mount Bonnel. Included in Comanche series.

Same as Edwards ls., later name but affording better type loc.

Barton Creek limestone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). *Barton Creek ls.*, in lower part of Mineral Wells fm., lies lower in section than Santo ls.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 106). *Barton Creek ls. memb. of Garner fm.* is preoccupied by Barton Creek ls. of Cret. of Tex. and is discarded. [It is listed as basal memb. of Garner fm., the name *Mineral Wells fm.* being restricted to upper part of the original Mineral Wells fm. Does not say what name replaces it.]

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534), do not refer to this name under their description of geol. of Palo Pinto Co., nor on map of that Co., but under description of "Underground water" of Palo Pinto Co., they state (p. 162) that their newly proposed *Buck Creek ss.* lies in interval btw. Brannon Bridge and Barton Creek ls. members of *Millsap Lake fm.*, which underlies Garner fm.

basement complex.

"Basement complex" and "Bedrock complex" are descriptive terms that have been rather loosely applied in the literature to the basement rocks of a region, regardless of whether they are or are not of complex structure.

Bashi formation. (In Wilcox group.)

Eocene (lower): Southern Alabama and southeastern Mississippi.

A. Heilprin, 1882 (Phila. Acad. Nat. Sci. Proc. for 1881, pp. 158–159). [See quotation under †*Eo-lignitic*.]

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 43–47). *Wood's Bluff or Bashi series.*—Consists of (descending): (1) Wood's Bluff or Bashi marl, 15 to 30 ft. thick; (2) 25 ft. of gray sandy clays containing toward base 4 or 5 thin seams of lignite; (3) 35 to 40 ft. of yellowish cross-bedded sands; and (4) lignite bed 2 ft. thick. Underlies Hatchetigbee series and overlies Bell's Landing series [Tuscahoma sand of modern nomenclature].

Is next to youngest fm. of Wilcox group in Ala., and contains deposits of both marine and nonmarine origin. Extends a short distance into Miss. Is believed to occupy a position btw. Grenada fm. and Holly Springs sand, but occurs 80 mi. SE. of the outcrops of those fms.

Named for exposures on Bashi Creek, Clarke Co., Ala., especially at Wood's Bluff, Tombigbee River, just below mouth of Bashi Creek.

†Bashi marl.

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1887 (U. S. G. S. Bull. 43, pp. 39, 43–46, 69). *Wood's Bluff or Bashi marl.*—Marl, with marine fossils and much greensand, 15–30 ft. thick, forming top memb. of Wood's Bluff or Bashi series. Overlain by purplish brown sandy clays forming basal part of Hatchetigbee series.

Conflicts with Bashi fm., of which it is top memb.

Named for exposures on Bashi Creek, Clarke Co.

†Basic claystone. (In Claiborne group.)

Eocene (middle): Southeastern Mississippi.

E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14, pp. 74-75). *Basic claystone.*—Marine beds, consisting of (descending): (1) White qtzite, 20 ft. (to W. these beds characterize the claystone and pass into soft ss.); (2) yellowish white claystone, 100 ft.; (3) semi-indurated grayish glauconitic sand, 10 ft. A phase of Tallahatta fm. Rests conformably on Winona sand phase of Tallahatta fm.

Is a facies of Tallahatta fm. for which a geographic name is considered unnecessary. The true Winona sand has been proved, by later work of C. W. Cooke, to be a memb. of Lisbon fm.

Named for exposures at Basic City, Clarke Co.

Basin shale.

Upper Cretaceous: Northern Wyoming (Basin and Greybull oil fields).

F. F. Hintze, 1915 (Wyo. State Geol. Bull. 10, on Basin and Greybull oil and gas fields, Bighorn Co., Wyo., pp. 17, 24-29). *Basin sh.*—Marine shales, dark colored, containing calc. concretions and many Niobrara fossils in upper half. The large brown sandy concretions at base are highly fossiliferous. There is at base a persistent cgl. 2 ft. thick. Thickness of fm. 900-1,000 ft. Rests discon. (erosion) on Torchlight ss. memb. of Benton, and underlies Pierre sh., which is overlain by Eagle ss. [Parkman ss.]. [In Wyo. State Geol. Bull. 11, 1915, on Little Buffalo Basin, Hintze gave thickness as 1,200 to 1,250 ft.]

As above defined, this unit includes Carlile and Niobrara shales of present nomenclature, the overlying so-called Pierre sh. of Hintze being the Steele sh. of current nomenclature.

Bas Obispo formation.

Eocene or older: Panama Canal zone.

D. F. McDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 708).

Basque formation.

Jurassic: British Columbia.

C. H. Crickmay, 1930 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 19, No. 2, p. 33).

Bass limestone. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Bass ls.*—White crystalline ls. alternating with beds of argill. and calc. red sh. containing sun cracks. Thickness 335 ft. Cut by a thick sill of intrusive diabase. Conformably underlies Hakatai sh. and conformably overlies Hotauta cgl., all of which belong to Unkar group. Named for Bass Canyon, where typically exposed.

Bassand member (of Bearpaw shale).

Upper Cretaceous: Alberta.

L. S. Russell, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 126).

Bassendorf shale.

Oligocene (?): Southwestern Oregon (Coos Bay district).

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 454, 457, 459). *Bassendorf sh.*—Sh., characterized in part by presence of diatoms and foraminifera. Estimated thickness 1,900 ft. Rests on Coaledo fm. as here restricted, and is overlain by Tunnel Point ss. No angular uncon. btw. Bassendorf sh. and Coaledo fm. could be established with certainty. Typical exposure at Bassendorf Beach, shown on U. S. Coast and Geodetic Survey chart No. 5984, in sec. 3, T. 26 S., R. 14 W. Contains microfossils and a few mollusks. Assigned to lower Olig.

H. G. Schenck, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, p. 16). There is some indication that an angular uncon. may exist btw. Bassendorf sh. and underlying Coaledo fm.

H. G. Schenck and R. M. Kleinpell, 1935 (Pan-Am. Geol., vol. 64, No. 1, p. 76). Microfossils and strat. relations suggest Bassendorf and Keasey shales are late Eo.

Bassick agglomerate.

Tertiary: Central southern Colorado (Custer County).

W. Cross, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 307). *Bassick aggl.*—Volcanic aggl., 1,400± ft. thick, composing Bassick Hill and greater part of Mount Tyndall. The rock that is predominant among the fragments of the aggl. is an andesite closely allied to both Rosita and Bunker types. Seems likely to be last of sequence of igneous rocks of Silver Cliff-Rosita Hills region.

†Bassimenan Lake granite.

Pre-Cambrian (Laurentian): Northeastern Minnesota (Vermilion district).

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4). *Bassimenan Lake or Basswood granite* is same as Saganaga granite. Well exposed on islands and along S. shores of Bassimenan Lake.

U. S. Geographic Board gives *Basswood* (not *Bassimenan*) as correct name of the lake.

Bass Islands dolomite.

Silurian (Cayugan): Southeastern Michigan, northern Ohio, and western Ontario.

A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 554). *Bass Islands series or Lower Monroe.*—Named for group of islands in western Lake Erie. Discon. underlies Sylvania ss. Overlies Salina. Includes (descending): Raisin River dol., 200± ft.; Put-in-Bay dolomites, 100+ ft.; Greenfield dol., 100+ft.; and Tymochtee shales and lss. of Ohio, 100+ft. which may represent in part one or more members recognized elsewhere. [See under *Tymochtee sh.*]

Type loc. of Greenfield dol. is in SW. Ohio.

Bass Mountain diabase.

Mississippian: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Bass Mountain diabase.*—Nonporphyritic, dark, somewhat greenish, compact lava, occasionally vesicular and more frequently fragmental. Is contemp. and partly interbedded with upper part of Bragdon fm. Named for fact it forms southern slope of Bass Mtn.

†Basswood granite.

Pre-Cambrian (Laurentian): Northeastern Minnesota (Vermilion district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept.). *Basswood granite* occupies all the Minn. shores of Basswood Lake except SW. shore of Arm 1.

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4). *Basswood granite* intrudes Lower Keewatin and is of same age as Saganaga granite.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 128). The *granite of Basswood Lake* is same as granite locally known as "Saganaga Lake granite."

The U. S. Geol. Survey uses *granite of Basswood Lake*, in a geographic sense.

Basswood Creek formation.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6).

Bastard limestone.

A term applied in some early N. Y. and Pa. repts to a ls. in Helderberg group, because of its impure or siliceous character.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G7, pp. 97–98). *Bastard ls.*—Buffish-gray impure mag. ls. 10 to 25 ft. thick. Overlies Bossardville ls. (basal part of

Lower Helderberg) and underlies Stormville ls. "Seems to represent Stormville cement bed as well as Decker's Ferry group of Pike and Monroe Counties."

Bastion schist.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 124) and 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 158). *Bastion schists*, pre-Beltian, B. C. Included in Shuswap series.

Batavia moraine.

Pleistocene (Wisconsin stage): Western New York. Named for Batavia. See U. S. G. S. Mon. 41, pp. 688–690.

Batchawana series.

Pre-Cambrian: Western Ontario.

E. S. Moore, 1926 (Ont. Dept. Mines 34th Ann. Rept., pt. 4, p. 9; and 35th Ann. Rept., pt. 2, p. 59) and 1929 (Geol. Soc. Am. Bull., vol. 40, p. 552). Occurs in upper waters of Batchawana River, in Mississagi Forest Reserve, 75± mi. N. of Sault Sainte Marie, Ont.

Bates Hole formation.

This name is listed in U. S. G. S. Bull. 191, but the reference cited (J. H. Smith, Jour. Geol., vol. 8, p. 456, 1900) does not use the term. Under heading "Eocene of Bates Hole, Wyo.," Smith stated: In valley of Bates Creek, Natron [a] Co., Wyo., fossiliferous Eocene beds occur, which have been but recently recognized, and no published account of them is known to writer.

Batesville sandstone.

Mississippian: Northern Arkansas and northeastern Oklahoma.

J. C. Branner and F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol 4, pp. xiii, 26, 49–53). [According to p. xiii the fm. was named by Branner; the description is by Simonds.] *Batesville ss.*—In Washington Co., Ark., consists of coarse ss., gray to brown, 10 to 60 ft. thick, in some places more or less massive but usually forms beds 1 to 4 ft. thick. Either immediately underlies Archimédes [Pitkin] ls. or is separated from it by Marshall sh. Overlies Fayetteville sh. [The ss. above described in Washington Co. is now known not to be the Batesville but the Wedington ss. memb. of Fayetteville sh.]

R. A. F. Penrose, Jr., 1891 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 1, pp. 113, 139–140). *Batesville ss.* at Batesville consists of brown or buff-colored, fine grained ss., generally soft, though sometimes hard; splits easily along bedding lines. Contains lenticular beds of sh. Thickness 20 to nearly 200 ft. Overlies Fayetteville [really Moorefield] sh. and underlies Genevieve or Boston group.

See under *Fayetteville sh.* for explanation of erroneous correlations in above definitions. The true Batesville ss. is of Chester age, and at Batesville it overlies Moorefield sh., or in its absence Boone ls.; and to W. it underlies true Fayetteville sh.

Named for Batesville, Independence Co., Ark.

† Batesville ash bed.

Upper Ordovician (Richmond): Northeastern Arkansas (Batesville district).

J. F. Williams, 1891 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 2, pp. 373–375). *Batesville ash bed* as described by Dr. R. A. F. Penrose, Jr., consists of compact, bluish green, earthy rock, 6 to 15 inches thick, containing small siliceous nodules, ⅛ to 1 inch diam., and small crystals of iron pyrites. The material is softly calc. and weathers into a brown or buff-colored mass much softer than original rock. Overlies residual clay derived from decomposition of St. Clair ls. [not St. Clair ls. of present usage but an older fm.] and underlies Boone chert [Miss.].

H. D. Miser (personal communication August 1933) states that this unit is not an ash bed but a bed in Cason sh., and that it is not a useful geologic name. It is also preoccupied.

Named for Batesville, Independence Co.

Bath sandstone sub-member (of Pony Spring siltstone member).

Permian: Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 973, 990, 995, 1,000). *Bath ss. sub-memb. of Pony Spring siltstone memb. of Maroon fm.*—Arkosic, greenish-gray, micaceous ss., with chloritic cement. Strata range from a few tenths of a foot to 8 ft. thick, and may alternate with thin layers of greenish gray to reddish-gray siltstone. Ripple marks common; many layers cross-laminated. Plant fossils abundant at some horizons near base. Rests conformably on Chubb siltstone memb. Assigned to Perm. Forms prominent ridge that separates the Platte and Arkansas drainage for several mi. NW. of summit of Trout Creek Pass, where is abandoned town of Bath.

Bath-Reef series.

Quaternary: West Indies.

J. W. W. Spencer, 1902 (London Geol. Soc. Quart. Jour., vol. 58, p. 361).

Bathurst formation.

Carboniferous: New Brunswick.

G. A. Young, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 220).

Battery formation.

Pleistocene: Northwestern California (Del Norte County).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, p. 136 and map). *Battery fm.*—A thin marine terrace capping of unconsolidated sands exposed over S. part of Crescent City platform. A fossiliferous lens contains a small fauna whose general aspect is that of upper San Pedro.

Battie quartzite.

Cambrian (?): Central southern Maine (Knox County).

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 3). *Battie qtzite.*—Massive buff qtzite and clean, buff-colored qtzite cgl. of very striking appearance. The qtzite cgl. makes up Mount Battie. Thickness 400 to 500 ft. Overlies Islesboro fm. and conformably underlies Penobscot fm. Assigned to Camb. (?). Named for development on Mount Battie, a small mtn on mainland N. of Camden, Knox Co., in Rockland quad.

On 1933 geol. map of Maine, by A. Keith, these rocks are included in the Ord. and Camb. block.

Battle Creek moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Named for Battle Creek. See back of 1918 ed. of U. S. G. S. Camp Custer topog. map; also Mich. Acad. Sci. Ann. Rept., pp. 53–54, 1918.

Battleground schist.

Pre-Cambrian: Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1931 (U. S. G. S. Gaffney-Kings Mtn folio, No. 222). *Battleground schist.*—Chiefly white, gray, bluish, bluish black, and mottled white and bluish sericite schists, with, at top, a manganese schist memb. nearly 300 ft. thick; several very persistent beds of cgl. are present. Thickness 1,000 to possibly 2,500 ft. Uncon. underlies Kings Mtn qtzite and uncon. overlies Archean rocks. Assigned to Algonkian.

Named for exposures on Kings Mtn Battleground, York Co., S. C.

Baucari division.

A term applied by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, 1900, and vol. 31, 1902) to a great thickness of late Tert. lake deposits in Sonora, Mexico, and Cochise Co., SE. Ariz.

Bautista beds.

Pleistocene: Southern California (San Jacinto quadrangle).

C. Frick, 1921 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 12, pp. 283–288). *Bautista beds* occur in Bautista Badlands or Bautista Creek area. They have yielded Pleist. vertebrate fossils, and were evidently accumulated in part in a playalike lake, as a series of fine, worked-over fangls. and clays derived from low highlands of immediate N. and E.

D. M. Fraser, 1931 (Min. in Calif., vol. 27, No. 4, pp. 504–516, 536–537). *Bautista beds* are 1,500 or 2,000 ft. thick, and cover area of 25 sq. mi. Contain Pleist. vertebrates.

Baxter shale.

Upper Cretaceous: Southwestern Wyoming (Sweetwater County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Baxter sh.*—Black and drab shales, very soft and friable; shaly sss. and aren. sh., in places highly gypsiferous. Greater part of fm. is sh. Thickness undet.; 1,000 ft. exposed in Baxter Basin, but base not seen. Underlies Blair fm. Contains fossils of Montana age. Named for exposures in vicinity of Baxter.

J. D. Sears, 1926 (U. S. G. S. Bull. 781, pp. 16, 19, map). Between Frontier and Blair fms. in Baxter Basin is 3,350 to 3,600 ft. of homogeneous gray and drab sh., in part of Colorado and in part of Montana age. Only upper part of this sh. is exposed. Schultz gave name *Baxter sh.* to this part, but in present rept the name is extended to include the whole body. It includes numerous zones of calc. concretions and soft thin-bedded ss. Thickness in Rock Springs uplift 3,350 to 3,600 ft. A ss. 850± ft. below top of fm. is called "marker bed" and is believed to mark base of Montana part of Baxter sh.

Baxters Brook formation.

Ordovician: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 241).

Bayard formation.

Pennsylvanian: Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Bayard fm.*—A lower ss. 196 ft. thick; a middle div. of shaly ss., sh., coal, and thin ls. 200 ft. thick; and an upper ss., which is a beach deposit. Thickness 400 to 475 ft. Underlies Fairfax fm. and overlies Savage fm. Exposed all around Bayard, Grant Co., W. Va.

Corresponds to lower part of Conemaugh fm.

Bayard sand.

A subsurface sand, of Upper Dev. (Chemung or Catskill) age and 3 to 30 ft. thick, lying 2,388 to 2,464 ft. below Pittsburgh coal in eastern Greene Co., Pa. The name is also used by drillers in W. Va. Named for Thomas Bayard farm, Whiteley Twp, Greene Co. Also called Sixth sand. Lies lower than McDonald sand and higher than Elizabeth sand. Two lower sands are called (descending) *Bayard Stray sand* and *Bayard Stray Stray sand.*

Bay City lime.

A name originally applied by miners to a zone of ls. cgl. at or near base of Dolores fm. in LaPlata dist., SW. Colo., but now applied by them to almost any limy beds in that dist., except the so-called "La Plata ls." forming basal bed of Morrison fm. Named for Bay City mine, on La Plata Creek.

Bay City moraine.

Pleistocene (Wisconsin stage): Eastern Michigan (The Thumb). Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Bay City.

Bay de Noc member (of Stonington beds).

Upper Ordovician (Richmond): Northern Michigan (Delta County).

R. C. Hussey, 1926 (Mich. Univ. Mus. Geol. Contr., vol. 2, No. 8, pp. 113–150). *Bay de Noc memb.*—Basal memb. of Stonington beds of Upper Ord. Richmond fm. Basal part of memb. is massive-bedded, argill. ls.; upper or main part consists of argill. ls. in alternate, comparatively thin, hard and soft layers. Grayish brown to dark brown. Thickness about 38 ft. Rests discon. on Bill's Creek beds and is conformably overlain by Ogontz memb. of Stonington beds. Chief exposure along E. shore of Little Bay de Noc, from 1½ mi. N. of Stratton's farm northward, and also S. to Stonington P. O.

Bayfield group.

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Douglas and Bayfield Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 25). *Bayfield ss. group.*—Chiefly quartz sss. Formerly called *Western Lake Superior ss.* but correlation with Lake Superior ss. of Mich. doubtful. No fossils. Largely or wholly nonmarine. Thickness 4,300 ft. Included in upper Keweenawan. Divided into (descending) Chequamegon ss., Devils Island ss., and Orienta ss. Rests conformably on Oronto group. [As mapped covers a large part of Bayfield Co.]

C. K. Leith, 1935 (U. S. G. S. P. P. 184). Recent work by G. I. Atwater and G. M. Clement in NW. Wis. and NE. Minn. has established presence of a great structural discordance and erosional uncon. btw. lowest Upper Camb. ss. and uppermost Keweenawan Bayfield group.

Bayfield gravel.

Tertiary? (Pliocene?): Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Bayfield gravel.*—Pebbles and boulders scattered over the surface at high levels within San Juan Mtn range or on crests of foothills. Lie at altitude of 8,000 to 13,000+ ft., but always near the summit levels. Composed chiefly of pebbles less than 5 inches diam. Thickness 0 to 200+ ft. Contemp. with Los Pinos and Bridgetimber gravels. Named for occurrence on several hills a few mi. N. of Bayfield, La Plata Co.

Bayhorse dolomite.

Cambrian (?): Southern central Idaho (Custer County).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Bayhorse dol.*—Generally massive, thick-bedded dol., in part oolitic. Thickness 1,000± ft. Assigned to Camb.(?). May possibly be Algonkian. Underlies (uncon.?) Ramshorn sh. and overlies (uncon.?) Garden Creek phyllite. Named for town and creek in Custer Co.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 941, etc.). *Bayhorse dol.*—Chiefly thick-bedded dol. Most of beds light creamy gray when fresh, but weather readily to rusty buff; many are crowded with small nearly black, oval chert masses. Exceptionally the dol. is nearly black and studded with slightly larger white bodies, each consisting of a single crystalline grain of dol., commonly with rim of fine-grained carbonate, at least in part calcite. Locally beds of chert, qtzite, and cgl. or breccia, and some lenses, especially near top, are argill. Max. thickness fully 1,000 ft. Underlies Ramshorn sl. and overlies Garden Creek phyllite. Crops out at intervals along crest and E. flank of anticline that extends diagonally across NW. part of Bayhorse quad. Best exposed near town of Bayhorse. No fossils.

Bayloran series.

A term introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 57, pp. 337, 350–355, 1932) to replace *Clear Fork group* of north central Tex., because "preoccupied by Broadhead, many years previously, for a coal measures section in west-central Mo." Named for Baylor Co., Tex., "through which the Clear Fork of Brazos River flows." [The Clear Fork group of Broadhead is a part of Cherokee sh. of Kans.]

Bayne series. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

G. W. Evans, 1912 (Wash. Geol. Surv. Bull. 3, pp. 42–49). *Bayne series.*—Basal div. of Puget fm. in King Co. Consists of sss. and shales, with far greater percentage of sh. than in overlying Franklin series. Some coal and bony beds. Named for town in King Co.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). *Bayne memb.* (of Eocene of Green River Canyon, western Wash.).—Predominantly shales, with subordinate amounts of ss., shaly ss., and carbonaceous beds. Thickness 3,000 ft. Underlies Franklin memb.

Bayou Chicot limestone.

Upper Cretaceous(?): Southwestern Louisiana.

G. D. Harris and A. C. Veatch, 1899 (La. Geol. Surv., pt. 5, Rept. for 1899, p. 61). *Bayou Chicot ls.*—On average is of much darker color than Winnfield ls., but some fragments show tendency to white and blue banded structure so characteristic of Winnfield layers. Assigned to Ripley stage of Upper Cret. Outcrops about 8 mi. SW. of Bayou Chicot P. O., Evangeline Co.

D. C. Barton, 1936 (letter dated Dec. 23). Bayou Chicot ls. of Harris and Veatch, 1899, is cap rock ls. of Pine Prairie salt dome.

†Bayou Pierre phase.

Miocene(?) and later(?): Southwestern Mississippi.

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90–91). The qtzitic phase of Grand Gulf Miocene, being only a phase of the next or Fort Adams or Ellisville phase roughly estimated. Extends from NW. corner of the fm. on Big Black River, to a curved line drawn across from Rodney to Pelatchie. It is most largely developed on Bayou Pierre and Cole's Creek. For convenience it may be called "Bayou Pierre phase." [All localities mentioned are in SW. Miss.]

Includes Catahoula ss. and possibly in places younger rocks. (See L. W. Stephenson, U. S. G. S. W. S. P. 576, pl. 2, 1928.)

Bayport limestone.

Mississippian: Michigan (Lower Peninsula).

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30, p. 81), mentioned *Bayport ls.* as having "strongest possible resemblance to *Grand Rapids ls.* in character and in fossils, and both are intimately associated with and underlain by sss."

A. C. Lane, 1900 (Mich. Geol. Surv. vol. 7, pt. 2, btw. pp. 1 and 30). *Maxville or Bayport ls.*—Sandy yellow lss., cross-bedded white ss., a little dol. Thickness 20 to 50+ ft. Top fm. of Grand Rapids group or series. Overlies Michigan series [fm.]. At bottom of Coal Measures is a ss. separated off by Winchell under name of *Parma ss.* I believe Bayport ls. in its sandy phase is Parma ss. [Later repts by Lane and others treat Parma ss. as younger than Bayport ls., and of Pottsville age. *Maxville ls.* is an Ohio fm.]

Named for outcrops at Bayport, Huron Co., where it is quarried.

Bayport chert.

F. Dustin, in a paper (entitled "A study of the Bayport chert") describing Indian artifacts of Mich., described the chert from which the implements were made, and stated that it occurs "in the ls. most prominently exposed near Bayport, Huron Co.;" which is type loc. of Bayport ls. of geologic literature.

Bays sandstone.

Ordovician: Northeastern Tennessee and southwestern Virginia.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 4). *Bays ss.*—Red calc. and argill. ss.; changes in composition very slight. In Knoxville area the lime becomes more important than in other areas, and the rock is often an impure ls. Near Montvale feldspathic grains appear in the rock, and not far toward SW. they are an important element. The red color, however, is marked and persistent. Thickness 300 to 1,100 ft. Overlies Sevier sh. and underlies Clinch ss. Named for Bays Mtns, Hawkins and Greene Counties, Tenn.

Foregoing is definition as originally prepared by Mr. Keith, author of name. Mr. Keith's name was accepted by M. R. Campbell, who used it on a map of SW. Va. published in 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 4), where the fm. was called *Bays* (*Red Medina*) *ss.*, and was shown as overlying Sevier sh. and underlying Clinch ss. (the name Clinch being here restricted to upper light-colored ss. of Safford's Clinch Mtn ss). The name was also used by Campbell in Estillville folio (No. 12), published in 1894. As defined in latter folio (which includes extreme N. end of Bays Mtn) the fm. consists of red ss. or sandy sh. 140 to 350 ft. thick, overlying Sevier sh. and underlying Clinch ss. In type area (described by Keith in Greeneville folio, No. 118, published in 1905) the fm. is everywhere an argill and calc. ss.; shows little change in appearance from place to place; color always red or brown; layers usually massive, but in some places thin and shaly; thickness 50 to 400 ft.; usually sharply separated from overlying Clinch ss., but in SW. end of Bays Mtn is more or less interbedded with the Clinch.

The Bays ss. was named "for its exposures in the Bays Mtns of Hawkins and Greene Counties, Tenn." (Morristown and Greeneville quads.). The geographic feature known as Bays Mtn extends from NW. part of Knoxville quad., across SE. corner of Maynardville quad., thence NE. across Morristown quad., the NW. corner of Greeneville quad., and SE. corner of Estillville quad. In Bays Mtn of all these quads. a fm. described as underlying Clinch ss. and overlying Sevier sh. was mapped as *Bays ss.* in early repts of U. S. Geol. Survey. But according to E. O. Ulrich and C. Butts the fm. thus mapped is not of same age in all of these areas, the Bays ss. of Estillville quad. being Juniata fm., of Upper Ord. (Richmond) age, while the Bays ss. SE. of Knoxville and at Bull Gap, in Morristown quad., is of Lowville age, a characteristic Lowville fossil (*Tetradium cellulosum*) having been found there at *base* of the rocks mapped as Bays ss.

Bays limestone.

In some areas the Bays ss. becomes so calc. that it is called *Bays ls.*

Bayview granodiorite.

Probably Cretaceous or Jurassic: Pend Oreille district, northern Idaho.

J. L. Gillson, 1927 (Jour. Geol., vol. 35, No. 1). Light-gray even-grained rock, speckled with very abundant biotite and hornblende crystals.

Named for exposures around Bayview, Kootenai Co.

Bay View Avenue sand.

Upper Cretaceous: Southeastern New Jersey.

J. K. Prather, 1905 (Am. Geol., vol. 36, pp. 171, 172, 175). *Bay View Ave. sand.*—Is a sand, although at first sight appears to be compact clay. Sometimes found as one bed, or may be made up of a number of small beds or lenses of local extent and 2 to 8 ft. thick. Color white to yellow, salmon, brown, orange, and red. Thickness 0 to 35 ft. Is probably upper part of Hazlet sand of Clark. Part of it may correspond to Wenonah sand of N. J. Survey, although on account of local variation it does not seem to fit this so well, and is therefore given a local name. Extends from Bay View Ave. Station near Atlantic Highlands some 800 ft. in direction of Hiltons.

Bay View Avenue lenses.

Upper Cretaceous: Southeastern New Jersey.

J. K. Prather, 1905 (Am. Geol., vol. 36, pp. 171, 172). *Bay View Ave. lenses*, Nos. 1, 3, 4, and 5. Lenses 4 and 5 are included as part of Bay View Ave. sand, and Nos.

1 and 3 as part of Mount Laurel sand. Lens No. 1 is 4 ft. thick and 120 ft. long; No. 3 is 4'5" thick and 120 ft. long; No. 4 is 2 ft. thick and 130 ft. long; No. 5 is 2 ft. thick and 70 ft. long.

†Bazoo porphyry.

A name applied locally, in Leadville dist., Colo., to Lincoln porphyry (Eocene). So called from its occurrence in Bazoo claim.

B. C. member.

Pre-Cambrian: British Columbia.

G. Hanson, 1935 (Canada Dept. Mines, Geol. Surv., Bur. Econ. Geol. Mem. 181, p. 4). *B. C. member of Richfield fm.* (lower fm. of Cariboo series), of Barkerville gold belt, Cariboo dist., B. C. [Apparently named for B. C. vein, on Cariboo claim.]

Beach formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Beach fm.*—Sss. and shales, underlying Eastern Head fm. and overlying McGraw bed. Included in Bell Island series. [Derivation of name not stated.]

Beach Mountain paramphibolite.

Pre-Cambrian: New York (eastern Adirondacks).

H. L. Alling, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 798–799).

Beacon Hill gravel.

Tertiary (Pliocene?): New Jersey.

R. D. Salisbury, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 47–57, 67–72). *Beacon Hill sand and gravel* (also *Beacon Hill fm.*).—Oldest phase of the yellow gravel. Consists of coarse gravel, also fine-grained, and sand. Thickness 0 to 100 ft. Uncon. underlies Pensauken fm. and uncon. overlies Cret. Well developed and exposed on summit of Beacon Hill, 3 mi. S. of Matawan.

R. D. Salisbury, 1898 (N. J. Geol. Surv. Ann. Rept. State Geol. 1897, pp. 13–15), restricted Pensauken fm. to upper part of Pensauken fm. as defined by him in 1894, and introduced *Bridgeton fm.* for lower part. The fm. overlying Beacon Hill gravel is therefore now known as *Bridgeton fm.*

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 137), *restricted Beacon Hill* to upper or gravel memb. (coarse gravel, chiefly quartz and chert) of the Beacon Hill of Salisbury, and applied *Cohansey sand* to lower memb. This is present accepted definition of *Beacon Hill gravel.*

Beadle Green granite.

Age (?): Northeastern Vermont (Orange County).

C. H. Richardson and C. K. Cabeen, 1923 (Vt. State Geol. Rept. 1921–22), stated that an intrusive *syenite* that occurs on Crompton Hill in SW. corner of Randolph Twp, Randolph quad., is locally known as *Beadle Green granite.*

Bead Mountain limestone member (of Belle Plains formation).

Permian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 426). *Bead Mtn. bed.*—Largely dark-colored, hard, brittle, slightly shaly ls., alternating with softer light-gray ls. Thickness 6 to 50 ft. Memb. of Albany div. Underlies bed No. 12 (12 to 75 ft. of clay) and overlies Valera bed, which rests on Jagger Bend bed.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, map and section, pp. 12–13, 18, 21). [Cross section on map shows following downward succession: Grape Creek ls., *Bead Mtn. fm.*, Valera sh., Jagger Bend ls. They also gave detailed section of Wichita fm. in SW. Coleman Co. and stated:] It seems that No. 5 of this section was regarded as base of Drake's Bead Mtn. beds, but there are at least 2 lss. and 2 sh. beds below it which might be included in the section. Beginning with top of Jagger Bend beds, which is second fm. below this section, the worm tubes and reefs set in along Colorado River. It seems probable that beds Nos. 5 to 36, inclusive, constitute Drake's Bead Mtn beds. They have a thickness of 55 ft. 6 in., which is practically the thickness he ascribed to the fm. The rocks from top of Jagger Bend beds to top of Bead Mtn beds form a striking paleontological unit along Colorado River in SW. Coleman Co. and SW. Runnels Co., and probably should be included in a single fm. Through entire thickness of these rocks the dominating fossils are worm remains. Worm tubes are characteristic fossils of Bead Mtn fm, the oldest beds exposed in Runnels Co. The Bead Mtn fm. is overlain by Grape Creek fm. [This would include bed No. 12 in Bead Mtn fm.]

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 195, 198). *Bead Mtn ls.* is top memb. of Belle Plains fm. (middle fm. of Wichita group). Overlies Valera sh. memb. of Belle Plains and underlies Grape Creek sh. and ls. bed, the basal memb. of overlying Clyde fm.

Named for Bead Mtn, Coleman Co.

Beady formation.

Cretaceous (?): British Columbia.

F. A. Kerr, 1926 (Canada Geol. Surv. Summ. Rept. 1925, pt. A, p. 94).

Beale diorite.

Jurassic (?): Vancouver Island.

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A).

V. Dolmage, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 15).

Bean Canyon formation.

Bean Canyon series.

Probably Triassic and Jurassic: Southern California (Los Angeles and Kern Counties).

E. C. Simpson, 1934 (Calif. Jour. Mines and Geol., vol. 30, No. 4, map and pp. 371–401). [*Bean Canyon series* on map; *Bean Canyon fm.* in table.] Schists, slates, qtzites, marble, crystalline ls., mica schist, amphibole schist, and andalusite-cordierite schist, meta-andesite and meta-dacite. Thickness 5,000 ft. [*Crystalline ls. of Bean Canyon series* mapped separately.] Named for excellent section in Bean Canyon, in NW. corner of Elizabeth Lake quad. Though a wider belt of schists is exposed in Bean Canyon than in the much larger roof pendants in the granitic rocks to W. (Tehachapi Mtns), the latter contain some 1,500 ft. of ls. compared with 200 ft. of it in Bean Canyon. No fossils. Probably in part Triassic and possibly in part early Jurassic.

Bear Branch limestone member (of Olive Hill formation).

Lower Devonian (Helderbergian): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 738). *Bear Branch memb.*—Massive ls. and oolitic hematite to N.; impure cherty ls. to S. Is more impure than overlying Flat Gap memb., and is cross bedded. Thickness 0 to 45 ft. Is middle memb. of Olive Hill fm., of Helderberg age. Overlies Ross ls. memb. Named for exposure on Bear Branch, about 2 mi. SE. of Olive Hill, Hardin Co., where it forms low bluff showing 20 ft. of low-grade ore resembling Clinton ore. Probably more or less = Pyburn ls. memb. of Olive Hill fm. at Pyburns Bluff, on Tenn. River.

C. O. Dunbar, 1919. (See 1919 entry under *Pyburn ls. memb.*)

Bear Creek shale. (In Clinton formation.)

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Bear Creek sh.*—Fossiliferous sh. just beneath Furnaceville ore at old "Wolcott ore bed" on Bear Creek (Black Creek of topographic map) [Wayne Co.]. If distinct from the Martville[ss.], the Bear Creek sh. will lie above rather than below it. [Belongs in lower part of Clinton fm.]

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 191), placed *Bear Creek sh.* above Reynales ls. and below Sterling ore, and included Furnaceville sh. in Reynales ls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 324, 326), placed *Bear Creek sh.* below Sterling Station ore and above Reynales ls., and included *Furnaceville ore* in the Reynales. She described *Bear Creek sh.* in Rochester section as consisting of 18 ft. of purple and olive shales with thin plates of fossiliferous ls.

J. T. Sanford, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 194). The former *Bear Creek* of Genesee Gorge is designated *Brewer Dock memb. of the Reynales*, as the fm. at Bear Creek is younger.

Bearian series.

A term applied by C. R. Keyes to the deposits underlying his Bentonian series and overlying his Dakotan series.

Bear Mountain granite.

Pre-Cambrian(?): Central northern Colorado (Summit County).

H. B. Patton, 1909 (Colo. Geol. Surv. 1st Rept., p. 128, map). *Bear Mtn granite.*—Gray medium-grained biotite granite. Closely resembles Santa Fe granite, but is a biotite granite and not a biotite-muscovite granite. Occurs in more or less isolated patches and dikes. Forms summit of Bear Mtn, Summit Co. Is in contact with hornblende-gneiss series (pre-Camb.).

Bear Mountain formation.

Silurian: Mackenzie.

E. M. Kindle, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 45).

Bear Mountain erosion surface.

Tertiary: Northeastern Utah and southwestern Wyoming (Uinta Mountains).

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). Older than Browns Park fm. and probably late Mio. or early Plio. Named for fact one of its more conspicuous remnants is the nearly level top of Bear Mtn, Utah.

Bear Passage granite.

Age(?): Ontario (Rainy Lake district).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 99).

Bearpaw shale. (Of Montana group.)

Upper Cretaceous: Northern, eastern, and southern Montana and Elk Basin region of central northern Wyoming; also southern Alberta.

J. B. Hatcher and T. W. Stanton, 1903 (Sci., n. s., vol. 18, pp. 211–212) and 1905 (U. S. G. S. Bull. 257). *Bearpaw shales.*—Dark clay sh., with many calc. concretions. Of marine origin. Thickness 600 to 700 ft. Conformably overlies Judith River beds. Well developed around N., E., and S. borders of Bearpaw Mtns. Not yet determined whether Bearpaw includes equivalents of Fox Hills ss. or is wholly of Pierre age.

T. W. Stanton, 1919 (U. S. G. S. P. P. 120, p. 187), correlated Bearpaw sh. with upper part of Pierre sh. and lower part of Fox Hills ss.

In central Mont. the Bearpaw is overlain by Lennep ss. (of Fox Hills age) and in NW. Mont. it is overlain by Horsethief ss. (also of Fox Hills age).

Bear Pond schist.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Bear Pond schist.*—A feldspar quartz-graphite schist, included in Grenville series. Is older than Beech Mtn amphibolite and younger than Catamount schist. Thickness 30± ft. Type loc. is Bear Pond, Ticonderoga Twp, Essex Co.

Bear River formation.

Upper Cretaceous: Southern Wyoming.

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex., 3d Ann. Rept. Hayden Surv., pp. 91, 92). I have named the group of coal strata that is exposed beneath the middle tert. beds by upheaval at Bear River City [Wyo.], Evanston [Wyo.], and Coalville [Utah], the *Bear River group.* In cut just W. of Bear River City the beds contain the greatest profusion of molluscan life I have ever seen in tert. beds of West. There seems to be mingling of fresh and brackish water fossils. Flora and fauna are distinct from those of any other fm.

inclined to regard the beds of lower tert. age. [Relations to Wasatch and other fms. not explained.]

F. V. Hayden, 1870 (Am. Phil. Soc. Proc., vol. 11, pp. 420–425). *Bear River group* is composed of clay, ls., ss., marl, gypseous earth, bituminous and fossiliferous sh. Is exposed in R. R. cuts about 1 mi. W. of Bear River. [Gives detailed section.]

F. B. Meek, 1873 (U. S. Geol. and Geog. Surv. Terr. 6th Ann. Rept., p. 462). Brackish-water beds of Bear River have always been regarded by me as Lower Eo., but I am not wholly without suspicion they may prove to be Cret.

E. D. Cope, 1874 (U. S. Geol. and Geog. Surv. Terr. 7th Ann. Rept., pp. 435–444, and Bull. No. 2, pp. 8–15), and F. V. Hayden, 1874 (U. S. Geol. and Geog. Surv. Terr. Bull. 1, No. 2, pp. 1–2), assigned *Bear River group* to Cret.

C. A. White, 1883 (U. S. Geol. and Geog. Surv. Terr. of Wyo. and Idaho for 1878, pt. 1, pp. 52–53). I formerly included *Bear River series* in Laramie group, but lower part, which is of brackish water origin, contains a molluscan fauna, every known sp. of which is distinct from other fms. and different from any found in any other parts of regional divisions of Laramie group. It is serious question whether we ought not to regard Bear River series as separate div. of Laramie group, if not a separate group. Continuity of Bear River series with great body of Laramie group elsewhere is not known to exist.

C. A. White, 1888 (Am. Geol., vol. 2, footnote in Cope's paper on pp. 265–267). Fauna of *Bear River Laramie* is entirely different from that of Laramie proper, but I do not know which is older.

C. A. White, 1891 (U. S. G. S. Bull. 82, p. 153). The so-called *Bear River Laramie* I have long believed to be considerably older than Laramie fm. proper.

C. A. White, 1892 (Am. Jour. Sci., 3d, vol. 43, p. 97). *Bear River fm.* is not=Laramie, but underlies equiv. of the Fort Benton.

T. W. Stanton, 1893 (U. S. G. S. Bull. 106, pp. 15–16, 45–46). *Bear River fm.*—Brackish-water deposits, 650 to 2,500 ft. thick. Has recently been shown to occupy much lower horizon than Laramie fm., or probably about that of the Dakota.

T. W. Stanton, 1903 (Am. Phil. Soc. Proc., vol. 42, p. 192). *Bear River fm.*—Cgls., sss., and shales, 4,000 ft. thick, containing a large and peculiar fresh-water fauna. Principal known area extends from neighborhood of Evanston northward near W. bdy of Wyo. for more than 100 mi. Is known to lie btw. the Fort Benton [Benton] and the marine Jurassic. Indications are that the Bear River and the Dakota are of nearly same age. [See also T. W. Stanton, 1913 (Wash. Acad. Sci. Jour., vol. 3, p. 63).]

Later field work showed thickness of *Bear River fm.* to range from 500 to 5,000± ft., and it is now believed to include considerably more than the equiv. of Dakota ss.

Bear River beds.

Upper Paleozoic: Northwestern British Columbia (Portland Canal region).

A. Bowman, 1889 (Canada Geol. Surv., vol. 3, pt. 1, pp. 20C to 22C). *Bear River beds, Upper Paleozoic,* include Bear River ls. and Cherty series.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d series, vol. 6, sec. 4, p. 207), assigned *Bear River fm.*, B. C., to Dev.; W. L. Uglow, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, p. 84), assigned *Bear River series* of B. C. to Carbf.; R. G. McConnell's repts have also described this fm. or a younger (?) Mesozoic *Bear River fm.*

Bear River series.

Miocene: Northern California (Humboldt County).

W. Stalder, 1915 (Calif. State Min. Bur. Bull. 69, pp. 447–449). *Bear River series.*—Conglomeratic sss. and cgl., resting on aren. bands and yellowish sss. of medium texture, poorly cemented, underlain by 300 ft. of shales of nodular character containing a little interbedded ls. and some glauconitic sand. Very fossiliferous at south fork of Bear River. Thickness 750 ft. Assigned to upper Mio. Underlies Wild Cat series and overlies Rainbow series (post-Franciscan).

†Bear River formation.

Jurassic or Triassic: Northwestern British Columbia.

S. J. Schofield and G. Hanson, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, p. 8). *Bear River fm.*, Jurassic, B. C. [Hanson in 1929 (Canada Geol. Surv.

Mem. 159, p. 7, assigned *Bear River fm.* of B. C. to Jurassic or Triassic. Canada Geol. Surv. Summ. Rept. 1923, pt. A, p. 34, stated this name should be abandoned, and *Hazelton group* used instead.]

Bear River greenstones.

Age (?): British Columbia.

W. V. Smitheringale, 1928 (Econ. Geol., vol. 23, pp. 193, 194). *Bear River greenstones,* B. C.

Bear Run member (of Pottsville formation).

Pennsylvanian: Southern Ohio.

H. Morningstar, 1922 (Ohio Geol. Surv. Bull. 25, pp. 13, 25–28, 299–300). *Bear Run memb. of Pottsville fm.*—Sh., blue, locally fossiliferous, 2± ft. thick, underlain by Bear Run coal, 1½± ft. thick. Lies 17 ft. below Vandusen coal and 27 ft. above Quakertown or No. 2 coal. [Derivation of name not stated. *Bear Run coal* had been in use many years in Ohio, but this appears to be the first time that the coal and overlying blue sh. were combined into a memb. called *Bear Run memb.*]

Bears Brook formation.

Cambrian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 241).

Beartooth quartzite.

Cretaceous (Upper?): Southwestern New Mexico (Silver City region).

S. Paige, 1916 (U. S. G. S. Silver City folio, No. 199). *Beartooth qtzite.*—Qtzite with a little interbedded sh.; at base in many places is a thin cgl. containing black and white quartz pebbles an inch or more in diam. in matrix of clearly washed, fine, glassy quartz grains. Thickness 90 to 125 ft. Lies uncon. on rocks ranging from pre-Camb. to Penn. (Fierro ls.). Overlain, apparently conformably, by Colorado sh., from which it is easily distinguished, the separation being at top of uppermost qtzite bed. No fossils. Age in doubt. Tentatively classified as Upper (?) Cret. Named for Beartooth Creek, near Fort Bayard.

Beartooth Butte formation.

Lower Devonian: Northwestern Wyoming (Park County).

E. Dorf, 1934 (Jour. Geol., vol. 42, pp. 723–737). *Beartooth Butte fm.*—Thin-bedded red and buff impure shales, ls. cgl., and massive gray ls.; coarse basal cgl. Thickness 0 to 150 ft. Underlies Jefferson ls. with slight, uncon. and overlies Bighorn dol. with marked discon. Is a channel deposit. Occurs only on Beartooth Butte, in SW. corner of T. 58 N., R. 105 W., Park Co., Wyo., 3 mi. S. of Mont. line, just NW. of Beartooth Lake; and in Crandall quad. of Absaroka folio. Lower Dev. fauna and flora. [Gave a detailed section of the 4 unnamed members of which t is composed.]

Bearwallow conglomerate. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Bearwallow cgl.*—Coarse cgl. in most places, but in some places the pebbles are absent and the rock is coarse ss. Thickness about 60 ft. Underlies Dotson ss. and overlies Dismal fm. Named for Bearwallow Ridge, W. of Dry Fork, McDowell Co., W. Va.

According to H. Hinds, 1918 (Va. Geol. Surv. Bull. 18), the typical Dotson ss. is same as typical Bearwallow cgl.

Bearwallow facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 288, etc., 1931) to a lithologic development of his Edwardsville fm. in a part of southern Ind.

Beattie formation. (In Council Grove group.)

Permian: Northeastern Kansas and southeastern Nebraska.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1, p. 13). *Beattie fm.*—In section on West Branch Creek, NW. ¼ of sec. 10, T. 1 N., R. 10 E., 3½ mi. S. and 7 mi. W. of Pawnee City, Pawnee Co., Nebr., it consists of (descending): Morrill ls., 1 ft.; Florena sh., 8 ft.; and Cottonwood ls., 11½ ft. The Kans. Geol. Surv. is to group the Morrill, Florena, and Cottonwood as *Beattie fm.;* type loc., Beattie, Marshall Co., Kans. The Nebr. Surv. concurs.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 7), followed above classification, as did R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).

Beatty sand.

A subsurface sand, 25 ft. thick, in Bradys Bend well, about 85 mi. SW. of Bradford, Pa., which is considered approx. same as Tiona sand.

Beattyville shale. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

A. M. Miller, 1917 (Table of geological formations of Ky., p. 2), and 1919 (Dept. Geol. and Forestry Ky., ser. 5, Bull. 2, pp. 10, 147—tables only). *Beattyville substage* (also *Beattyville shales*).—Mainly shales; ss.; coal from 2 seams 3 to 4 ft. thick—Beaver Creek (Beattyville and Hudson). Bituminous ss. of Carter Co., and some of that of W. Ky. Is lower part of Lee fm., beneath Rockcastle ss. [Apparently named for Beattyville, Lee Co. In 1919 rept Miller gave thickness as 40 to 150 ft.]

Beauceville series.

Ordovician: Quebec.

B. R. MacKay, 1921 (Canada Geol. Surv. Mem. 127, pp. 12, 24).

Beauharnois formation.

Ordovician: Ontario and Quebec.

E. J. Chapman, 1863 (Can. Inst., n. s., vol. 8, pp. 186–190). [Assigned to Camb., but all later repts assign these rocks to Ord.]

Beaumont clay.

Pleistocene: Eastern Texas.

W. Kennedy, 1903 (U. S. G. S. Bull. 212, pls. 1, 2, pp. 20, 27). *Beaumont clays.*—Brown, blue, yellow, gray, and black clays, in places carrying nodules of ls. irregularly distributed through the clays; interstratified with gray, grayish white, brown and blue sands. Thickness 25 to 400 ft. Overlies Columbia sands [Lissie fm.] and underlies Recent coastal marsh deposits in eastern div. of Tex.-La. Gulf Coastal Plain.

A. Deussen, 1924 (U. S. G. S. P. P. 126), gave thickness of 300 to 900 ft.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 789). Beaumont clay is uncon. on Lissie fm.

Named for Beaumont, Jefferson Co.

Beauport sands and gravels.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 224).

Beauvais sandstone.

Middle Devonian: Eastern Missouri (Ste. Genevieve County).

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser., pp. 88, 174–175). *Beauvais ss.*—Name taken from unpublished ms. of S. Weller. Consists of very pure quartz sand of medium grain, well rounded. Chiefly very white and moderately friable, but at places becomes stained and indurated. Underlies St. Lorens [St. Laurent] ls. and overlies Grand Tower ls. Lithologically closely resembles St. Peter ss. Max. exposed thickness 50 ft.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 148–150). *Beauvais fm.*—[Same definition as above.] In some places the ss. becomes harder, finer grained, and somewhat qtzitic. Type exposures along Little Saline Creek, in Beauvais Twp, Ste. Genevieve Co. Occurs only within Little Saline faulted zone in Ste. Genevieve Co. The sand of fm. was clearly derived from St. Peter ss. No evidence of uncon. with overlying St. Laurent ls. but there may be uncon. btw. Beauvais and underlying Grand Tower ls. Fossils rare. Probably of early Hamilton age, but possibly of latest Onondaga age.

Beaver division.

Upper Cambrian or Lower Ordovician: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 259–306). *Beaver div.*—Lower 200 ft. chiefly sandy buff dolomites with some dark dol. in upper third, called *Cavern subdivision,* from caves and grottoes in it; lower 60 to 80 ft. nonfossiliferous, blue mag. dolomites, in beds 5 to 20 ft. thick, called *Bluff subdivision,* from exposures in bluffs. Basal div. of Leon series. Underlies Wyo div. and overlies Potsdam.

Named for Beaver Creek, Burnet Co.

†Beaver limestone.

Lower Cambrian: Eastern Tennessee.

A. Keith, 1895 (U. S. G. S. Knoxville folio No. 16, p. 3). *Beaver ls.*—Massive blue ls. about 300 ft. thick. Overlies Apison sh. and underlies Rome fm.

Foregoing is original definition of fm. in type region. The name, however, was incidentally referred to by C. W. Hayes in 1894 (Geol. Soc. Am. Bull., vol. 5, p. 467), in description of gray siliceous ls. underlying Rome fm. in vicinity of Rome, Ga., which was "provisionally correlated with the Beaver ls., which occupies a similar position in the stratigraphy of east Tennessee, and has been there determined as lower Cambrian." The name was also used in Ala. Later work, however, proved that the ls. of Beaver Ridge, N. of Knoxville, Tenn., for which the ls. beneath Rome fm. and above Apison sh. was named, is Rutledge ls. faulted over, and that so-called "Beaver ls." of Ga. and Ala. is Shady dol., which is older than the Apison. *Beaver* has therefore been discarded and a new name has not yet been adopted for the ls. btw. Rome fm. and Apison sh. of Tenn. (See L. LaForge, Ga. Geol. Surv. Bull. 35, 1919, pp. 43–45.) C. E. Resser (personal communication, May 1936) considers the Apison sh. as a part of Rome fm., and the so-called Beaver ls. of Knoxville folio as a ls. lentil in Rome fm.

Beaver gypsum.

Permian: Panhandle of Oklahoma.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 359, 363). *Beaver gyp.*, of Beaver Co., is well up in Kiger div. Seems to belong to lower horizon than One Horse gyp. or Old Crow gyp. Named for occurrence near Beaver City and in Beaver Co. and river basin of Beaver, Okla.

†Beaver sandstone. (In Pottsville group.)

Pennsylvanian: Eastern Kentucky (Magoffin County).

I. B. Browning and P. G. Russell, 1919 (Ky. Geol. Surv., 4th ser., vol. 5, pt. 2, btw. pp. 11 and 18). *"Beaver" ss.*—Massive, white, coarse-grained, cliff-forming ss., containing small white quartz pebbles. Thickness 160 ft. The lowest rock exposed in Magoffin Co. Probably = Nuttall ss. of W. Va. Is "Beaver" sand of oil drillers. Overlies Mine Fork coal and lies 60 to 90 ft. below Wheelersburg coal.

Beaver "sand."

A subsurface *ls.* in base of New Providence fm. (Miss.) of southern Ky. and in Highland Rim section of Tenn. Has also been called *Beaver Creek "sand."* *Beaver* has also been applied to a sand of Penn. age in eastern Ky. (See under †*Beaver ss.*)

Beaver granite.

Trade name of granite quarried at Beaver, Utah.

†Beaver group.

Pennsylvanian: Pennsylvania.

Same as *Beaver River fm.*

†Beaver Bay diabase.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 143–146). *Beaver Bay group.*—Characterized by predominance of black, coarse-grained, olivine-bearing gabbro in very heavy layers without amygdaloids, and by great abundance and prominence of included red felsitic porphyries and granite-like rocks, also considerable thickness of fine-grained ashbed diabases, with and without amygdaloids, and some ordinary fine-grained diabases with amygdaloids. Thickness 4,000 to 6,000 ft. Underlies Temperance River group and overlies Agate Bay group, all included in Keweenaw series. Exposed on Beaver Bay, Minn.

A. H. Elftman, 1898 (Am. Geol., vol. 21, pp. 90–109, 175–188, and map). *Beaver Bay diabase.*—Chiefly massive flows of coarse diabase. Includes part of Duluth, Lester River, Agate Bay, and Beaver Bay groups of Irving. Forms greater part of Irving's Beaver Bay group. Named because all essential characters appear in region of which Beaver Bay forms central point.

The U. S. Geol. Survey uses *diabase of Beaver Bay* in a geographic sense.

†Beaver Bay group.

See under *†Beaver Bay diabase.*

Beaver Bend limestone. (In Chester group.)

Mississippian: Southwestern Indiana and central northern Kentucky.

C. A. Malott, 1919 (Ind. Univ. Studies, vol. 6, No. 40, pp. 7–20). *Beaver Bend ls.*—Bedded ls., often having massive beds, and highly oolitic; conspicuously jointed. Thickness 0 to 14 ft. Is upper ledge of Mitchell ls. Underlies Brandy Run ss. and overlies Sample ss. Named for conspicuous bend in Beaver Creek just E. of Huron, Lawrence Co., Ind.

Later repts give thicknesses up to 118 ft.

Beaverburk limestone. (In Wichita group.)

Permian: Central northern Texas (Wichita, Baylor, and Archer Counties).

J. A. Udden and D. M. Phillips, 1912 (Univ. Tex. Bull. 246, pp. 31–36, 42–43). *Beaverburk ls.*—Ls., capping upland bluffs on N. side of Wichita River in SW. corner of Wichita Co. Mostly tough dark-gray rock, 0 to 3 ft. thick. Traced from basin of Beaver Creek NE. to Burk. Memb. of Wichita fm., 125 ft. above base. Separated from overlying Bluff bone bed by 65 ft. of sh. Lies 102 ft. below top of Wichita fm., and the Wichita rests on the Cisco. Fossils listed. Named for development in basin of Beaver Creek and exposures at and around Burk, Wichita Co.

W. E. Hubbard and W. C. Thompson, 1926 (A. A. P. G. Bull., vol. 10, No. 5). *Beaverburk ls.*, or, more properly, *dol.*, is important key horizon and can be traced SW. to S. line of Baylor Co.

A. S. Romer, 1928 (Univ. Tex. Bull. 2801, pp. 69–76). *Beaverburk (?) ls.* is top bed of Belle Plains fm. in Baylor and Archer Counties.

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913), placed *Beaverburk ls.* in interval btw. Bead Mtn ls. above and Elm Creek ls. below.

M. M. Garrett, A. M. Lloyd, and G. E. Laskey, 1930 (Tex. Bur. Econ. Geol. map of Baylor Co.), assigned *Beaverburk ls.* to top of Belle Plains fm., as did J. Hornberger, Jr., 1932 (Tex. Bur. Econ. Geol. map of Throckmorton Co.).

F. B. Plummer, 1932 (Tex. Bur. Econ. Geol. geol. map of Callahan Co.), assigned *Beaverburk ls.* to top of Belle Plains fm. and 20± ft. above Bead Mtn ls.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 173), included in top of Belle Plains fm. the Bluff bone bed of Udden and Beaverburk ls. of Udden, both of which he assigned to higher horizon than Bead Mtn ls. The Bead Mtn ls. is top memb. of Belle Plains fm. according to original definition and usage, and Clyde fm. overlies Belle Plains.

Beaver Creek coal group.

A term applied to a group of Eocene strata, of Fort Union (?) age, in SW. N. Dak., which includes coals N, O, and P. (See A. G. Leonard, 1908. N. Dak. Geol. Surv. 5th Bien. Rept.)

Beaver Creek "sand."

Mississippian: South-central Kentucky (Wayne, Pulaski, and Russell Counties).

D. C. MacLachlan, 1928 (Papers Mich. Acad. Sci., Arts, and Lett, vol. 8, pp. 298, 302). The massive, uneven-bedded, very hard, siliceous, pinkish gray ls. containing irregular masses of chert, and 5 to 10 ft. thick, occurring 40 to 45 ft. above base of New Providence sh. is so-called Beaver Creek "sand."

Beaver Creek chalky member (of Niobrara formation).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Beaver Creek chalky memb.*—Chalk marl and calc. siltstone, gray where fresh; weathers to light yellow. Marine fossils. Thickness 125 to 200 ft. Upper memb. of Niobrara fm. Overlies Sage Breaks sh. memb. of Niobrara. Named for exposures along Beaver Creek, in T. 46 N., R. 64 W., Weston Co., Wyo.

Beaverdell quartz monzonite.

Eocene (?): British Columbia.

L. Reinecke, 1915 (Canada Geol. Surv. Mem. 79, pp. 48, 51).

Beaver Falls moraine.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). "Not well defined. Extends S. from Beaver Falls 2 mi., and N. extension is indicated btw. 2 and 3 mi. N.-NW. of Beaver Falls."

Beaverfoot formation.

Upper Ordovician (Richmond): British Columbia and Alberta.

L. D. Burling, 1922 (Geol. Mag., vol. 59, pp. 453, 454).

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, p. 463), gave a rather complete definition of the fm., and it has also been described in several repts by other geologists. Its Upper Ord. (Richmond) age seems to be generally accepted.

Beaver Mountain group.

Tertiary or Mesozoic: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 7, 8, 117° to 118°). [Maps show following blocks: *Beaver Mtn sediments* (gray and brown shales and sss.) and *Beaver Mtn volcanics* (flows and pyroclastic deposits of augite andesite and basalt), both assigned to Tert.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 317, 352). *Beaver Mtn group.*—It is proposed that *Beaver Mtn volcanic group* be extended to all lavas and pyroclastics of the complex which are contemp. with those shown typically on and in vicinity of Beaver Mtn [B. C.?]. In this area 2 patches of waterlaid clastics contemp. with the volcanics are mapped. A small outcrop of them also occurs on railway near the water tank at Beaver [B. C.?]. These sediments may be called *Beaver Mtn sediments*. They consist of black to dark-gray and brown thin-bedded shales and gray and greenish thin-bedded to massive sss. A massive cgl. crops out just W. of Champion Station. Plants, but no diagnostic fossils. More than 1,000 ft. of the sediments are exposed in section running from Champion Station eastward into Beaver Mtn. There is some ground for referring the *Beaver Mtn sediments and volcanics* to Mesozoic [but they are tentatively classified as Tert.].

Beaver River formation. (In Pottsville group.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia(?).

J. P. Lesley and I. C. White, 1876 (2d Pa. Geol. Surv. map of Beaver Co.), used *Beaver River group* for rocks beneath "Clarion group," which probably correspond in whole or in part to Pottsville fm.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 65–71). *Beaver River group.*—Underlies fire clay beneath Brookville coal. Typical section is along Big Beaver River and Connoquenessing Creek in Beaver Co., Pa., the only place it is exposed in Beaver Co., and where it consists of (descending): Upper Homewood [Homewood] ss., 155 ft.; shales, 20 to 80 ft.; Connoquenessing (Lower Homewood) ss., 115 ft.; and Sharon shales, 7+ ft.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 65–66). For local use in western Pa. there is no objection to term *Beaver River group*, provided it be clearly understood that the term has the same systematic value as those of the Freeport, Kittanning, and Clarion groups, and that the group is the lowest part of the well-established Allegheny River series, being synonymous with the so-called Sharon coal series.

J. P. Lesley, 1879 (2d. Pa. Geol. Surv. Rept. V). *Beaver River cgl. series* includes Homewood ss. at top and Sharon Lower ss. at base.

H. M. Chance, 1879 (2d Pa. Geol. Surv. Rept. V, pp. 6–34 and map). *Beaver River or Congl. series (No. XII, Pottsville cgl.).*—Includes Homewood ss. (at top), Mercer group, Connoquenessing sss., Sharon group, and Sharon cgl.

H. M. Chance, 1881 (The Virginias, vol. 2, p. 153). The term "Beaver River series" was proposed as a substitute for the conglomerate measures by Prof. White and myself in 1876. I think the name *New River series* may now appropriately replace it.

I. C. White, 1908 (W. Va. Geol. Surv., vol. 2A, pp. 14–16). *Beaver group (Upper Pottsville)* of W. Va., includes (descending) Homewood ss. stage, Mercer stage, and Connoquenessing ss. stage. The underlying Sharon ss. (basal bed of Pottsville series in western Pa. and Ohio) is included in New River group and correlated with Nuttall ss.

J. J. Stevenson, 1908 (Am. Phil. Soc. Proc., vol. 51), excluded Sharon cgl. from *Beaver River fm.*

The W. Va. Geol. Surv. now applies *Kanawha fm.* to upper Pottsville deposits down to top of Nuttall ss. lentil, and does not use *Beaver* or *Beaver River*. The Pa. Geol. Surv. also seems to have abandoned these names. The 1923 classification of State Geologist Geo. H. Ashley uses Kanawha for the upper Pottsville rocks.

Beavertail limestone.

Devonian: Mackenzie.

E. M. Kindle, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 46).

Beavertown marl. (In Brassfield limestone.)

Silurian: Southwestern Ohio.

A. F. Foerste, 1885 (Denison Univ. Sci. Lab. Bull. 1, p. 65). *Beavertown marl.*—Fine clayey or marly bed, 9 inches thick; in some places becomes quite hard and in others is replaced by soft blue clay. For present included in [so-called] Clinton group [Brassfield ls.], at top.

A. F. Foerste, 1909 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, pp. 1–8). Dayton ls. includes at base fine-grained ls. 9 inches thick for which name *Beavertown marl* has been used.

A. F. Foerste, 1923 (Denison Univ. Sci. Lab. Jour., vol. 20, p. 40). In SW. Ohio the *Beavertown marl* is regarded as upper part of Brassfield ls. The name was not intended to designate the richly fossiliferous clay forming upper part of the Brassfield, but was used to designate a soft, very fine-grained deposit, an argill. ls., and not a marl in any sense of the term. The large crinoid beads it contains are of same type as those in upper part of Brassfield ls.

A. F. Foerste, 1935 (Denison Univ. Sci. Lab. Jour., vol. 30, p. 149). *Beavertown marl* was applied by Foerste in 1885 to indurated fine-grained argill. rock resting on top of typical Brassfield fm. at various localities in vicinity of Dayton, the more fossiliferous phases being located near Beavertown, SE. of city and

SE. of Soldiers Home, W. of city. [Lists fossils.] The occurrence of ***Aspidopora parmula*** in this marl and in underlying typical Brassfield suggests the Beavertown is essentially of same age as the Brassfield, differing chiefly in its depauperate fauna.

Beccaguimic formation.

Ordovician: New Brunswick.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 199). Exposed along Beccaguimic River.

Bechler conglomerate. (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 82). *Bechler cgl.*—Gray, reddish, and "salt and pepper" sss. with interbedded cgls. Pebbles of cgl. are small, few having diam. of more than 1 inch. Thickness 1,775 ft. Underlies Draney ls. and overlies Peterson ls.; all in Gannett group. Named for Bechler Creek, which enters Stump Creek from N. about ¼ mi. N. of mouth of Boulder Creek, T. 6 S., R. 45 E., Boise meridian, Bannock Co. May be Jurassic.

Becket granite gneiss.

Pre-Cambrian: Western Massachusetts, western Connecticut, and southwestern Vermont.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Becket gneiss*, a light-gray biotite gneiss, underlies Cheshire qtzite.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 18, 31–38, pl. 34). *Becket gneiss* (also *Becket white cgl. gneiss*).—Light gray biotite gneiss, at times a cgl. Thickness 2,000 (?) ft. Uncon. underlies Hoosac schist and uncon. overlies Washington gneiss. [Shown on p. 18 as underlying Cheshire qtzite.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 150–155), called the fm. *Becket granite gneiss*. "Named for fact it is quarried at Becket, Mass."

W. M. Agar, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 197+). *Becket quartz monzonite gneiss (intrusive)*.—B. K. Emerson chose the even-grained slightly gneissic rock of the quarry of Ball Mtn, N. of Norfolk, Conn., as one of type localities of Becket gneiss. Present study confirms existence of this rock as a separate type and Emerson's name is retained for it where present in Conn. But Becket as mapped in prel. geol. map of Conn. included much more. The Becket of Emerson intrudes Sharon Mtn quartz diorite, Barrack Mtn granite gneiss, and Grenville. [In 1934 (Am. Jour. Sci., 5th, vol. 27, p. 356) Agar adopted *Becket granite gneiss* as appropriate name of the fm.]

Becket moraine.

Pleistocene (Wisconsin stage): Western Massachusetts (Berkshire County). See F. B. Taylor, 1903 (Jour. Geol., vol. 11).

Beckett sand.

A subsurface sand, 10 to 20± ft. thick, in Milton field, Cabell Co., W. Va., that is believed to lie in top of Pocono fm. and to correspond to Keener sand. Named for E. W. Beckett well.

Beckwith formation.

Upper Jurassic and Cretaceous (?): Southwestern Wyoming.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Beckwith fm.*—Red, yellow, and reddish yellow shales and sss., at many places containing thick reddish cgl. beds. Thickness 3,800 to 5,500 ft. Underlies Bear River fm., and overlies Twin Creek ls. Extensively developed on leased State lands now forming part of Beckwith ranch, situated just E. of Beckwith Station, on Oregon Short Line.

This name has been used in Idaho, in some old repts, but its use there is now discontinued, the rocks having been divided into several fms.

Becraft limestone.

Lower Devonian: Eastern New York and Pennsylvania, western Maryland and Virginia, and northern West Virginia.

J. Hall, 1893 (N. Y. State Geol. 12th Ann. Rept., pp. 9–13). *Upper Pentamerus ls. or Scutella (Becraft) ls.* underlies Oriskany ss. and overlies Shaly ls. in Schoharie and Albany Counties. Top fm. of Lower Helderberg.

N. H. Darton, 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 393–505). *Becraft ls.*—Pure, semicrystalline, massive, very fossiliferous ls., 0 to 60 or more ft. thick. Formerly called *Scutella or upper Pentamerus beds.* Underlies Upper Shaly [Port Ewen] ls. and overlies Lower Shaly [New Scotland] beds. The geographic name, suggested by Dr. Hall, is from Becraft's Mtn, Columbia Co.

Was for many years considered top fm. of Helderberg group, but in eastern N. Y. two younger fms. (Port Ewen ls. (restricted) and Alsen ls.) are now included in the Helderberg. (See W. Goldring, 1931, N. Y. State Mus. Hdb. 10, pp. 370, 376–379.)

Becsie formation.

Silurian: Quebec (Anticosti Island).

C. Schuchert, 1924 (Textbook geol., 2d ed., vol. 2).

Becsie River formation.

Silurian: Quebec (Anticosti Island).

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 695, 705).

Bedford shale.

Devonian or Mississippian: Eastern Ohio, southwestern Pennsylvania, and northeastern Kentucky.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 21). *Bedford sh.*—Red and blue clay sh., 60 ft. thick, overlying Cleveland sh. and underlying Berea grit in northern Ohio. Included in Waverly group.

Named for Bedford, Cuyahoga Co., Ohio.

For many years this fm. was classified as Carbf. In 1912 (N. Y. Acad. Sci. Annals, vol. 22, p. 295) G. H. Girty placed it in Dev. The same year C. S. Prosser (also E. M. Kindle) assigned it to Dev., and repeated this classification in 1913, as did VerWiebe in 1917; but most geologists continue to classify it as Carbf. In 1914 the U. S. Geol. Survey adopted *Dev. or Carbf.* as age designation of Bedford sh., and still classifies it thus.

†Bedford limestone.

Mississippian: Indiana.

C. E. Siebenthal and T. C. Hopkins, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., p. 291). *Bedford oolitic ls.*—Has been called Warsaw ls., Indiana oolite stone, Spergen Hill ls., White River stone, and St. Louis ls. Underlies Mitchell ls. and overlies Harrodsburg ls. in Lawrence, Monroe, and Owen Counties.

Same as Spergen ls. The quarried rock is still known commercially as *Bedford ls.*

Named for Bedford, Lawrence Co., where it is extensively quarried.

Bedford formation.

Ordovician: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 200).

Bedford "augen" gneiss.

Age (?): Southeastern New York (Westchester County).

C. R. Fettke, 1914 (N. Y. Acad. Sci. Annals, vol. 23, p. 239). *Bedford "augen" gneiss.*—"Augen" gneiss associated with Manhattan schist SE. and S. of Bedford village [Westchester Co.]. The "augen" structure is developed in two types of rock, a mica schist and a hornblende schist, but entire area does not have the "augen" structure. It appears in bands usually parallel to the foliation. The bands grade into the ordinary schist by gradual disappearance of the "augen," which sometimes stops suddenly and at other times drops out gradually.

Bedford clay. (In Pottsville formation.)

A term applied to the clay, 4 ft. thick, underlying Bedford coal in eastern Ohio.

Bedias sandstone member.

Eocene (upper): Southeastern Texas (Grimes, Brazos, Burleson, Fayette, Lee, and Gonzales Counties).

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and pp. 26–28). *Bedias ss. memb.*—Basal memb. of Wellborn fm. of Jackson group, in Grimes, Brazos, Lee, Fayette, Burleson, and Gonzales Counties, in all of which it is exposed. [Exposures listed.] Consists of massive gray ss., locally qtzitic, containing marine beds near top at some localities. Thickness 0 to 30 ft. Conformably overlies Caddell fm., into which, at some localities, it interfingers at base. Fossils identified by Miss Gardner as upper Jackson. Named for town of Bedias, Grimes Co., in vicinity of which it is well exposed.

† Bedrock complex.

See under *basement complex.*

† Bedrock series.

A descriptive term used in folios and other early repts on Gold Belt region of northern Calif., to include the Jurassic, Triassic, and Carbf. fms., in contradistinction to "Superjacent series," which included the Cret., Tert., and Quat. deposits. The term has also been applied to the basement rocks of any region.

Bedson limestone.

Mississippian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 299–300). *Bedson ls.*—Thick-bedded gray ls., 1,085 ft. thick, exposed in backward folds on S. end of Bedson Ridge.

Bee rock.

A term that has been applied locally to Yellow Creek and Cawood ss. members of Hance fm. (of Pottsville group) of SE. Ky., "because of their tendency to weather out large cavities resembling a magnified honey comb." (G. H. Ashley and L. C. Glenn, U. S. G. S. P. P. 49, p. 38.) The term has also been applied to top ss. of the Pottsville of SW. Va., "because the laurel blossoms which cover it in early summer are the resort of immense numbers of bees." (J. J. Stevenson, Am. Phil. Soc. Proc., vol. 19, p. 96.) The top ss. of Lee fm. in Bigstone Gap coal field of SW. Va. has also been called "Bee rock" (M. R. Campbell, U. S. G. S. Bull. 111, p. 17), "probably because it weathers into a pitted surface in which bees probably found refuge at times." (M. R. Campbell, personal communication.)

Beebe limestone.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 402). *Beebe ls.*—This ls. (only 5 to 20 ft. thick) would in most other regions be called a memb. of the sl. fm. But here it is such an exceptional change from usual character of the sediments, and so fossiliferous, that it is most important fm. of entire Taconic sequence. Named for exposures near Beebe Pond, in Hubbardton, Vt. Is everywhere present at proper horizon so far as known. Underlies Hooker sl. and overlies Bull sl., all of Lower Camb. age.

Beebe limestone.

Upper Devonian: Central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). [See under *Triphammer sh. memb.*]

Beech granite.

Pre-Cambrian: Western North Carolina and eastern Tennessee.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 3). *Beech granite.*—Huge masses of coarse granite, usually porphyritic and seldom fine-grained. In the porphyritic varieties, constituting bulk of fm., the feldspars make greatest part of rock, giving it a dull whitish or light-gray color. Biotite is more prominent in massive portions, and causes a distinct spotted appearance. A third variety, of considerable extent, is a coarse red granite found near border of the area Cuts Cranberry granite and Blowing Rock gneiss. Youngest massive plutonic rock in region.

Named for Beech Mtn, Cranberry quad., Watauga Co., N. C.,

Beech Bottom sand.

An oil-bearing sand 1,350 to 1,385 ft. below Chattanooga sh. in Beech Bottom section of SE. part of Clinton Co., Ky. Referred by W. Nelson to Knox dol.

Beech Creek limestone. (In Chester group.)

Mississippian: Southwestern Indiana and central northern Kentucky.

C. A. Malott, 1919 (Ind. Univ. Studies, vol. 6, No. 40, pp. 7–20). *Beech Creek ls.*—Two or more massive to thin-bedded ledges with total thickness of 8 to 24 ft. Is gray, compact to suboolitic, and often crystalline ls., frequently completely oolitic. Is "middle" or "second" ls. of Chester series of Ind. Underlies Cypress ss. and overlies Elwren ss. and sh. Named for exposures along Beech Creek, Green Co., Ind. [Later repts give thicknesses up to 75 ft.]

W. N. Logan, 1926. See under *Beech Creek sh.*

Beech Creek shale. (In Chester group.)

Mississippian: Southwestern Indiana.

W. N. Logan, 1926 (Ind. Dept. Cons., Div. Geol. Pub. 55). *Beech Creek sh.*—Sh., 12 ft. thick, separating lower Beech Creek ls. (21 ft. thick) from upper Beech Creek ls. (10 ft. thick).

Beecher Island shale member (of Pierre shale).

Upper Cretaceous: Northwestern Kansas (Cheyenne County) and northeastern Colorado (Yuma County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7). *Beecher Island sh. member of Pierre sh.*—Chiefly light gray sh. with distinct greenish tint on many outcrops; thin streaks of white and brownish bentonite occur in lower part of the sh., where also ls. concretions (the largest 1 ft. thick) are common; irregular-shaped and comparatively small ls. bodies with *Lucina* constitute uppermost concretionary zone, above which occur 5 to 10 ft. more of sh. with rusty limonite streaks. Thickness of memb. 100± ft. Is top memb. of Pierre sh. in Yuma Co., Colo. Lies 500 to 600 ft. higher than Salt Grass sh. memb. of Pierre. Named for exposures at Beecher Island, Yuma Co., NE. Colo.

Beechhill formation.

Silurian: Nova Scotia.

F. H. McLearn, 1918 (Am. Jour. Sci., 4th, vol. 45, p. 128).

Beechhill Cove formation.

Silurian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 243).

Beech Mountain amphibolite.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). A para-amphibolite, included in Grenville series. Thickness 150 ft. Younger than Bear Pond schist. Named for occurrence on Beech Mtn, SE. of Graphite, Warren Co.

Beech River shaly limestone member (of Brownsport formation).

Silurian (Niagaran): Western Tennessee.

W. F. Pate and R. S. Bassler, 1908 (U. S. Nat. Mus. Proc., vol. 34, pp. 410–432). *Beech River fm.*—Almost exclusively fine shales; highly fossiliferous; gray, yellow, and bluish; weathering into white clay; some beds of ls. Thickness 74 to 106 ft. Divided into (descending): *Eucalyptocrinus* zone, *Troostocrinus* zone, and *Coccocrinus* zone. Basal fm. of Brownsport group. Underlies Bob fm. and overlies Dixon fm.

Now treated as basal memb. of Brownsport fm.

Named for Beech River, Decatur Co.

Beechwood limestone member (of Sellersburg limestone).

Middle Devonian: Central northern Kentucky and southern Indiana.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, pp. 118, 120). *Beechwood ls. memb.*—Coarse crinoidal ls., 2 to 8 ft. thick. The "Encrinal" ls. of early repts, also the Sellersburg ls. of Siebenthal, but is top memb. of Sellersburg ls. as originally defined (by Kindle) and as used in this rept. It overlies Silver Creek ls. memb. of the Sellersburg and underlies New Albany sh.

Named for Beechwood Station, Jefferson Co., Ky. Is exposed in stream a few rods N. of Shelbyville turnpike, ½ mi. S. of Beechwood, and it probably underlies Beechwood.

Beehive formation.

Pre-Cambrian: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 7, 117° to 117°30′). *Beehive fm.*—Banded qtzite with thin interbeds of metargillite. Underlies Lone Star fm. and overlies Ripple fm.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 156, 178, 194). *Beehive fm.*—Chiefly qtzites and metargillites; some phyllite, ls., and quartz schist. Thickness 7,000 ft. Underlies Lone Star fm., with apparent conformity, and rests conformably on Ripple fm., all of which belong to Summit series of Selkirk Mtns at 49th par. Typical occurrence of Beehive fm. on Beehive Mtn, N. of Lost Creek, B. C.

Beekmantown group (also limestone).

Lower Ordovician: New York, western Vermont, Pennsylvania, western Maryland and Virginia, and Tennessee.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Beekmantown ls. (new).*—The Calciferous sand rock of Eaton and authors generally. [C. A. Hartnagel (N. Y. State Mus. Hdb. 19, p. 33, 1912) stated that Calciferous sand rock of Eaton included the Little Falls dol.] At Beekmantown, N. Y., the normal fauna is finely developed and the rock section essentially complete. Underlies Chazy ls. and overlies Potsdam ss. and ls.

In 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 501–516) E. Brainerd and H. M. Seely divided the †Calciferous of Champlain Valley, Vt., into (descending): E, fine-grained mag. ls. in beds 2 ft. thick, weathering drab, yellowish, or brown, 450 to 500 ft.; D, blue ls., mag. ls., sandy ls., drab and brown mag. ls., some tough ss., some cgl., 375 ft.; C, alternating ss. and mag. ls. 350 ft.; B, masses of nearly pure reticulated ls. weathering white, intermingled with light-colored dol., 295 ft.; A, drab mag. ls., 310 ft. Overlain by Chazy ls. (div. A) and underlain by Potsdam ss. In 1891 (Am. Mus. Nat. Hist. Bull., vol. 3, pp. 1–3) Brainerd and Seely published the following subdivisions of div. D (descending): No. 4, 100 ft. of blue ls. in thin beds separated by very thin, tough, slaty layers, which protrude on weathered edges in undulating lines, the ls. often appearing to be a cgl., the small enclosed pebbles being somewhat angular and aren.; No. 3, 120 ft. of sandy ls. in thin beds, weathering on edges in horizontal ridges 1 or 2 inches apart, giving to escarpments a peculiar banded appearance, interstratified with a few thin beds of pure ls.; No. 2, 75 ft. of drab and brown mag. ls. containing toward middle several beds of tough ss.; No. 1, 80 ft. of blue ls. in beds 1 or 2 ft. thick, breaking with flinty fracture; considerable dolomitic matter often intermixed.

R. P. Whitfield, 1890 (Am. Mus. Nat. Hist. Bull., vol. 3, pp. 25-28), stated that Brainerd and Seely included "Fort Cassin layers" in div. D, 375 ft. thick, which contains *Ophileta* at base "and the Fort Cassin fauna in a very few ft. at the very top, the intervening layers being essentially unfossiliferous." In his opinion the line btw. div. C and div. D should have been made above the *Ophileta* bed; and "there is certainly a much greater affinity btw. Fort Cassin fossils and those of the rocks above them than with those of the Calciferous, and as latter name applies to beds having peculiar lithological characters, and containing a very limited fauna, it appears to me much more natural to associate the later fauna with that of the rocks above, and place the lss. there also, or else consider them as distinct from those below or above, and use a distinct name, as *Fort Cassin, or Philipsburg fm.*, or any other appropriate one."

In 1903 (N. Y. State Mus. Hdb. 19, p. 16 and chart) J. M. Clarke introduced *Little Falls dol.* for "the highly mag. sparsely fossiliferous phase of 'Calciferous sandrock' in Mohawk valley."

In 1905 (N. Y. State Mus. Bull. 77) H. P. Cushing mapped *Beekmantown fm. and Little Falls dol.* in Little Falls quad., and the same year (N. Y. State Mus. Bull. 95) he proposed *Cassin fm.* (from Fort Cassin, Vt.) for Brainerd and Seely's divisions E, D_4, and D_3 of the Beekmantown, and stated that these beds "are confined to Champlain Valley so far as the immediate region is concerned, and have therefore the same restricted distribution as the following Chazy;" also that he agreed with Whitfield that these beds have more natural affinity with Chazy than with Beekmantown, and that they should either be placed with that fm. or considered distinct from either and given a separate name. He also stated that at Beekmantown type section these rocks are not exposed; that to S. and around into Mohawk Valley they are absent; and that the question as to whether the rocks involved are to be classed with Chazy or Beekmantown, or with neither, is not at issue in the giving of the name; but he assigned his *Cassin ls.* to upper Beekmantown.

In 1906 (N. Y. State Mus. Bull. 90) R. Ruedemann included *Fort Cassin beds*, as he called them, in the Beekmantown, but stated (p. 525) that "all evidence goes to show that the *Philipsburg beds*, like the typical beds at Beekmantown, are older than Fort Cassin beds."

In 1907 (N. Y. State Mus. Bull. 114) C. A. Hartnagel stated *Beekmantown dol.* (*Little Falls dol.*) is not exposed in Rochester and Ontario Beach quads.

In 1908 (Geol. Soc. Am. Bull., vol. 19, p. 171) H. P. Cushing excluded div. A from Beekmantown, stating that it is uncon. with div. B and of Camb. age, and he named these beds in Jefferson Co. the *Theresa fm.*, and doubtfully correlated them with Little Falls dol. of Mohawk Valley.

In 1909 (Jour. Geol., vol. 17, p. 251) A. W. Grabau included div. A, also Little Falls dol. and Theresa fm., in the Beekmantown.

In 1910 (N. Y. State Mus. Bull. 138) R. Ruedemann included div. A in Beekmantown, but stated that "it will probably in time be separated from the rest of the Beekmantown by Dr. Ulrich, who considers it the eastern representative of a separate fm. having possibly even the value of a system fully developed in the Mississippi Basin," and that there is a strong uncon. btw. divisions A and B. He also included in Beekmantown the *Cassin fm.*, as he called it, "although its recognition as a distinct unit is urged by Prof. Cushing, apparently on good grounds. This *Cassin fm.* is to comprise upper part of D and all of E."

In 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 780-781) E. O. Ulrich and H. P. Cushing divided *Little Falls dol. of Mohawk Valley* [type region] into (descending): (1) *Tribes Hill ls.* (new name); heretofore described as "fucoidal beds" of Calciferous; contains Beekmantown fossils and represents lowest known div. of Beekmantown of N. Y.; fauna not yet recognized in Champlain Valley, and if present there the fm. is represented in upper part of div. B; (2) *Little Falls dol. restricted;* uncon. underlies Tribes Hill ls., and traced to Champlain Valley constitutes div. A and lower half of div. B of Beekmantown of Brainerd and Seely; is not Beekmantown but late Camb. (Saratogan or Ozarkian); rests on passage beds [Theresa dol.] to Potsdam ss. [This classification (which restricted Beekmantown to Brainerd and Seely's divisions E, D, C, and upper part of div. B, assigned Tribes Hill ls. to the Beekmantown, and excluded Little Falls dol.) was continued for many years. by geologists generally, although A. W. Grabau in 1916 (Geol. Soc. Am. Bull., vol. 27, p. 589) still considered the Little Falls dol. as lowest Beekmantown.]

In 1914 (N. Y. State Mus. Bull. 169, btw. pp. 66-99) R. Ruedemann stated *Fort Cassin beds* correspond to unknown parts of Brainerd and Seely's divisions D and E of the Beekmantown. In 1915 C. Schuchert (Textbook of geology, p. 629 and index) excluded *Fort Cassin fm.* from Beekmantown. Ulrich's later charts show *Fort Cassin zone*, as he called it, btw. div. D and div. E, and that it is properly a part of the Beekmantown.

E. J. Foyles, 1923 (Rept. Vt. State Geol. 1921-22, pp. 71-86) and 1924 (Rept. Vt. State Geol. 1923-24), reported that *Fort Cassin rocks* are not Beekmantown but belong to 2 fms., one of Chazy and the other of Trenton age; but A. Keith, C. Schuchert, and other geologists still consider the beds at Fort Cassin to be of Beekmantown age.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 263, 268), stated that *Beekmantown* submergence in N. Y. in general begins with Tribes Hill ls., which overlies Little Falls dol. nearly everywhere in Mohawk Valley, and includes Beekmantown E, D, C, and part of B.

In Jan. 1936 the U. S. Geol. Survey decided to adopt Ulrich's classification, which correlated, by faunas and lithology, Chepultepec dol. of Ala. and Tenn., Gasconade and Van Buren dolomites of Mo., and Oneota dol. of upper Miss. Valley with the 30± ft. of cherty beds forming top part of Little Falls dol. in Champlain Valley, N. Y., but locally absent in Mohawk Valley, the type region of Little Falls dol. This classification restricted *Little Falls dol.* to lower (major) part of the beds included in it since 1910, or to the typical Little Falls, which is said by Ulrich to be uncon.

with the overlying cherty beds. These upper cherty beds (for which no N. Y. name has been adopted) correspond to part of Beekmantown B of Brainerd and Seely, are older than Tribes Hill ls., and contain a fauna that is not Camb. and which, although differing slightly from that of the Tribes Hill, shows many relationships to the latter fauna. These beds are, therefore, restored to the Beekmantown, although they are said by Ulrich to be uncon. with overlying Beekmantown beds. The Chepultepec, Gasconade, Van Buren, Oneota and equiv. fms. are now classified by U. S. Geol. Survey as of *Lower Ord.* (*Beekmantown*) *age.*

See also under *Little Falls dol.*

The U. S. Geol. Survey treats the beds at Fort Cassin as of Beekmantown age, but has not adopted either *Cassin fm.* or *Fort Cassin fm.*

In central Pa. the *Beekmantown group* is divided into (descending) Bellefonte dol., Axemann ls., Nittany dol., and Stonehenge ls. In western Md. and Va. the rocks are not subdivided and are called *Beekmantown ls.*

Named for exposures at Beekmantown, Clinton Co., NE. corner of N. Y.

Beekmantownian.

Time term proposed by A. W. Grabau (Jour. Geol., vol. 17, pp. 209–252, 1909) "for the North American equivalent of Lower Ordovicic [exclusive of Chazy ls., which is included in Lower Ord. by most writers], while the term Canadian becomes obsolete." Underlies, uncon., Chazy ls. Includes Theresa fm. at base. "Accepted base of Ordovicic is top of Saratoga fm. of N. Y."

Bee Spring sandstone.

Pennsylvanian (Pottsville): Western central Kentucky.

C. J. Norwood, 1876 (Ky. Geol. Surv. vol. 1, n. ser., pt. 6, pp. 16, 42, 52–55). *Bee Spring ss.*, 15 to 45 ft. thick, in Upper Coal Measures of region adjacent to Louisville, Paducah & Southwestern R. R., Ky. Lies 20 ft. above coal K. Is=5th ss. of Lyon.

P. N. Moore, 1884 (Ky. Geol. Surv. Western coal field, btw. pp. 8 and 38). The 4th ss. above St. Louis ls. is here named *Bee Spring ss.*, from Bee Spring, Edmonson Co. It is 50 to 60 ft. thick. As underlying heavy cgl. thickens this ss. thins and disappears in about 2 mi. Is usually coarse and contains small pebbles; in some areas it is thin bedded and shaly. Included in Coal Measures. Overlies Nolin coal in Nolin River dist.

Beidell latite-andesite.

Miocene (?): Southwestern Colorado (south of Saguache River).

E. S. Larsen, 1935 (U. S. G. S. Bull. 843). Flows and tuffs. Lowest beds are rhyolites of no great thickness; they are overlain by several hundred ft. of hornblende andesites near quartz latites with some quartz latite and some pyroxene andesite. Over this are several hundred ft. of quartz latites near the andesites in composition, which in drainage of San Juan and Red Rock Creeks reach a thickness of nearly 1,000 ft. Probably accumulated about several centers. Largest body (rudely circular in outline and 7± mi. across) is just W. of San Luis Valley, about old mining camp of Beidell, in extreme N. part of Del Norte quad. and adjoining part of Saguache quad. The rock of this body is gray andesite porphyry. Underlies Tracy Creek andesite. Is of pre-Potosi age. Assigned to Mio. (?).

Bell limestone. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1930 (Nebr. Geol. Surv., 2d ser., Bull. 3, p. 48). *Bell ls.* (not the Cullom), underlies King Hill sh. and overlies Queen Hill sh. in Jones Point to Sand Point section. Is in 2 beds separated by sh. with fossils typical of the unit. Thickness 4 ft. 8 in. to 5 ft. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 176). Type loc. of *Bell ls.* is Bell farm, on Missouri River bluffs, mouth of Kenosha Creek, S. of Rock Bluff, Nebr.

Bejucal formation.

Eocene: Cuba.

E. L. De Golyer, 1918 (A. A. P. G. Bull., vol. 2, p. 142).

Belcher series.

Pre-Cambrian: Belcher Islands, Canada.

E. S. Moore, 1918 (Jour. Geol., vol. 26, p. 415).

Belcher sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 318–320). *Upper Belcher ss.*—Greenish-gray, massive, medium coarse ledge, 15 to 40 ft. thick, underlying Bratton sh. and overlying Upper Belcher sh. *Upper Belcher sh.*—Red sh., with lenticular streak of carbonaceous fire clay near middle and with marine fossils; thickness 15 to 30 ft. Rests on *Lower Belcher ss.*, which consists of greenish-gray massive or flaggy micaceous ss., 15 to 45 ft. thick, which rests on *Lower Belcher sh.*, a red sandy sh. 20 to 30 ft. thick, carrying marine fossils. All are members of Bluestone group [fm.] and all are exposed just N. of Belcher School, in Mercer Co.

Belcher shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926. [See under *Belcher ss.*]

Belchertown tonalite.

Late Carboniferous or post-Carboniferous: Central Massachusetts and northern Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 243–248, pl. 34). *Belchertown tonalite.*—A granitoid quartz-plagioclase-hornblende rock.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 208–217 and map). *Belchertown tonalite*, a stock of tonalite 8 mi. square and other small patches. Named for occurrence at Belchertown, Mass.

†Belemnites beds.

A paleontologic name introduced by O. C. Marsh and used in some early repts for the marine Sundance fm. (Upper Jurassic), according to J. B. Reeside, Jr.

Belfast bed.

Upper Ordovician (?): Southwestern Ohio (Highland and Adams Counties).

A. F. Foerste, 1896 (Cincinnati Soc. Nat. Hist. Jour., vol. 18, pp. 161, 189, 190). *Belfast bed.*—Unfossiliferous sandy and argill. ls., in places clayey sh., 3 to 6 ft. thick. Formerly called Medina, but not Medina. Underlain by Cincinnati fm. and overlain by Clinton or Montgomery fm. [Brassfield ls.]. Included in Lower Sil. [Ord.] of Ohio and SE. Ind. [Later repts state this bed is not present in Ind.]

For many years was regarded as top bed of Richmond group.

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, p. 184). The term *Belfast*, proposed for an aren. ls. in Highland and Adams Counties, Ohio, was dropped when it was learned that it could be traced laterally into ls. strata containing a typical Brassfield fauna. The Belfast is merely a local phase of the base of the Brassfield [early Sil.].

A. F. Foerste, 1935 (Denison Univ. Bull., Sci. Lab. Jour., vol. 30, p. 147). East of Cincinnati anticline base of typical Brassfield ls. is underlain by argill., bluish, usually massive ls., 3 to 6 ft. thick, which contains annelid teeth at Todd Fork (N. of Wilmington, O.), at Sharpsville (in NW. margin of Highland Co.), and at Belfast (in SE. corner of Highland Co.). Presence of *Halysites* in this ls. suggests Sil. age, though a distinguishable sp. is known also from Richmond beds in other areas. Writer in 1896 named this argill. ls. *Belfast bed or fm.*

Named for Belfast, Highland Co.

†Belfast beds.

Mississippian: Southeastern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 43, 47, and 214). The Spergen is represented in SE. Iowa by an attenuated, near-shore facies, to which name *Belfast beds* is given, because of excellent exposures of fm. near town of Belfast, Lee Co.

The name is preoccupied, and throughout rept cited the beds are called *Spergen fm.*

Belgium member.

Devonian: Southeastern Wisconsin (Ozaukee County).

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 260, 262, 263). *Belgium memb. novum.*—Basal memb. of Lake Church fm. Above the basal clastic zone this memb. consists of thin-bedded chocolate-brown dol., weathering readily and having a bituminous odor. Very fossiliferous. Greatest observed thickness 6 ft. Is present only to north. [Page 262 gives thickness as 8 ft.] Fauna and lithology are duplicated in basal Dev. at Spring Valley, Minn. Underlies Ozaukee memb. of Lake Church fm. and overlies Racine fm. (Sil.).

Probably named for town in Ozaukee Co.

Belknap limestone member (of Harpersville formation).

Pennsylvanian: Central northern Texas (Young County, Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 39). *Belknap ls. memb. of Harpersville fm.*—Lies 30 to 50 ft. below top of fm. Is traceable a long distance.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 161–166). *Belknap ls. lentil of Harpersville fm.*—Yellow to buff ls., nodular, 2 to 4 ft. thick, locally very fossiliferous. Lies 60 to 80 ft. above Crystal Falls ls. lentil of Harpersville fm. and 30 to 50 ft. below top of fm. Named for old Fort Belknap, Young Co.; typical exposures in vicinity of Newcastle, Young Co., where it lies above the workable coal bed.

Belknap syenite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series.* Type on Belknap and Gunstock Mtns.

Bell shale.

Middle Devonian: Michigan (northern part of Lower Peninsula).

A. W. Grabau, 1902 (Mich. Geol. Surv. Rept. 1901, pp. 191, 210). *Bell shales.*—Descending order: (1) Sh., 24 ft.; (2) hard white ls., 5 ft.; (3) mostly blue sh., 52 ft. Underlie Long Lake series and form basal div. of Traverse group in Alpena region. [On p. 210, in describing the rocks of Little Traverse Bay, Mich., he says that Bell sh., from its constant thickness, gives a very clear and sharply defined base for Traverse group wherever it occurs in this portion of Lower Peninsula, and shows it separated from the younger Petoskey ls. by 110 ft. of *Acervularia* and *Stropheodonta nacrea beds.*]

R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14, geol. ser. 11, btw. pp. 22 and 32). *Bell sh.*—Heavy blue or black sh. occurs everywhere at base of Traverse fm.

W. A. VerWiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 181). At time of writer's visit in 1925 the Bell sh. was to be seen at only one place in Alpena Co., and that in quarry of Great Lakes Stone and Lime Co., at Rockport. At N. side of quarry it shows 12 ft. of soft, blackish or blue, rather massive clay sh., underlying 40 ft. of Rockport ls. At E. end of quarry only a few ft. of sh. are exposed under the ls.

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14, p. 25), reporting from unpublished ms. of A. W. Grabau, showed *Long Lake beds* (top memb. of Presque Isle series) as separated from *Bell shales* (basal memb. of Presque Isle series) by Grand Lake ls. memb. of Presque Isle series.

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad Sci. Jour., vol. 25, No. 12, pp. 524–526), redefined *Long Lake stage* by including in its top the lower part of

Alpena ls. of VerWiebe (which they named *Killians ls.*) and by treating Rockport ls. as a distinct fm. underlying Long Lake stage and overlying Bell sh. (See 1935 entry under *Traverse fm.*)

Named for Bell, Presque Isle Co., NE. Mich.

Bell oil zone (also *Bell sand*).

An oil-bearing zone, about 370 ft. thick, in Santa Fe Springs field, Los Angeles Co., Calif. Is capped by Foix oil zone and in turn caps Meyer zone. Top lies at depth of 3,650 to 3,850 ft. Basal bed consists of 30 to 50 ft. of sticky brown sh.

Bella shale.

Upper Devonian: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. No. 19, pp. 7-21). *Bella shales.*—Green shales, 60 ft. thick, underlying Berenda ls. and overlying Silver shales. Named for Bella mine, near Lake Valley. No recognizable fossils. Assigned to Dev.

Appears to be upper part of Percha sh.

Bellabella formation.

Post-Pleistocene (?): British Columbia.

V. Dolmage, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 27).

Bellair sands.

Subsurface sands in Carbondale fm. (Penn.) and Chester group (Miss.) of Clark Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Bellaire sandstone. (*In Conemaugh formation.*)

Pennsylvanian: Eastern Ohio.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, pp. 20, 22). *Bellaire ss.*—Massive ss., 8 to 20 ft. thick, immediately underlying Pittsburgh ls. and overlying Summerfield ls. Included in Conemaugh fm. Correlated with Lower Pittsburgh ss.

Named for Bellaire, Belmont Co.

Belle City limestone.

Pennsylvanian: Central Oklahoma (Seminole County).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 123-125, pls. 3, 27, and map). *Belle City ls.*—Name used by Boone Jones in unpublished ms. prepared for Okla. Geol. Surv. in 1922. The name was published, but not defined, by Morgan in Okla. Geol. Surv. Circ. No. 12, pl. and p. 15, 1923. The fm. consists of two lss. and an intervening sh., all fossiliferous. Average thickness 30 ft. The upper ls. is white or light gray, often characterized by well-developed stylolites; is more massive than lower ls. and from 1 ft. (near Byng) to 15 ft. (near Canadian River) thick. The lower ls. is of buff color, 1 ft. (near Byng) to 5 ft. (near Canadian River) thick, and relatively thin bedded. The intervening sh. averages 12 ft. in thickness and is of green, blue, and black colors. Underlies Vamoosa fm. and overlies Francis fm. Greatest thickness and probably best exposure on S. bluff of Canadian River in sec. 15, T. 5 N., R. 6 E.

A. I. Levorsen, 1928 (Okla. Geol. Surv. Bull. 40BB). *Belle City ls.*, 0 to 30 ft. thick, underlies Vamoosa fm. and overlies Francis fm. in Seminole Co., central Okla.

R. C. Moore, 1929 (A. A. P. G. Bull., vol. 13, p. 888). *Belle City ls.* lies at horizon of Dewey ls. and may be more or less exactly equivalent.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454, 1458, 1459), reported that N. of Stonewall quad. 225 ft. of "unclassified nonconglomeratic shales and sss." separate Vamoosa fm. from Belle City ls.

Named for exposures around Belle City, Seminole Co.

Belledune group.

Silurian: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 38).

Bellefonte dolomite. (In Beekmantown group.)

Lower Ordovician: Central Pennsylvania (Center and Blair Counties).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 552, 553, 652–660, pl. 27). *Bellefonte dol.*—At Bellefonte, Center Co., it is 2,145 ft. thick. Upper 400 ft. consists of mostly argill., highly mag. ls., compact, often laminar, easily weathered, of light-gray color, and unfossiliferous. Lower 1,745 ft. consist of yellowish-gray or drab, generally fine-grained and occasionally laminated dol., alternating with fewer ledges of comparatively dark, finely crystalline dol., both generally in rather even layers and of medium thickness, with cherty beds 800 to 900 ft. below top. Is uncon. overlain by Upper Stones River ls. [Carlim ls.] and underlain by Axeman [n] ls.

The Bellefonte dol. is top fm. of Beekmantown group in central Pa.

Belle Fourche shale member (of Graneros shale).

Upper Cretaceous: Northeastern Wyoming.

A. J. Collier, 1920 (U.S.G.S. Press Bull. 9065). *Belle Fourche sh.*, Upper Cret., underlies Greenhorn ls. and overlies Mowry sh.

A. J. Collier, 1922 (U.S.G.S. Bull, 736, table opp. p. 76, p. 88, etc.). *Belle Fourche sh. memb.*—Top memb. of Graneros sh. Consists of dark-gray sh., which varies in hardness but is all softer than underlying Mowry sh. Thickness 560± ft. Contains calc. concretions near top and zone of Mowry-like sh. 100± ft. below top. Many ironstone concretions occur in lower part, and thick bed of bentonite near base. Few fossils. Named for exposure along Belle Fourche River in neighborhood of Wind Creek, Crook Co.

Belle Isle shale.

Cambrian: Newfoundland.

J. B. Jukes, 1839 (Rept. Geol. Newfoundland, p. 1). *Belle Island sh. and gritstone fm.*, Newfoundland.

J. B. Jukes, 1840 (Edinburgh New Phil. Jour., vol. 29, p. 104), and 1843 (Gen. rept. geol. Newfoundland, pp. 51+). *Belle Isle sh.*, Camb.(?), Newfoundland.

C. D. Walcott, 1889 (Am. Jour. Sci., 3d, vol. 37, p. 383), and 1890 (U. S. G. S. 10th Ann. Rept., p. 548). *Belle Isle.*—Shales and sss. of Great and Little Bell and Kelley's Islands, Conception Bay, Newfoundland, are Upper Camb.

Belle Plains formation. (In Wichita group.)

Permian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192–198 and charts). *Belle Plains fm.*—Middle fm. of Wichita group. Includes all strata btw. top of Elm Creek ls. below and top of next higher persistent escarpment-forming stratum, named by Drake *Bead Mtn bed*, which forms top of high escarpment W. of Baird. These beds form a strikingly characteristic unit. Underlie Clyde fm. and overlie Admiral fm. Thickness 300 ft. in Callahan Co. and 200 to 250 ft. in Coleman Co. Includes (descending) following beds described by Drake: Bead Mtn ls. [includes more than Drake's Bead Mtn ls.], Valera sh., Jagger Bend ls., and "bed No. 8" sh. Named for town of Belle Plains, Callahan Co. [which is in midst of the fm. as mapped].

In central northern Tex. the Beaverburk ls. and overlying Bluff bone bed of Udden are now included in Belle Plains fm. by Tex. Geol. Survey. See under *Beaverburk ls.*

Bellepoint member (of Columbus limestone).

Middle Devonian: Central Ohio.

C. K. Swartz, 1907 (Johns Hopkins Univ. Circ. No. 7, p. 62). *Bellepoint memb.*—Fossiliferous brown ls. with coral bed; 4 to 24 ft. thick. Basal memb. of Columbus fm. Overlain by Marblehead memb. of Columbus.

Named for Bellepoint, Delaware Co.

Bellepoint limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 365). *Middle Bellepoint ls.*—Yellow, shaly, calc. stratum, 0 to 3 ft.

thick, with marine fossils. Lies 0 to 7 ft. below Middle Bellepoint ss. and overlies Middle Bellepoint sh. All members of Hinton group [fm.]. Type loc. in vicinity of Bellepoint, Summers Co., and well exposed on Keeney Mtn road E. of Hinton.

Bellepoint sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297–298, 360–368), applied *Bellepoint* to 3 distinct sss., 3 distinct shales, and 1 ls. The sss. are defined as follows: *Upper Bellepoint ss.*—Reddish brown or greenish gray, medium coarse, sometimes massive but often shaly; 30 to 40 ft. thick; underlies Lower Goodwyn sh. and overlies Upper Bellepoint sh.; type loc. in bluffs of New and Greenbrier Rivers near Bellepoint, Summers Co.; also seen in Mercer Co. *Middle Bellepoint ss.*—Greenish gray or reddish brown, usually shaly, but often forms cliffs; 5 to 30 ft. thick; underlies Upper Bellepoint sh. and lies 0 to 7 ft. above Middle Bellepoint ls.; type loc. on lower slope of Keeney Mtn, 0.2 mi. N. of Bellepoint. *Lower Bellepoint ss.*—Greenish gray or reddish brown, usually shaly but often forms cliffs; 10 to 25 ft. thick; underlies Middle Bellepoint sh. and overlies Lower Bellepoint sh.; type loc. same as Middle Bellepoint ss. All members of Hinton group [fm.].

Bellepoint shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297–298, 362–371), applied *Bellepoint* to 3 distinct shales, 3 distinct sss., and 1 ls. The shales are defined as follows: *Upper Bellepoint sh.*—Red and variegated and argill., or green and sandy with occasional streaks of impure ls., and carrying marine fossils; 30 to 35 ft. thick; underlies Upper Bellepoint ss. and overlies Middle Bellepoint ss.; type loc. on lower slope of Keeney Mtn, 0.2 mi. N. of Bellepoint, Summers Co. *Middle Bellepoint sh.*—Often red and variegated but sometimes greenish gray and sandy; marine fossils, also plants; 25 to 40 ft. thick; underlies Middle Bellepoint ls. and overlies Lower Bellepoint ss.; type loc. same as Upper Bellepoint sh. *Lower Bellepoint sh.*—Red, argill., and variegated, or greenish gray and sandy; 30 to 40 ft. thick; plant and marine fossils; underlies Lower Bellepoint ss. and overlies Stony Gap ss.; type loc. in road which ascends Wolf Creek Mtn just SE. of Bellepoint; also observed in Giles and Tazewell Counties, Va. All are members of Hinton group [fm.].

Belleville formation.

Tertiary (late) or Pleistocene: Central northern Kansas (Cloud and Republic Counties).

M. E. Wing, 1930 (Kans. Geol. Surv. Bull 15, pp. 12, 19). *Belleville fm.*—Thick deposits of gravel, sand, and clay occurring in N. half of Republic Co. Primarily clay or sandy clay in upper half and sand or gravel in lower part. Most prominent feature is that it occupies a broad but well-defined channel, approx. 200 ft. deep, extending from near White Rock, Republic Co., to Chester, Nebr. Also extends beyond the old channel onto the uplands, where it is 40 to 80 ft. thick. North of Belleville the base of fm. rests on an almost flat surface of Carlile sh. Farther E. the deposit is slightly lower and in contact in places with "fence-post" ls., in upper part of Greenhorn ls. The stream in which the fm. was deposited flowed from W., and was comparable in size to Republican River. As far as can be determined only one fm. fills the channel, but this can not be determined with certainty. Is clearly Tert. and probably=part of Ogalalla fm. of western Kans. Few fossils.

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, p. 355). *"Belleville fm."* (Wing) of northern Republic Co., Kans., is extension of fluviatile Pleist. sand and gravel fms. of Nebr. It is continuous with Pleist. deposits in Nuckolls and Thayer Counties, Nebr. *Equus* and other Pleist. mammalian remains have been gotten from these deposits at same localities described by Wing. Name "Belleville fm." should be discarded.

Bellevue limestone member (of McMillan formation).

Upper Ordovician: Southwestern Ohio, central northern Kentucky, and southeastern Indiana.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, p. 82). *Bellevue or Monticulipora molesta beds.*—Lower 15 ft. rather shelly ls.; upper 5 ft. considerably different lithologically and somewhat faunally. Overlain by Corryville or *Chiloporella nicholsoni* beds and underlain by Fairmount or *Dekayia aspera* beds.

Basal memb. of McMillan fm., of Maysville group.

Named for old Bellevue House, a landmark, now disappeared, at bend in Clifton Ave., Cincinnati.

Bellingham conglomerate.

Carboniferous: Southeastern Massachusetts and northeastern Rhode Island.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol 49, geol. ser. vol. 8, No. 4, p. 99). *Bellingham cgl.* occupies only small area a few mi. NW. of Narragansett Basin.

C. H. Warren and S. Powers, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 448). *Bellingham series.*—Dark-green schists and sheared cgls. intensely metamorphosed. Supposed to be of same age as Narragansett series. [Probably refers to Bellingham cgl.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 56, and map). *Bellingham cgl.*—A coarse basal cgl. composed of pebbles of granite, qtzite, and green schist in a matrix of sericite schist. Is regarded as = Pondville cgl. Extends southward in a sinuous belt from near North Bellingham, Mass., past Woonsocket into Rhode Island. The rock has presumably been isolated by erosion from Narragansett Basin.

Bellingham beds.

Eocene: Northwestern Washington (Bellingham Bay region).

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 225–226). *Bellingham beds.*—Continental deposits at Bellingham and Bellingham Bay, containing flora that appears to be later than Cret. and earlier than known middle Eo. flora. The Chuckanutz flora appears to be later than the leaves from Bellingham, and it is possible that there are different beds exposed near Bellingham which represent different periods. It is quite possible that Bellingham flora may represent a lower Eo. age, which might possibly belong to same epoch as Martinez fm. of Calif.

Bell Island series.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Bell Island series.*—Middle part of Lower Ord. of Newfoundland. Discon. overlain by Wabana series and discon. underlain by Clarenville series. Divided into (descending): Dominion ore bed, unnamed ss. and sh., Redmond fm., unnamed grits and shales, Eastern Head fm., Beach fm., McGraw bed, Lance Cove, Little Bell Island, and Kelly Island fms. Correlated with Lower Arenig and overlying Armorican of western Europe. [Derivation of name not stated.]

Bell Mountain sandstone member (of Miguel formation).

Upper Cretaceous: Southwestern New Mexico (Alamosa Creek Valley, Socorro County).

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A). *Bell Mtn ss. memb.*—Top memb. of Miguel fm. Consists of thick-bedded, yellow to gray, coarse ss., containing *Halymenites* at top and *Inoceramus* at base. Thickness 79 ft. Well exposed near foot of Bell Mtn, T. 3 N., R. 9 W., Socorro Co. Lies about 983 ft. above Gallego ss. memb.

Bellows Falls granite gneiss.

Post-Ordovician: Southeastern Vermont (Windham County) and southwestern New Hampshire (Walpole).

E. Hitchcock, 1823 (Am. Jour. Sci., 1st, vol. 6, pp. 11–12 and map dated 1822), in description of Conn. River area from New Haven, Conn., to Bellows Falls, Vt., introduced *Bellows Falls granite* for a "sienitic granite."

C. H. Richardson and E. J. Foyles, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned *Bellows Falls granite gneiss* to Camb., but without description or discussion.

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., p. 229). *Bellows Falls gneiss.*—Underlies village of Bellows Falls, Vt., extends S. into Westminster, and E. across Conn. River into Walpole, N. H. Is also found in extreme SE. corner of Charlestown, N. H. Varies from medium to coarse, and in places becomes porphyritic. Color varies from light or medium gray to very dark gray. Is an acid intrusive. Age is definitely post-Ord., for the gneiss cuts Brattleboro phyllite, which is Ord.

Bellowspipe limestone.

Ordovician: Northwestern Massachusetts.

T. N. Dale, 1891 (Am. Geol., vol. 8, pp. 1–7). *Bellows Pipe ls.*—More or less crystalline ls., generally micaceous or pyritiferous, passing into calc. mica schist, feldspathic qtzite, or fine-grained gneiss. Thickness 600 to 700 ft. Underlies Greylock schists and overlies Berkshire schists on Mount Greylock. Named for occurrence at the "Bellows Pipe," in notch btw. Ragged Mtn and Greylock.

†Bellowspipe formation.

Ordovician: Northwestern Massachusetts.

T. N. Dale, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pp. 559, 562). On Mount Greylock the Berkshire schist, 1,000 ft. or more thick, is overlain by a mass, 600 ft. thick, of more or less impure ls., qtzite, calc. sericite schist and muscovite-biotite schist, constituting *Bellowspipe fm.* [As thus defined includes Greylock schist (muscovite (sericite), chlorite, and quartz schist) and Bellowspipe ls.]

†Bellowspipe quartzite.

Ordovician: Southwestern Massachusetts.

T. N. Dale, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, p. 559, pl. 71). [The geol. map (pl. 71) of Monument Mtn, in SW. part of Berkshire Co., applies name *Bellows Pipe qtzite* to the rocks overlying the Berkshire schist. Page 559 states that the qtzite shown on the map is a vitreous qtzite, petrographically identical with that which underlies Stockbridge ls., as well as that which overlies it in places, and also with that which occurs on Mount Greylock [in NW. part of Berkshire Co.] in the Bellowspipe fm., above the Berkshire schist; also that it is 500 to 600 ft. thick.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the qtzite of Monument Mtn as Cheshire qtzite, of Lower Camb. age. The qtzite in the Bellowspipe ls. of Mount Greylock is a much younger bed, of Ord. age.

Bells Landing marl member (of Tuscahoma sand).

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1883 (Ala. Geol. Surv. Prog. Rept. for 1881–82, pp. 256, 321). *Bell's Landing marl.*—Greensand shell marl with indurated bed in its midst or at top; thickness 10–15 feet. Separated from younger Wood's Bluff marl by 50–80 ft. of lignitic clays and sands. Included in Lagrange or Lignitic.

E. A. Smith, 1886 (Ala. Geol. Surv. Bull. 1, p. 12). *Bell's Landing marl.*—Fossiliferous marine marl, 10 ft. thick, distinguished from all marls in Ala. by great size of shells it contains. Overlain by 40 ft. of sandy strata, forming top of Bell's Landing section, and separated from the older Gregg's Landing marl by 20–25 ft. of dark-gray sandy clays.

Is a memb. in upper part of Tuscahoma sand.

Named for exposures at Bells Landing, on Alabama River, in Monroe Co.

†Bells Landing series.

Eocene (lower): Southwestern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 46–51). *Bell's Landing series.*—Consists of (descending): (1) 40 ft. of reddish sands and laminated gray, sandy clays; (2) Bell's Landing marl bed proper (fossiliferous marl, 10 ft. thick, containing some greensand); (3) gray sandy clays, 20–25 ft.; (4) Gregg's Landing marl, 4–5 ft.; and (5) 60 ft. of sandy clays of prevailingly gray color, with 1-foot marl bed about 10 ft. above base. Underlies Wood's Bluff or Bashi series and uncon. overlies Nanafalia series.

Replaced by Tuscahoma sand, better established name. Has also been called "Bells Landing fm."

Named for exposures at Bells Landing, on Alabama River, in Monroe Co.

Bellton coal group. (In Greene and Washington formations.)

Permian: Southwestern Pennsylvania and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 32, 34). *Bellton coal group.*—Shales, sss., coals, and 2 important lss., 200 to 300 ft. thick. Top lies 275 to 300 [?] ft. below Nineveh ss. Includes Nineveh coal at top and Jollytown coal at base. Included in Dunkard Creek series [Dunkard group]. Named for Bellton, Marshall Co., W. Va., where all of the beds are present.

Has also been called "Bellton stage."

Bellvale flags.

Bellvale sandstone.

Devonian (Middle): Northern New Jersey and southeastern New York (Orange County).

N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 367, 373). *Bellvale flags.*—Hard thin-bedded sss. merging into dark-colored below. Chiefly dark gray. Bellvale Mtn [Orange Co., N. Y.] consists largely of these flags. Overlain by Skunnemunk cgl. and underlain by Monroe [Cornwall] shales. Thickness 1,300 to 2,000 ft.

H. Ries, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1). The *Bellvale flags* extend from N. J. State line to N. end of Skunnemunk Mtn, where they terminate somewhat abruptly. Assigned to Hamilton epoch.

E. C. Eckel, 1902 (N. Y. State Geol. 20th Ann. Rept., pp. r144 to r150). The *Bellvale flags* contain Middle Dev. plants.

H. B. Kümmel and S. Weller, 1902 (N. J. Geol. Surv. Ann. Rept. State Geol. 1901). The lower beds of *Bellvale flags* contain Hamilton fossils [listed].

C. A. Hartnagel, 1912 (N. Y. Geol. Surv. Hdb. 19, p. 69). The plant remains from *Bellvale flags* indicate Middle Dev. age, and it seems probable the higher beds are as late as Portage.

J. V. Lewis and H. B. Kümmel, 1915 (N. J. Geol. Surv. Bull. 14, p. 56, and geol. map of N. J.). *Bellvale ss.*—Gray ss. and sandy sh. A few Hamilton fossils.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 396). *Bellvale sh.* contains Mid. Dev. plants.

Bellyan series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). Sss., 2,000 ft. thick, lying uncon. below Pierrian series and uncon. above Coloradan series in Alberta. Of Mid Cretacic age. Includes Allison fm. [only fm. mentioned].

Derivation of name not stated.

Belly River formation.

Upper Cretaceous (of Montana age): Alberta and Saskatchewan, Canada.

G. M. Dawson, 1883 (Canada Geol. Surv. Rept. 1880–82, p. 4B) and 1885 (Canada Geol. Surv. Rept. 1882–3–4, pp. 37C–126C). *Belly River series, Cretaceous, Canada.*

R. G. McConnell, 1886 (Canada Geol. Surv., n. s., vol. 1, pp. 63C–65C). *Belly River series, Cretaceous, Canada.*

The Belly River fm. of Canada has been considered to be=Two Medicine fm. and Virgelle ss. of Blackfoot Indian Res., northern Mont., and Judith River fm., Claggett fm., and Eagle ss. of central Montana.

W. S. Yarwood, 1931 (A. A. P. G. Bull., vol. 15, No. 10, pp. 1269–70). *Belly River group* as here used includes (descending) Pale, Foremost, Pakowki, and Milk River fms. Belly River as used by Canadian Geol. Survey is restricted to Pale beds and Foremost fm. and is=Judith River of Mont.

M. Y. Williams, 1932 (Jour. Geol., vol. 40, No. 6, p. 561). *Belly River* of Alberta and Saskatchewan is=Judith River fm. of Mont.

Belmont porphyry.

Tertiary (late?): Central western Montana (Marysville district).

J. Barrell, 1907 (U. S. G. S. P. P. 57). *Belmont diorite porphyry dikes and sheets.*—Later than Marysville batholith. [Mapped on and around Mount Belmont, 1 mi. W. of Marysville. The Marysville batholith is probably late Cret. or Tert., and may be as young as Mio. Personal communication of J. T. Pardee.]

Belmont amygdaloidal basalt and tuff.

Pre-Cambrian: Southeastern Ontario (Belmont Lake area).

W. G. Miller and C. W. Knight, 1914 (Ontario Bur. Mines Rept., vol. 22, pt. 2, p. 19). Younger than Belmont gabbro diabase.

Belmont gabbro diabase.

See under *Belmont amygdaloidal basalt and tuff.*

Belmont facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 143, etc., 1931) to a lithologic development of his Locust Point fm. in a part of southern Ind.

Belmont limestone.

Pleistocene: Bermuda.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 740).

Beloit dolomite.

Middle Ordovician: Eastern Wisconsin and northeastern Illinois (in wells).

F. W. Sardeson, 1896 (Am. Geol., vol. 18, pp. 356–368). *Beloit fm.*—Name proposed for the beds beneath Galena ls., which in previous repts have been called *Trenton ls.* but which are now considered to probably be older than Trenton ls. of N. Y., the Galena probably being=N. Y. Trenton. The Beloit includes beds which in previous repts have been called *Blue ls.* and *Buff ls.*

The Beloit dol. overlies St. Peter ss., and includes equivalents of Decorah sh. (of Trenton age) and Platteville ls. (of Black River age).

Named for exposures at Beloit, Wis.

Belt series.

A provincial series of pre-Camb. metamorphosed sed. rocks widely developed in Mont., Idaho, eastern Washington, and British Columbia. In early repts called "Belt fm.," "Belt terrane," "Belt beds," and "Belt group." For definition see U. S. G. S. Bull. 769, pp. 108–112.

Beltian system.

A term introduced by R. A. Daly in 1913 (12th Int. Geol. Cong. Guidebook 8, p. 132) for rocks in B. C. that correspond to Belt series of Mont. and Idaho.

Belva shale.

Pennsylvanian: Western Arkansas coal field.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Belva sh.*—Sh., 0 to 500 ft. thick, overlying Ozark ss. and underlying Hartwell ss.; all included in Sebastian stage. [Is a part of Fort Smith fm.]

Probably named for Belva, Scott Co.

Belveal sand.

A subsurface sand, of Penn. age and 25± ft. thick, in central northern Okla., probably correlating with part of Sand Creek fm. In Garber pool, Garfield Co., it lies at 1,600 ft. depth, the Walker sand lying at 1,500 ft. and the Campbell at 1,700 ft.

†Belvidere shale.

Lower Cretaceous (Comanche series): Central southern Kansas.

R. T. Hill, 1895 (Am. Jour. Sci., 3d, vol. 50, pp. 208–234). [On pp. 208 to 210 *Belvidere sh.* is defined as consisting of blue sh., with indurated fossil layers, 106 ft. thick, overlying Cheyenne ss. and underlying "Dakota" ss., both including and excluding oyster bed (Champion shell bed) at base. On p. 211 *Belvidere* is defined as including *Belvidere shales* ("for which Cragin has proposed *Kiowa* since this paper was written") and Cheyenne ss., or all beds btw. "Dakota" ss. [the quotation marks are Hill's] above and Red Beds below.] Contains Comanche fossils. Named for Belvidere, Kiowa Co.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 357–385). *Belvidere beds* (or *Walker beds*) is proposed to include Kiowa sh. (=Belvidere sh. of Hill), Champion shell bed, and underlying Cheyenne ss., *Walker* being suggested in case objection is made to use of *Belvidere* to include more than Belvidere shales of Hill, but *Belvidere* is preferable name for this larger unit.

C. S. Prosser, 1897 (Univ. Geol. Surv. Kans., vol. 2, pp. 111+), divided the Comanche of southern Kans. into Kiowa sh. (including *Champion sh. bed*) and Cheyenne ss., and suggested that, if a name is needed for the 2 fms. combined, some other name than *Belvidere* be adopted.

Subsequent repts simply used *Kiowa* and *Cheyenne* for the subdivisions of the Comanche in southern Kans., and *Belvidere* and *Walker* dropped out of the literature until 1924. The *Mentor fm.* of central Kans. was assigned to a higher position in the Comanche than the Kiowa, and the 3 names were used for many years for the subdivisions of the Comanche in Kans.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9). *Belvidere fm.* as here defined includes (descending): Greenleaf ss. memb., 25 to 50 ft.; Spring Creek sh. memb., 25 to 50 ft.; and Kiowa sh. memb., the latter including "Champion shell bed" at base. Overlies, apparently conformably, Cheyenne ss., but R. C. Moore says there is evidence, at least locally, of uncon. Underlies Kirby clay memb. of "Dakota" fm., apparently conformably. [Twenhofel divided Belvidere fm. of McPherson Co. into 4 members, listed in 1924 entry under *Mentor fm.*]

F. M. Bullard, 1928 (Okla. Geol. Surv. Bull. 47, p. 49). It seems unadvisable to retain Hill's term *Belvidere* and place the various beds as members of this fm. They certainly do not contain enough characteristics to justify placing them in a single fm. The term *Belvidere* is therefore discarded and the members (Greenleaf ss., Spring Creek clay, and Kiowa sh.) are described as fms.

Belvidere Mountain amphibolite.

Paleozoic: Northwestern Vermont (Jay Peak quadrangle).

S. B. Keith and G. W. Bain, 1932 (Econ. Geol., vol. 27, No. 2, pp. 173–174). *Belvidere Mtn amphibolite.* Paleozoic, extends from Belvidere Mtn [SE. corner of Jay Peak quad.] as far N. as Hazen's Notch road. Is a typical metamorphosed diabase or pyroxene diorite.

Bemis moraine.

Pleistocene (Wisconsin stage): South Dakota, southern Minnesota, and northern Iowa.

F. Leverett, 1922 (Geol. Soc. Am. Bull., vol. 33, pp. 102–103 and map). Name introduced for outermost moraine of Wisconsin drift in S. Dak., southern Minn., and northern Iowa, which was previously mapped as part of Altamont moraine, but which is now known to be older than the moraine at Altamont, S. Dak., the type loc. of Altamont moraine. Named for occurrence at Bemis, Deuel Co., S. Dak.

Is of late Wisconsin age, according to W. C. Alden.

Bend group (Pennsylvanian).

†Bend series (Pennsylvanian and Mississippian).

Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxv). *Bend series.*—Lss. and shales forming basal Carbf. deposits in central Tex. [Llano, Burnet, and Mason Counties]. Probably includes Subcarbf. and coal measures. Contains one or more coal beds. In places seems to show uncon. with overlying Richland ss. (undoubted Carbf.). Well exposed at McAnnelly's Bend [of Colorado River], San Saba Co., for which it is named.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept.). *Bend div.* is present in only central area of northern Tex. Consists of 140 ft. of shales underlain by 220 ft. of lss. Is basal div. of Coal Measures [Penn.].

G. H. Girty, 1912 (U. S. G. S. Llano-Burnet folio, No. 183, p. 8). Typical *Bend series of Tex. Surv.* is divisible into 3 portions—an upper and lower sh. separated by a series of lss. The lower div. [Barnett sh.] I am referring to Miss. According to canons at present used for determining the Penn. by paleontologic evidence the middle [called Marble Falls ls. in folio] and upper [called Smithwick sh. in folio] divisions would be called Penn. I feel no hesitation in recognizing Marble Falls ls. as middle div. of typical Bend of Tex. Surv., and although I did not see or collect fossils from the sh. at Marble Falls, it seems a fairly safe inference that this [Smithwick sh.] is upper div. It seems somewhat doubtful whether the lowest div. is represented in Burnet and Llano quads.

C. Schuchert, 1915 (Textbook geol., pt. 2, p. 732), included *Bend* in Penn., without specifying subdivisions.

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 41–43), divided *Bend series* into (descending) Smithwick sh., Marble Falls ls., and Lower Bend sh., and stated: The age of the Bend may be Upper Miss. (St. Louis–Chester stage), as thought by J. P. Smith, but it will here be described under Penn. heading. It is uncon. overlain by Strawn fm. *Lower Bend sh.* is 0 to 50 ft. thick, and contains some layers of dark ls. [The 1919 ed. of this bull. stated: "The age of the Bend is probably early Penn."]

L. S. Kempher, 1918 (Remarks on geol. of north-central Tex. oil and gas region), assigned *Bend fm.*, as he called it, to Miss., and divided it into (descending): (1) Smithwick sh. (fauna possibly extremely early Penn., but more probably extremely late Miss.); (2) Marble Falls ls. (fauna not more recent than St. Louis–Chester and not older than Kinderhook); (3) *Bend fm.* (200 to 300 ft. of black sh., black lss. and sss., carrying fauna not more recent than early or middle Miss. and not older than extremely late Dev.).

J. A. Udden, 1919 (A. A. P. G. Bull., vol. 3, pp. 34–38), divided *Bend series*, as he called it, into (descending): Smithwick sh. (few ft. to 700± ft.); Marble Falls ls. (200 to 400± ft.); and Lower Bend sh. (few ft. to 150 ft.); age uncertain—whether all Penn., or all Miss., or part Penn. and part Miss. F. B. Plummer (pp. 132–145 of same bull.) assigned *Bend fm. or Bend series*, as he called it, to lower Penn., and included in it Smithwick sh., Marble Falls ls., and Lower Bend sh. W. G. Matteson (pp. 169–211 of same bull.) assigned *Bend series* (including the same 3 fms.) to Miss. R. C. Moore (on pp. 217+ of same bull.) assigned *Bend series* to early Penn., and stated that all fossils of basal black sh. are common to overlying beds in *lower part* of Marble Falls ls. G. H. Girty (pp. 71 to 81, 418–420 of same bull.) expressed opinion *basal Bend sh.* is Miss. and Marble Falls ls. and Smithwick sh. are Penn. Also that a thin ls. of Miss. age had been included in base of Marble Falls ls. of some authors; that lower part of this Miss. ls. is absent at Marble Falls, but that upper part of it may or may not be represented at Marble Falls. He included this thin Miss. ls. in his basal Bend sh. He also stated that important uncon. and faunal change exists btw. Marble Falls ls. and underlying sh. of Miss. age. M. I. Goldman, 1921 (U. S. G. S. P. P. 129A), assigned *true Marble Falls ls.* to Penn. and called the 20 to 50 ft. of black Miss. ls. "*Lower Bend*" *ls.* and underlying black sh. "*Lower Bend*" *sh.*, and reported an uncon. at base of Marble Falls ls. and at base of "Lower Bend ls." The *Bend series* being thus subdivided into Penn. and Miss. fms. the name was in 1920 discarded by U. S. Geol. Survey.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25–26), replaced "Lower Bend sh." with *Barnett sh.*, which they tentatively referred to Miss. In Univ. Tex. Bull. 2132, 1922, they continued to use *Bend group* (as it is "one of most widely known geological units of the SW."), classified it as Penn., and included in it Barnett sh. They also stated that Barnett sh. included at top a thin ls. that contains fossils of "Miss. aspect," and that the Barnett appears to writers to belong to Penn. but that it may prove to be upper Miss.

C. Schuchert, 1924 (Textbook geol., pt. 2, pp. 353, 357, 358, 368), stated: *Bendian series* includes Smithwick shales, 0 to 1,000 ft.; Marble Falls ls., 200 to 700 ft.; and Lower shales. Assigned to Penn., although considered older than usual type of Penn. fms.

W. E. Hubbard and W. C. Thompson, 1926 (A. A. P. G. Bull., vol. 10, No. 5, pp. 461–462), *restricted Bend group* to Penn. (Smithwick sh. and Marble Falls ls.) and assigned Barnett sh. to Miss., as did M. G. Cheney, 1929 (Univ. Tex. Bull. 2913). R. C. Moore, 1929 (A. A. P. G. Bull., vol. 13, p. 894), however, continued to include Barnett in *Bend.* But J. P. Bowen and J. F. Gibbs, 1932 (A. A. P. G. Bull., vol. 16, No. 2, p. 181), restricted *Bend group* to Penn.

R. C. Moore, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 279), divided the Penn. "system" of Mid-Continent field into 4 "series," to which he applied following names (descending): Virgil, Pottawatomie, Des Moines, and Bend. He defined latter as follows: "The *Bend series*, at base of the system, consists predominantly of marine beds containing a distinctive fauna that shows strong relationship with uppermost Miss. faunas. A distinct and widespread uncon. marks top of the series."

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 99–100), included in *Bend group* only Smithwick sh. and Marble Falls ls., and assigned both to Penn.

C. Schuchert and C. O. Dunbar, 1933 (Textbook geol., pt. 2, p. 248), included in *Bend* the Smithwick sh., Marble Falls ls., and Barnett sh., and assigned its upper part to Pottsville time and its lower part to a period of pre-Pottsville *Penn.* time "not represented by deposits in Appalachian region, Kans., Nebr., or Ill., but corresponding to lower part of Namurian of Europe."

R. H. Dott, 1934 (A. A. P. G. Bull., vol. 18, No. 5, p. 579), used *Bendian* as a time term for Penn. rocks underlying *Pottsville* of "standard" classification; but this constitutes a restriction of Pottsville, which, according to established classification, includes the oldest Penn. sediments in America. The Marble Falls ls. was in 1924 pronounced by G. H. Girty to be of Pottsville age.

B. H. Harlton, 1934 (A. A. P. G. Bull., vol. 18, No. 8, pp. 1018–1049), used *Bendian period* as a time term separating Penn. (restricted) "period" from Miss. "period," and showed unconformities at top and base of the rocks assigned to his Bendian period. He divided his Bendian period into paleontologic subdivisions called *Upper Bendian, Middle Bendian,* and *Lower Bendian,* and assigned to it various named fms. of western Tex., central Tex. (the typical Bend region), Arbuckle Mtn and Ouachita Mtn regions of Okla., and also NE. Okla and NE. Ark. In Bend region he assigned to his Bendian period the Smithwick sh., Marble Falls ls., and what appears to be upper part of Barnett sh., which he showed (p. 1020) as separated from Marble Falls ls. by a great hiatus, and as separated from what appears to be Barnett sh. restricted by another hiatus.

The U. S. Geol. Survey in 1935 adopted *Bend group* as defined by Tex. Geol. Survey in 1933, i. e., to include the two fms. of Penn. age (Smithwick sh. above and Marble Falls ls. below) that are present in Bend region. F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Surv. Bull. 3534, p. 65), also included in Bend group (Penn.) the Smithwick and Marble Falls fms. and assigned the Barnett to Miss.

†Bend formation.

Middle and Lower Jurassic: Northern California (Gold Belt region).

J. S. Diller, 1892 (prel. proof-sheet edition of U. S. G. S. Lassen Peak folio, No. 15) and 1895 (published Lassen Peak folio, No. 15). The *Bend fm.* contains some ls., but is composed chiefly of slates, sss., and cgls., and crops out along western arm of Great Bend of Pit River. Isolated areas of the ls. are exposed near stage road 1 mi. W. of Montgomery Creek, and the slates and sss. form upper part of N. slope of Cedar Creek 4 mi. W. of Round Mtn. Jurassic fossils. Rests on Cedar fm. and is overlain by Chico fm.

H. W. Fairbanks, July 1894 (Am. Geol., vol. 14, p. 27). *Bend fm.*, consisting of slates and argill. ls., embraces, as far as is known, the Lower and Middle Jura.

J. P. Smith, October 1894 (Jour. Geol., vol. 2, p. 611). *Bend fm.* was named by J. S. Diller (U. S. G. S. Lassen Peak Sheet, 1892) to include all Jurassic deposits of region of Big Bend of Pitt River. In a later publication Mr. Diller (Bull. Geol. Soc. Am., vol. 4, 1893, p. 221) stated that Pitt River Jura corresponds to Mormon ss. (Middle Jura) of Taylorsville region. About 6 mi. W. of Big Bend, in Big Canyon, H. W. Fairbanks discovered fossils, in shaly lss., which, on examination by writer, proved to be Jurassic and probably = Hardgrave ss. (Lower Jura) of Indian Valley.

Includes Potem and Modin fms.

Bend sand.

A subsurface sand, of Penn. age, in Brown, Eastland, Stephens, and Young Counties, north-central Tex. Lies at 2,700 to 4,200 ft. depth.

†Bendian series.

See under *Bend group*, C. Schuchert 1924 and R. H. Dott 1934.

Benezette limestone member (of Pocono formation).

Mississippian: Central northern Pennsylvania (Elk County).

C. A. Ashburner, 1885 (2d Pa. Geol. Surv. Rept. R_2, pp. 104–105). Ls., in Pocono fm. along main branch of Straight Creek, lying 200 ft. below Olean cgl. is probably same as *Benezette ls.*, found along road SW. of Benezette village.

F. G. Clapp, 1905 (U. S. G. S. Bull. 249, p. 21). *Benezette ls.*—At a few points in Elk Co. a triple bed of ls., supposed to be of Pocono age, has been found about 200 ft. below Olean cgl. The upper bed is reported as having probable max. thickness of not over 7 ft., the others being considerably thinner. Outcrops 1 mi. W. of village of Benezette.

Ben Harrison limestone.

Miners' local name for an ore-bearing ls., 40± ft. thick, in middle part of Oquirrh fm. (Penn.) of northern Utah. Lies 120 to 250 ft. below Black Bear ls. (miners' name) and 500± ft. above Larsen ls. (miners' name). Is worked in Ben Harrison mine, Stockton dist. (See U. S. G. S. P. P. 173, 1932.)

Ben Lomond formation.

Oligocene (?): Trinidad.

V. C. Illing, 1928 (Geol. Soc. London Quart. Jour., vol. 84, p. 15).

Bennett quartzite.

Pre-Cambrian: Quebec.

J. K. Knox, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 233).

Bennett shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 86, 88, 185). *Bennett sh.*—Bluish-gray and nearly black argill. sh. with one carbonaceous streak resembling coal and a thin yellowish to brownish ls. Thickness 8 to 10 ft. in Nebr. and 12 ft. in NE. Kans. Underlies Howe ls. and overlies Glenrock ls.; all included in Elmdale sh. memb.

G. E. Condra, 1935. (See under *Howe ls.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of Bennett sh. is along the Little Nemaha and its branches S. of Bennett, Lancaster Co., Nebr.

Bennett oil sand.

Subsurface sand in lower part of Penn. section of Graham field, in NW. part of Carter Co., Okla., from 80 to 135 ft. below Graham oil sand and about 165 ft. above Sutherland oil sand. Thickness 10 to 45 ft.

Bennett Bridge beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 87–89, 138, 141, 149, 154). *Bennett Bridge beds, zone of Pholadomorpha nasuta.*—Uppermost part of Pulaski fm. Overlie Sandy Creek beds and underlie Oswego ss. Exposed along upper Sandy Creek and at Bennett bridge, below Salmon River Falls [Oswego Co.].

Bennettsville facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 149, etc., 1931) to a lithologic development ("that of the type locality of the fm.") of his Carwood fm. in a part of southern Ind.

Benning granite.

Trade name for a white, coarse, granular, imperfectly schistose granite exposed at Benning mine, NE. of Dahlonega, Ga., where it is associated with a dark-colored mica schist. (See U. S. G. S. Bull. 293, p. 122, 1906.)

Bennington quartzite.

Lower Cambrian: Southwestern Vermont (Bennington County).

C. D. Walcott, 1896 (U. S. G. S. Bull. 134, p. 33), in discussion of the correlation of the Lower Camb. qtzite in Eastern States, called this qtzite in N. Y. and Vt. *Bennington qtzite,* but did not otherwise define the name.

G. W. Bain, 1927 (15th Rept. Vt. State Geol., pp. 222–226). *Bennington qtzite.*—In N. part of Vt. coarse bouldery deposits were left on the ancient piedmont plain. In central Vt., btw. Brandon and Rutland, the beds are thinner and only in rare instances do constituent grains exceed ¼ inch diam. At Bennington the beds are composed of small sand grains. Unweathered feldspar pebbles are common in the deposits btw. Brandon and Rutland, which indicates rapid erosion and deposition.

F. A. Burt, 1929 (16th Rept. Vt. State Geol., pp. 68–84, in description of Bennington area). Vermont fm. consists locally of 1,600± ft. of Lower Camb. qtzites called by Bain the *Bennington qtzite.*

Bennington limestone.

Lower Cretaceous: Southeastern and central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79, p. 6). *Bennington ls.*—Massive dull-blue shell ls., 10 to 15 ft. thick, underlying Silo ss. and overlying Bokchito fm. In Tex. is represented by 80 to 100 ft. of calc. fossiliferous clays.

Named for Bennington, Bryan Co.

Benoist sand.

A subsurface sand in Chester group (Miss.) of Marion Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Bens Creek sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 204). *Bens Creek ss.*—Massive, medium-grained, micaceous, grayish brown. Thickness 0 to 30 ft. Lies 0 to 5 ft. below Eagle coal and 5 to 10 ft. above Bens Creek coal. Named for association with Bens Creek coal, which was named for Bens Creek, Mingo Co.

Benson formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 96, and Canadian Min. Inst. Trans., vol. 15, p. 338).

Benson limestone.

Middle Ordovician (Trenton): Central Kentucky.

A. F. Foerste, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, imprint on title page July 1913, pp. 380, 389, 429, 430). *Benson or Bigby bed.*—Fossiliferous granular ls., occasionally phosphatic at top; 35 ft. thick. Underlies Brannon bed and overlies Wilmore bed. Has been regarded same as Bigby fm. of Tenn., but Bigby should either include all strata btw. Wilmore and Perryville fms. or be restricted to Woodburn horizon.

Named for Benson, Franklin Co.

Benson limestone.

Mississippian (lower and upper?): Central northern Utah (central Wasatch Mountains).

F. F. Hintze, Jr., Dec. 12, 1913 (N. Y. Acad. Sci. Annals, vol. 23, pp. 109, 113). *Benson ls.*—Descending: (1) Hard, dark-blue, cherty, coralline ls., 100 ft.; (2) massive dark-blue ls., 300 ft.; (3) fossiliferous blue ls., 3 ft.; (4) thick-bedded blue ls., 100 ft.; (5) dark-blue cherty and brecciated ls., 200 ft.; (6) hard blue ls., 100 ft.; (7) dark porous ls., very fossiliferous, 21 ft.; (8) thick-bedded blue ls., extensively bored, 120 ft.; (9) thick-bedded light-blue ls., 43 ft.; (10) thin-bedded blue ls., 45 ft.; (11) ls. cgl. at base, thin. Total thickness 1,032 ft. Underlies Reade fm. without observed discon. Uncon. overlies Maxfield fm. (Ord.). Named for occurrence in Reade [Reed] and Benson Ridge, just above old mine workings of same name [in Salt Lake Co.].

Fossils collected from lower 500 ft. of these rocks (by B. S. Butler in 1916 and 1917) have been identified by G. H. Girty as clearly of Madison (lower Miss.) age. Whether upper 900 ft. contains evidence indicating that any part of fm. is post-Madison, and of Brazer age, remains to be determined, but probably some of it is of Brazer (upper Miss.) age.

Benson sand.

A subsurface sand, of Upper Dev. (Chemung or Portage) age, in W. Va. that lies lower than Cooper sand and higher than Elk sand. The name has also been carried into SW. Pa., where it appears to have been applied to a lower sand, 70 ft. thick in boring near McDonald, Pa., where its top lies 2,129 ft. below Gordon Stray sands. Named for J. C. Benson well in W. part of Barbour Co., W. Va.

Bent sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 315). *Bent ss.*—Greenish brown, micaceous, flaggy or shaly ledge, usually 40 to 60 ft. thick. Lies 50 to 200 ft. below top of Bluestone group [Bluestone fm.]. Rests on Upper Bent sh. Type loc. is on Bent Mtn (Mercer Co., 1.2 mi. SE. of Pride), where it is 55 ft. thick.

Bent shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 315–316). *Upper Bent sh.* immediately underlies Bent ss. memb. of Bluestone group and is separated from *Lower Bent sh.* by Bent ls., 0 to 1 foot thick. All belong in Bluestone group [Bluestone fm.]. *Upper Bent sh.* is sometimes red and variegated, and sometimes black and fissile, 20 to 40 ft. thick, and contains marine fossils. Its type loc. is on Bent Mtn (Mercer Co., W. Va., 1.2 mi. SE. of Pride), where it is red and green and 55 ft. thick. The *Lower Bent sh.* is green, argill., and fissile, and carries marine fossils. It was not seen in Mercer, Monroe, and Summers Counties, W. Va., but is visible in Tazewell Co., Va., about 1 mi. NW. of Bailey Station; thickness 6 to 18 ft. [See also under *Bent ls.*]

Bent limestone. (In Bluestone formation.)

Mississippian: Southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 316). *Bent ls.*—A thin lenticular horizon, 0 to 1 foot thick, named for its association with Upper Bent sh. Contains ostracods. Is a memb. of Bluestone group [Bluestone fm.]. Presence not noted in Mercer, Monroe, and Summers Counties, but is exposed in Tazewell Co., Va., on a cross road that passes Bailey Station NW. to Mud Fork of Bluestone River, the outcrop being on the Mud Fork side of the ridge and about 1 mi. from the station, where it lies btw. Upper Bent sh. and Lower Bent sh.

Benton shale. (In Colorado group.)

Upper Cretaceous: Southeastern Montana, South Dakota, eastern Wyoming, Nebraska, southern Minnesota, eastern Colorado, Kansas, northeastern New Mexico.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 419, 421). *Fort Benton group (Formation No. 2 of Cret.).*—Dark-gray laminated clays, sometimes alternating near upper part with seams and layers of soft gray and light-colored ls. Fossiliferous. Thickness 800 ft. in vicinity of Fort Benton, on Upper Missouri River. Also occurs along Missouri River from 10 mi. above James River to Big Sioux River; along eastern slope of Rocky Mtns; and at Black Hills. Overlies Dakota group and underlies Niobrara div. [This paper by Meek and Hayden described the rocks of Nebr., which at that time included Wyo., Mont., and Dak.]

Is lower fm. of Colorado group. For many years the "Fort" has been dropped from the name, and *Benton sh.* has been used.

Named for Fort Benton, on Missouri River, about 40 mi. below Great Falls, Mont., but the strat. limits of the fm. are based largely on sections along Missouri River in northern Nebr., where Benton sh. rests on Dakota ss. and is overlain by Niobrara ls. The early Cret. rocks of central Mont. region, including Fort Benton, are now classified as Colorado sh. (= undivided Niobrara and Benton) and Kootenai fm. (Lower Cret.). In parts of Wyo. and eastern Colo. the rocks formerly called Benton are now divided into (descending) Carlile sh., Greenhorn ls., and Graneros sh. In central southern Wyo. and Bighorn Mtns they are divided into (descending) Carlile sh., Frontier fm., Mowry sh., and Thermopolis sh.

Benton sand.

Tertiary: Southeastern Missouri.

C. F. Marbut, 1902 (Mo. Univ. Studies vol. 1, No. 3, pp. 18, 23, 32). *Benton sands.*—Gray, reddish, or brownish sands in lower part, white sands and whitish clays in upper part; thickness 0 to 200 ft. Underlie whole area of Crowley and Benton ridges and apparently Sikeston ridge also. Of late Tert. age, probably Lafayette [also calls them *Lafayette sands*]. Rest uncon. on Idalia sh. or clay, and underlie, probably uncon., Piketon or Lafayette gravels or the loess.

Appears to belong to Wilcox fm.

Named for exposures at Benton Ridge, Scott Co.

Bentonian series.

A term applied by C. R. Keyes to deposits underlying his Pierran series and overlying his Bearian series. Includes Niobrara ls. and Benton sh. (See Pan-Am. Geol., vol. 63, No. 4, 1935, p. 281, and vol. 64, No. 1, 1935, p. 11.)

Benwood limestone member (of Monongahela formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

M. R. Campbell, 1903 (U. S. G. S. Brownsville-Connellsville folio, No. 94, p. 10). *Benwood ls.*—Geographic name (to replace inappropriate name "Great ls.") for the thick ls. which occupies interval btw. Sewickley coal and Uniontown coal. Is generally composed of 2 members having total thickness of about 140 ft. Lower memb. is entirely ls. and 70 or 80 ft. thick. Upper memb. is considerably broken by ss. and sh. beds. Name *Benwood* suggested, in correspondence, by Dr. I. C. White, from town of Benwood, Marshall Co., W. Va. According to Dr. White the ls. is well exposed in river bluffs in that vicinity.

In 1907 the W. Va. Geol. Surv. (Repts. on Ohio, Brooke, Hancock, Marshall, Wetzel, and Tyler Counties) restricted *Benwood ls.* to lower div. of "Great ls.," and applied *Fulton green sh.* to the thin sh. (0 to 5 ft.) in places separating it from overlying Uniontown ls., or upper div. of "Great ls." This is present established definition of Benwood ls.

Berea sandstone.

Mississippian: Ohio, southern Michigan, western Pennsylvania, northeastern Kentucky, and northern West Virginia.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 21, 29). *Berea grit.*—Drab ss., 50 ft. thick, underlying Cuyahoga sh. [Cuyahoga as here used included Sunbury sh.] and overlying Bedford sh. Included in Waverly group.

Named for Berea, Cuyahoga Co., Ohio.

†Berea shale.

A name applied in some early repts to Sunbury sh. of Ohio. Abandoned because of conflict with Berea ss.

Berenda limestone.

Mississippian: New Mexico.

C. R. Keyes, 1906 (Jour. Geol., vol. 14, pp. 147–154), applied *Berenda lss.* to lss. said to underlie Lake Valley ls. in N. Mex. Derivation of name not given.

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. No. 19, pp. 7–21). *Berenda ls.*—Nodular lss., 50 ft. thick, consisting of (descending): (1) 10 ft. of bluish thinly bedded cherty ls.; (2) 30 ft. of gray thinly bedded ls.; (3) 10 ft. of massive compact ls. Underlies Grande ls. and overlies Bella sh.

Probably (?) named for Berenda Valley.

In several subsequent repts Keyes assigned his Berenda ls. to Dev. and correlated it with Martin ls. of Ariz.

Beresford phase.

Pre-Cambrian: Manitoba.

J. F. Wright, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 160).

Beresford Lake phase.

Pre-Cambrian: Manitoba.

J. F. Wright, 1932 (Canada Geol. Surv. Mem. 169, p. 17).

Bergman group.

Cretaceous (Upper?): Northwestern Alaska (Koyukuk River region).

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 246). *Bergman series.*—Essentially thin-bedded or medium-bedded impure gray or brownish sss. and dark slates, with some dark sh. and occasional cgls., but on N. it is bordered by belt of cgl. several to 10 mi. wide, which apparently is basal memb. of series. Thickness 2,000 ft. Probably Cret. Conformably overlies Koyukuk series, also Totsen series.

W. C. Mendenhall, 1902 (U. S. G. S. P. P. 10, pp. 31–48). *Bergman series.*—Folded ss., fine cgls., and dark sandy shales, the sss. and shales usually alternating in thin bands, but occasionally the sss. disappear and broad belts of sh. many hundred ft. thick occur. To N. the sss. are replaced by cgls., and cgl. forms base of series. No fossils. Tentatively assigned to Mesozoic.

Named for trading post (Bergman) on Koyukuk River.

Berkeley group.

Pliocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, p. 375 and map). The entire series of rocks, volcanic and sedimentary, from base of Orindan fm. to crest of Frowning Ridge, is here named *Berkeleyan series,* and the interval is regarded as having a break in its accumulation dividing it into Upper and Lower Berkeleyan. The Upper Berkeleyan includes Bald Peak basalt, Siestan fm., Grizzly Peak andesite, and several other unnamed fms. The Lower Berkeleyan includes Trampan and Orindan fms. and a great thickness of unnamed igneous and sed. fms. The Berkeleyan series is uncon. overlain by Campan series and uncon. underlain by Monterey series.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Berkeley group* includes rocks btw. *top* of Orinda fm. and base of Campus fm. Divided into (descending) Bald Peak basalt, Siesta fm., and Moraga fm. Rests, with probable uncon., on Orinda fm., and is uncon. overlain by Campus fm.

Named for occurrence E. of Berkeley.

†Berkeleyan series.

See *Berkeley group.*

†Berkshire limestone.

Lower Ordovician to Lower Cambrian: Western Connecticut, Massachusetts, and Vermont.

E. Hitchcock, 1833 (Rept. on Geol., Min., Bot., and Zool. of Mass., pp. 297–305). *Berkshire ls.*—Constitutes part of the extensive ls. fm. which occupies western part of Conn., Mass., and Vt. It passes through numerous gradations of texture and color, from the snow-white coarsely granular and crystalline variety *in Adams [Mass.] to the dark-gray almost compact variety in* Williamstown, and to the even darker variety in West Stockbridge.

Replaced by *Stockbridge ls.*, the name *Berkshire* having for many years been restricted to the schist.

Berkshire schist.

Ordovician, Cambrian, and pre-Cambrian(?): Western Massachusetts, Connecticut, southwestern Vermont, and eastern New York.

T. N. Dale, 1891 (Am. Geol., vol. 8, pp. 1–7). *Berkshire schists.*—In character like Greylock schists, but more frequently calc., especially toward underlying Stockbridge ls. Overlain by Bellows Pipe ls. in western Mass. Thickness 1,000 to 2,000 ft. Named for prevalence in Berkshire Co., Mass.

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pp. 303–306 and map). *Berkshire schist.*—Phyllite and muscovite chlorite schist, generally greenish or grayish, of fine micaceous aspect, saponaceous to touch; in some places contains cubes of pyrite; often interbedded with purplish schist of similar character; both often traversed by veins of milky quartz and chlorite. Thickness 200 to 2,000 ft. Is contemp. with Hudson River sh., of Lower Sil. [Ord.] age. Rests conformably on Stockbridge ls. [Now known to be, in places at least, overthrust on Stockbridge ls. See 1932 paper by Prindle and Knopf cited beyond.] Is overlain, without evidence of uncon., by Rensselaer grit in Rensselaer grit plateau of eastern N. Y.

In 1899 (U. S. G. S. Bull. 159) B. K. Emerson described *Berkshire schist* of western Mass. as a chloritic hydromica or sericite schist. In 1912 (U. S. G. S. Bull. 521) T. N. Dale assigned the Berkshire to Middle Ord.

(Trenton) and Upper Ord. In 1917 (U. S. G. S. Bull. 597, p. 39) B. K. Emerson described (and mapped) *Berkshire schist* as an extensive slaty fm., which in its western parts in N. Y. is characterized by presence of Upper Ord. fossils and in its eastern parts becomes a complete mica schist, with garnet, staurolite, and tourmaline, and so much feldspar that it may be called in places a schistose gneiss. "It makes up nearly all mtn ridges that rise from the ls. valleys in western Mass." [Mapped as Ord.]

In 1927 the U. S. Geol. Survey discarded *Hudson schist*, upon recommendation of E. B. Knopf, who stated it is same as Berkshire schist, the preferred name. For many years the Berkshire was classified as Ord., but additional work proved that in some areas the rocks mapped under that name included Camb. and pre-Camb. rocks. (See E. B. Knopf, Am. Jour. Sci., 5th, vol. 14, Dec. 1927, pp. 429–458, and references therein; also L. M. Prindle and E. B. Knopf, Am. Jour. Sci., 5th, vol. 24, Oct. 1932, pp. 257–302.) The latter rept divided the rocks in N. half of Berkshire Co., Mass., that had previously been mapped as *Berkshire schist* into several named fms. of Ord., Camb., and pre-Camb. age; and subsequent work has shown that Berkshire schist in S. half of Berkshire Co. is also susceptible of subdivision into several fms. of different ages. The name, however, is still considered a useful blanket term, in other areas in which it has been used, and its retention is recommended by Mrs. Knopf "to cover certain predominantly argill. rocks of variable metamorphic rank whose age is still undet. except that the existing evidence indicates that they are not younger than Ord. and that they may include rocks as old as pre-Camb." This recommendation has been adopted by U. S. Geol. Survey, with the expectation that as rapidly as accumulated evidence justifies, this composite unit in other areas will be separated into rocks of different ages, bearing different names.

Berkshire sand.

A commercial term applied to the friable beds of Cheshire qtzite excavated E. of the station at Berkshire, Berkshire Co., Mass.

Berkshire County series.

Pre-Cambrian: Western Massachusetts.

W. O. Crosby, 1876 (Rept. on geol. map of Mass., p. 40), applied *Berkshire County series* to pre-Paleozoic rocks of Berkshire Co., including Eolian ls., qtzite, Taconic sl., and clay sl., gneiss, and mica schist.

Berland River shales.

Cretaceous: Alberta.

J. MacVicar, 1924 (Canada Geol. Surv. Summ. Rept. 1923, pt. B, p. 34).

†Berlin gneiss.

Late Paleozoic (?): Northern New Hampshire (White Mountains).

C. H. Hitchcock, 1873 (Rept. Geol. Surv. N. H. 1872, p. 7), used, but did not define, *Berlin gneiss*, and showed it as older than gneiss of Winnipesogee Lake and younger than the porphyritic gneiss and granite of N. H. In same year (Proc. Boston Soc. Nat. Hist., vol. 15, pp. 304–309) he stated that Bethlehem gneiss "may possibly be same as the gneiss at Berlin." In 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545) he stated: I think the Lake gneiss (Lake Winnipiseogee gneiss) includes the Berlin and Manchester ranges.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, p. 111), used *Berlin or Lake gneiss* for fine-grained gneiss underlying Montalban group and overlying Bethlehem gneiss in White Mtns, in N. part of which is Berlin Twp and village of Berlin.

On 1932 geol. map of U. S. the rocks of Berlin region are mapped as pre-Camb., upon basis of information supplied by M. Billings. But Billings later (Sci., Jan. 19, 1934) stated: "It is very probable that there are no pre-Camb. rocks in central N. H., and perhaps in whole State;" also that "most of the intrusive rocks, originally assigned to pre-Camb., are actually younger than lower Dev.;" also that "even the high-grade metamorphic rocks are Paleozoic."

M. Billings, 1935 (letter dated Aug. 27). *Berlin gneiss* belongs to New Hampshire magma series [which he classifies as late Dev. or late Carbf.].

Berlin rhyolite gneiss.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Green Lake County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 520). *Berlin quartz porphyry* occurs at city of Berlin, Green Lake Co. [See also T. C. Chamberlin, p. 149, of same vol., where he called the rock *Berlin porphyry.*]

S. Weidman, 1898 (Wis. Geol. Nat. Hist. Surv. Bull. 3, Sci. ser. 2, pp. 32–47). *Berlin rhyolite gneiss* (pre-Camb.) outcrops at Berlin, Green Lake Co. Is the Berlin porphyry of Chamberlin.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). The pre-Camb. crystalline rocks at Berlin "may be supposed to be pre-Huronian."

†Berlin limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, pp. 223, 286, 292). *Berlin ls.*—At Forwardstown, Somerset Co., it consists of an upper ls. 2 ft. thick, which rests on 1 ft. 6 in. of yellow clay underlain by 2 in. of coal, and a lower ls. 1 ft. 6 in. thick; and its top lies 90 ft. below Elk Lick ls. and its base lies 8 ft. 6 in. above Harshberger ls. [A section on p. 292 shows Berlin coal 65 to 70 ft. below Elk Lick ls. and 10 ft. above Berlin ls., which here is 8 ft. thick and occurs 5 ft. above Platt coal.]

Same as Ames ls. memb. of Conemaugh fm.

Berlin group. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Berlin group* underlies Morgantown ss. and extends to base of Platt (?) coal, which underlies Green Crinoidal (Berlin) ls. in Allegheny Co.

Berlin clay.

Name applied by R. F. Flint (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 965–987, 1933) to a late Pleist. clay that underlies parts of eastern Berlin Twp, Conn.

Bermuda earth.

Miocene: Eastern Virginia.

W. B. Clark, 1897 (Md. Geol. Surv., vol. 1, p. 197). The nearly pure diatomaceous earth of Chesapeake fm. is sometimes known as "Richmond earth," from its wide occurrence in vicinity of Richmond. It was long referred to in literature as *"Bermuda earth,"* from its supposed occurrence on Island of Bermuda, but the specimen upon which the reference was based was ultimately shown to have come from Bermuda Hundred, on James River [in Chesterfield Co., Va.].

Bernadotte sandstone. (In Pottsville formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316). *Bernadotte ss.*—Coarse-grained, massive ss. at base of Carbondale fm. [as he proposed restricting

Carbondale] in Fulton Co. Fills erosion channel in Pottsville fm. [Derivation of name not stated, but probably town of Bernadotte, Fulton Co.]

H. R. Wanless, 1931 (Ill. State Geol. Surv. Bull. 60, pp. 179–193). *Bernadotte ss.* in places cuts out underlying beds down to coal No. 1.

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804), showed top of Bernadotte ss. lying 50± ft. below coal No. 2 and as cutting out beds down to and into coal No. 1.

Bernadotte cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a middle portion of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of deposition. Derivation of name not stated.

†Bernalillan series.

A time term introduced by C. R. Keyes to cover part of the Perm. deposits of N. Mex.

Bernalillo shale.

Permian: Central northern New Mexico.

C. R. Keyes, 1903 (Ores and Metals, vol. 12, p. 48). The Permo-Carbf. of N. Mex. consists of series of red shales and sss. called *Bernalillo shales* in Sandia Mtns. Younger than Coyote ss. [Derivation of name not given.]

C. R. Keyes, 1903 (Rept. Gov. N. Mex. to U. S. Secy Interior, pp. 337–341), gave thickness of *Bernalillo terrane* as 1,000 ft.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 37, p. 426). The so-called Bernalillo shales comprise Abo red beds and Yeso pink beds.

†Bernallian series (Keyes).

Same as †Bernalillan series.

Bernardston formation.

Devonian: Western and central Massachusetts, southeastern Vermont, and southwestern New Hampshire.

J. D. Dana, 1873 (Am. Jour. Sci., 3d, vol. 6, pp. 339–352), in describing the Helderberg rocks of Connecticut River Valley, referred frequently to *Bernardston garnetiferous mica sl., Bernardston sl.,* and *Bernardston qtzite,* as being of Helderberg age.

B. K. Emerson, 1890 (Am. Jour. Sci., 3d, vol. 40, pp. 263–275, 362–374). *Bernardston series.*—Upper Dev. metamorphic rocks, containing Chemung fossils, with a few Hamilton forms. Includes amphibolite, mica schist, hornblende schist, qtzite, ls., cgl., argillite, and gneiss. Occurs at Bernardston, Mass.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 253–300 and map). *Bernardston fm.*—Mica schists and hornblende schist; underlain by qtzite in thick beds, with lss. containing Upper Dev. corals; at base cgl. of pebbles derived from Leyden argillite, which is locally changed to gneiss. Thickness 1,650 ft. Uncon. overlies Leyden argillite and uncon. underlies Juratrias [Newark group]. [See also B. K. E., U. S. G. S. Bull. 597, 1917.]

Named for occurrence at Bernardston, Mass.

†Bernardston limestone.

Devonian: Western and central Massachusetts.

J. D. Dana, 1877 (Am. Jour. Sci., 3d, vol. 14, pp. 379–387), applied *Bernardston ls.* to crinoidal ls. in midst of Helderberg fm. at Bernardston, Mass., which is a bed in Bernardston fm. The U. S. Geol. Survey does not apply the same name to a geologic unit and to a part thereof.

Berne member.

Mississippian: South-central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 659, 660, 667, 669, 674–682). *Berne memb.*—Largely pebbles, but sss. of moderate coarseness and shales are found in it at some localities. Thickness 0 to 20 ft. Always present (in Licking, Fairfield, and Hocking Counties) and readily recognized resting on Black Hand memb. [restricted use of Black Hand]. Lithologically very like underlying cgls. and heretofore included in Black Hand fm. but here separated out as distinct top memb. of Cuyahoga fm. Whether it be regarded as closing the Cuyahoga or opening the Logan it separates two groups of sediments essentially different from each other in many ways. Underlies Byer memb. of Logan fm. [the beds called Byer were previously included in Black Hand fm.]. Equivalent to cgl. 1 of C. S. Prosser.

J. E. Hyde, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, pp. 43–64). *Berne cgl. memb.*—Coarse conglomeratic ss. Can be traced from Vinton Co. to Wayne Co., a distance of 120 mi. Its history belongs to Logan fm. [In detailed sections in this rept the Berne is included in Cuyahoga fm., but in description it is included in Logan fm.]

These beds belong to Black Hand fm. of Prosser and others.

Named for exposures in Berne Twp, Fairfield Co.

Berne member (of Marcellus shale).

Middle Devonian: Eastern New York (Berne-Durham quadrangle).

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 544, 548). *Berne memb.* is proposed for interval btw. Onondaga ls. and Otsego memb. of Marcellus in region E. of Schoharie. Dark gray sh., with a white or gray streak, and usually crumbles into small lumps; conchoidal fracture when fresh. Type section is in hill S. of Berne, where memb. is 280 ft. thick. It is = Union Springs, Cherry Valley, and Chittenango members of the Marcellus of Unadilla and Chenango Valleys and other areas.

†Berners formation.

Jurassic, Triassic, and probably Paleozoic: Southeastern Alaska (Berners Bay region).

A. Knopf, 1911 (U. S. G. S. Bull. 446, pp. 14–19, map). *Berners fm.* (*Jurassic-Cret.*).—A sed. fm., dominantly slates and graywackes. Some basaltic greenstones and quartz porphyry schists, of small importance, are associated with it. Splendidly displayed along W. shore of Berners Bay and along Lynn Canal from Point St. Mary to mouth of Independence Creek; also on E. shore of Berners Bay.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 256–260). "Berners fm." includes rocks of Jurassic, Triassic, and probably Paleozoic age, and name is discarded.

Beroun moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Beroun, Pine Co.

Bertha limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 393). *Bertha ls.*—Yellow, impure, siliceous; 2 to 15 ft. thick; marine fossils. Underlies Upper Bertha sh. and overlies Lower Bertha sh., all members of Bluefield group [fm.]. Named for association with Bertha ss. and Upper Bertha sh., but not exposed at type loc. of Bertha ss. Observed, however, at other localities in Summers Co., and in Monroe and Mercer Counties, also in Tazewell and Giles Counties, Va.

Bertha sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 391). *Bertha ss.*—Usually greenish gray, shaly, and 30 to 50 ft. thick, but in some localities is massive and gray. Underlies Lower Graham sh. and overlies Upper Bertha sh., all members of Bluefield group [fm.]. Type loc. along mtn road which ascends from Bertha toward Low Gap School, Summers Co. Also exposed in Monroe Co., W. Va., and in Tazewell Co., Va.

Bertha shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe and Summers Counties, pp. 299, 392–394). *Upper Bertha sh.*—Usually sandy, but sometimes red and variegated; 45 to 75 ft. thick; occasional plant and marine fossils; underlies Bertha ss. and overlies Bertha ls., all members of Bluefield group [fm.]; named for association with Bertha ss., but is concealed at type loc. of that ss.; occurs in Mercer, Monroe, and Summers Counties. *Lower Bertha sh.*—Usually greenish yellow, but occasionally a red and variegated or sandy deposit, 50 to 90 ft. thick; underlies Bertha ls. and overlies Bradshaw ss.; type loc. same as Upper Bertha sh.; occurs in Mercer, Monroe, and Summers Counties.

Berthelet member.

Middle Devonian: Southeastern Wisconsin (Milwaukee region).

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 262, 265). *Berthelet memb.* (*novum*).—Basal memb. of Milwaukee fm. Consists of dol. and waterlime, dull gray, shaly in lower part, upper few ft. a hard vitreous single layer of dol. with many cavities containing calcite, marcasite, sphalerite, and millerite crystals, and asphaltum. Faunules change considerably vertically. Highest beds contain many cephalopods; below this pelecypods and small brachiopods are abundant; lower beds have yielded most of fish remains for which Milwaukee locality has long been famous. Thickness of memb., 21 ft. at type loc., which is Milwaukee cement quarry. Underlies Lindwurm memb. of Milwaukee fm. and overlies Thiensville fm.

Probably named for village of Berthelet, Milwaukee Co.

Bertie limestone member (of Salina formation).

Silurian: New York (western to east-central) and southeastern Ontario.

E. J. Chapman, 1864 (A popular and practical exposition of the minerals of Canada, p. 190). Lower Helderberg group occupies a comparatively narrow strip of slight thickness in Western Canada, btw. E. end of Lake Erie and township of Cayuga [Ontario]. It in no place exceeds 50 ft. in thickness and consists of lowest div. of the group as subdivided by N. Y. geologists, or of equivalents of their "Waterlime group or Tentaculite ls." With us, in Western Canada, it might be called *Bertie or Cayuga dol.*, as its only known exposures are in those townships; or a still better term would be *Eurypterus fm.*, so named from its principal and characteristic fossil, *Eurypterus remipes*. In above townships it consists of thin-bedded grayish dolomites, interstratified toward base with a few brownish shales and with a brecciated bed composed chiefly of dol. fragments.

C. Schuchert, 1903 (Am. Geol., vol. 31, pp. 160–175). *Bertie fm.*—Name proposed by Chapman in 1864. The Lower Waterlime *Eurypterus*-bearing mag. lss. and shales, 50 ft. thick. Underlies Cobleskill ls. (called "Bullhead rock" in western N. Y.), and overlies *Salina proper* or Onondaga salt group. In southern half of Appalachian region the Bertie fm. is not lithologically distinguishable from the Salina, and here the latter term [Salina] is extended to embrace entire interval btw. Niagara and Manlius. [He at that time treated Cobleskill ls. as basal part of his "Manlius fm. redefined."]

In 1903 (N. Y. State Mus. Hdb. 19) J. M. Clarke introduced *Camillus sh.* for the beds underlying *Bertie waterlime*, and applied *Cobleskill* to fm. overlying the Bertie. For many years this was definition of the Bertie of N. Y. In 1909, however, W. H. Sherzer and A. W. Grabau (Geol. Soc. Am. Bull., vol. 19, pp. 544, 550) introduced *Akron dol.* for †Bullhead dol. of western N. Y., which they stated is approx.=Cobleskill of eastern N. Y. But the beds above the Bertie in western N. Y. continued to be called *Cobleskill ls.*

In 1917 (Geol. Soc. Am. Bull., vol. 28, pp. 173–174) G. H. Chadwick revived *Akron dol.* (stating that "the correlation eastward of the Akron with the Cobleskill remains to be worked out anew, but it is now believed to be substantially correct"), and divided the beds which for 14 years had been called *Bertie ls.* or *Bertie fm.*, as follows (descending):

Buffalo cement bed [later renamed *Williamsville* by Chadwick], carrying eurypterids, 0 to 6 ft.; *Scajaquada dark shales and blocky waterlimes,* 0 to 8 ft., with at base the *Bridgeburg horizon,* with eurypterids; *Falkirk dol.,* 30 ft.; *O-atka beds* (dark gray and shaly, with blocky waterlime at base carrying eurypterids), 20 ft. Chadwick also stated "the name Bertie should either be retained in the primitive sense, covering the entire series inclusive of the Akron, or else be restricted to the cement bed here called the Buffalo, a name said to be preoccupied." On p. 174 of same publication M. Y. Williams stated: I wish to make a plea for the continued use of the term Bertie. At type loc. it was clearly used to include the beds below the Akron dol. and above the Camillus sh., although the sh. is not exposed.

In 1919 (Canada Dept. Mines, Geol. Surv. Mem. 111) M. Y. Williams classified the rocks of Niagara River as follows: Akron dol., Bertie waterlime, Camillus sh. In 1925 (N. Y. State Mus. Bull. 265, pp. 5–14) R. Ruedemann divided the late Sil. deposits of western N. Y. as follows: (1) "*Bull Head*" (*Akron dol.*), "the western continuation of the Cobleskill ls.;" (2) Bertie waterlime; (3) Camillus sh.

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 80–82), stated: It is possible the entire succession in eastern N. Y. (Binnewater, Wilbur, Rosendale, Cobleskill, Rondout, and "Manlius") all belongs to Manlius group (Keyser) rather than any of it to the Bertie (Tonoloway) or Salina.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 343), stated: Wilbur ls. and Rosendale waterlime probably together represent Bertie waterlime farther W.

Adopted by U. S. Geol. Survey as top memb. of Salina fm. in N. Y.

Named for exposures at Bertie (and in Bertie Twp), Ontario, about 6 mi. W. of Buffalo, N. Y.

Bertram dolomite.

Silurian? (Niagaran?): Eastern Iowa (Linn County).

W. H. Norton, 1895 (Iowa Geol. Surv. vol. 4, pp. 135–138). ***Bertram beds.***—Light to medium drab mag. ls., hard and brittle, 0 to 24 ft. thick, near top of Sil. Underlie Coggon beds and overlie Anamosa or Mount Vernon beds. Assigned to Sil. See also under *Gower dol.*

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, Ann. Rept. 1916, p. 372). While true place of *Bertram beds* must be uncertain until fossils are found in it or a distinct uncon. is seen above or below, it is related to Wapsipinicon (Dev.) in texture and brecciation, *and may now be provisionally classed with that fm.* Occurs, so far as known, in Linn Co. only, and outcrops along zone of contact btw. Sil. and Dev. Extends from Bertram up valley of Big Creek, and appears at various points in valley of Indian Creek to W. Sections on Big Creek show thickness of 50± ft. Occurs btw. the fossiliferous beds of *Coggon phase of the Otis* and uppermost Niagaran, and shows well-defined contacts with each.

M. A. Stainbrook, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 249–251), included *Bertram beds* in Otis, placed Otis above Coggon, and included all in Wapsipinicon ls. (Dev.). But A. H. Sutton (p. 277 of same rept.) stated Bertram is Niagaran, and belongs in the Gower.

See also under *Anamosa dol.*

Named for Bertram, Linn Co.

Berville moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Berville, Macomb Co.

Berwick gneiss.

Pre-Cambrian(?): Southwestern Maine (Berwick and North Berwick Townships) and southeastern New Hampshire.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Berwick gneiss.*—Highly metamorphosed and recrystallized graywacke, qtzite, and thin micaceous beds, developed in belt, 1 to 10 or more mi. wide, extending SW. from Falmouth and Gorham, Maine, to and beyond Lee, N. H. Probably Pre-Camb.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, pp. 166-167). *Berwick gneiss.*—Chiefly graywacke gneiss, but contains clean qtzites, micaceous qtzites, mica schist, and argillite schist and sl. Beds range in thickness from an inch to few ft. Almost all rocks are moderately fine-grained and delicately banded. Colors dark gray, bluish gray, and brown. Thickness undeterminable. Age unknown, but pre-Carbf. Relations to Algonkian(?) complex undet. Included in Merrimack slates and Rockingham schist of Hitchcock. Named for development at Berwick, York Co., Maine.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as pre-Camb.

Berwick quartz diorite.

Devonian(?): Southwestern Maine.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, p. 153). *Berwick quartz diorite.*—Small stock of quartz diorite about 2 mi. E. of Berwick, York Co. The contact phase is essentially a gabbro, but central mass is a typical quartz diorite. Included in Agamenticus complex, but may possibly correlate with Cape Neddick gabbro. Assigned to Dev.(?).

Berwyn conglomerate.

Pennsylvanian: Central southern Oklahoma (Arbuckle Mountains).

J. T. Richards and R. A. Birk, 1925 (A. A. P. G. Bull., vol. 9, No. 6, pp. 983, 987-988). *Berwyn cgl.*—A series of ls. cgls., arkosic sss., dark shales, and thin lss. Banded pebbles form part of the ls. cgls. at several horizons. The pebbles vary in size from a fraction of an inch to 3 inches in length. Their most common material is ls. derived from the older lss. of Arbuckle Mtns, but granite, chert, and other fragmentary materials are not uncommon. South of Arbuckle Mtns the series rests uncon. on Glenn fm. (Penn.) and is overlapped by Trinity sand (Comanchean). North of the mtns the relation of the series to underlying fm. was not determined and areal extent in this region was left for future determination. Eastern and western limits not determined definitely. Formerly called *Franks cgl.* Probably belongs to Vanoss fm. of Morgan.

Named for occurrence S. of town of Berwyn, Carter Co.

Berwyn member. (In Skaneateles shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 219, 221, etc.). *Berwyn memb. of Skaneateles fm.*—Dark, aren. sh. overlying Pompey memb. of Skaneateles. Well exposed in Conklin's Falls (The Cascades) ravine in Butternut Valley, SE. of Syracuse. At type section the fauna has a "Marcellus or *Leiorhynchus* facies." Traced westward it becomes argill. and fissile. Well exposed at Rose Hill below the Centerfield and in Clintonville Ravine, Skaneateles quad. At both places it grades into Centerfield. Thickness at type section is 200± ft. Thins to W. to 90± ft. at Rose Hill. Is 235 ft. thick at Hamilton village. To E. of type section the "*Leiorhynchus* facies" becomes less prominent by influx of typical Hamilton fossils as the shales become more aren. At Gould's quarry, in Unadilla Valley, the characteristic *Leiorhynchus laura* is lacking and Hamilton fossils are abundant at top of section; also the basal 65 to 90 ft. of Berwyn has become aren. and similar to upper Pompey. [Derivation of name not stated, but probably is village in Tully quad.]

Bessemer granite.

Pre-Cambrian: Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1917 (U. S. G. S. Bull. 660D, p. 129). *Bessemer granite.*—Medium- to fine-grained muscovite-biotite granite near quartz monzonite in composition. Locally porphyritic. In all outcrops it has a strong schistose structure, and in many places it has been metamorphosed into white and gray quartz-sericite schists that bear no resemblance to the original granite. Only in certain favorable outcrops can the gradation from the schistose granite to sericite schist be seen. The porphyritic varieties have in some places been metamorphosed into quartz-augen sericite schist or "bird's-eye" schists.

Named for fact that one of minor bodies of the granite underlies Bessemer City, Gaston Co., N. C.

Bessie member (of Quartermaster formation).

Permian: Western Oklahoma.

H. L. Griley, 1933 (Pan-Am. Geol., vol. 59, No. 3, p. 284). Subdivision of Quartermaster fm. of western Okla. has been made by field geologists to facilitate description and correlation. Names for these divisions have been in use several years without definition in geol. literature. The fm. is divided into 3 members (descending) *Elk City, Doxey,* and *Bessie.* The basal memb. (Bessie) was named by Schweer and Buckstaff. The Elk City ss., Triassic age being unproved, is left as a memb. of the Quartermaster. [All there is about these new members.]

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1473, 1474), divided Quartermaster fm. of Custer, Washita, Beckham, Caddo, and Grady Counties into (descending): *Elk City ss., Doxey sh.,* and Cloud Chief memb. (ss., gyp., and dol. facies). The Doxey is 160 to 200 ft. thick in Washita and Beckham Counties. Contact with Elk City ss. is irregular. Near middle of the Doxey there are several bench-forming beds of siltstone. The Elk City memb. is almost solid ss. It is well exposed in SE¼ of T. 11 N., R. 19 W. Its max. observed thickness is approx. 170 ft., but cover of windblown sands has made it impossible to locate its top.

†Bethany limestone.

An abbreviated form of Bethany Falls ls. that has been used by some geologists. According to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 87), the Bethany ls. of C. R. Keyes, 1896 (Am. Jour. Sci., 4th, vol. 2, pp. 221–225) is synonymous with †Erie ls. of Haworth.

Bethany gas sand.

A subsurface sand occurring at depth of 2,800± ft. in Waskom gas field, Caddo Parish, NW. La.

Bethany Falls limestone. (In Kansas City group.)

Pennsylvanian: Southwestern Iowa, northwestern Missouri, southeastern Nebraska, and eastern Kansas.

G. C. Broadhead, 1868 (St. Louis Acad. Sci. Trans., vol. 2, p. 320). *Bethany Falls ls.*—Upper 7 inches fine-grained, buff-colored, brittle, shelly, fucoidal ls., with very few fossils; lower part irregularly and evenly bedded light-grayish or drab crystalline ls. weathering buff. Thickness 18 to 22 ft. Is bed 166 of detailed section of Coal Measures from NW. corner of Mo. to Glasgow, Howard Co. Mo.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), defined *Bethany Falls ls. memb. of Kansas City fm.* as consisting, in NW. Mo., of 15 to 25 ft. of ls. (locally called "cotton rock") underlying Galesburg sh. memb. and overlying Ladore sh. memb.

Until 1932 Bethany Falls ls. was included in the Kansas City (which U. S. Geol. Survey treated as a *fm.* in Mo. and Iowa and as a *group* in Kans.), and was defined as underlying Galesburg sh. and overlying Ladore sh. In Jan. or Feb., 1932 (Nebr. Geol. Surv. Bull. 5, 2d ser., pp. 17–18), C. O. Dunbar, R. C. Moore, and G. E. Condra divided Bethany Falls ls. into (descending) Swope ls., Sugar Creek sh., and Middle Creek ls. Later in 1932 (Aug. 28 to Sept. 3) R. C. Moore (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook) used *Swope ls.* to include (descending) Bethany Falls ls., Hushpuckney sh., Middle Creek ls., Elm Branch sh., Sniabar ls., Mound City sh., Critizer ls., Tennison Creek sh., and Schubert Creek ls.; and this definition was repeated by Moore and Condra in their Oct. 1932 chart, and by Moore in his classification of May 1, 1935. N. D. Newell in his May 15, 1935, classification (Kans. Geol.

Surv. Bull. 21) restricted Swope ls. to beds btw. top of Bethany Falls ls. memb. and base of Middle Creek ls. memb. Also in 1932 Moore and Condra greatly restricted both Kansas City group and Ladore sh., and treated Swope ls. as basal fm. of their Bronson group.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 86–88). *Bethany Falls ls.* (Broadhead 1868, Hinds and Greene, 1915, etc.) is traced from south-central Iowa (†Earlham ls. of Iowa Geol. Surv.) to southern Kans., near Okla. bdy. It was called †Mound Valley by early Kans. Geol. Surv., but Bethany Falls has priority. Lower part consists of 1 to 20 ft. of light-gray, dense, thin-bedded ls., in uneven, somewhat wavy layers with sh. partings and fairly abundant fossils. Upper part consists of up to 7 ft. of bluish-gray, massive, mottled or nodular ls. that is believed to be of algal origin, and locally of 13±ft. of gray-white oolitic ls. Total thickness of Bethany Falls ls. 12 to 27 ft.; av. in E. Kans., 18±ft.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

The name *Bethany Falls* has also been used in a broader sense, to include beds from top of Westerville ls. of Iowa repts to base of Hertha ls., but this usage was long ago discarded.

Bethel sandstone. (Of Chester group.)

Mississippian: Western Kentucky, southeastern Illinois, northeastern Mississippi, and northwestern Alabama.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian series in western Ky., p. 63). *Bethel ss.*—The ss. overlying, probably with slight uncon., Ohara ls. memb. of Ste. Genevieve ls. in western Ky. Is thick-bedded, rather coarse-grained ss.; with some pebbles but not conglomeratic. Thickness 10 to 40 ft. Is Cypress ss. [so-called] of Ulrich in U. S. G. S. P. P. 36. Is overlain by Ridenhower sh. in some places and by Gasper oolite in other places. Is especially thick and well displayed in vicinity of Bethel School, 3½ mi. W. of Marion, Crittenden Co., Ky.

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41). *Bethel ss.* underlies Paint Creek fm. and overlies Renault fm.

S. Weller, 1923 (Ky. Geol. Surv., ser. 6, vol. 10). *Bethel ss.* of Butts is same as his Sample ss.

S. Weller, 1927 (Ky. Geol. Surv., ser. 6, vol. 26). *Bethel ss.* underlies Paint Creek fm. and uncon. overlies Renault ls.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, p. 184), extended the use of *Bethel ss.* into northern Ala., for the ss. overlying Ste. Genevieve ls. in that area.

C. Butts, 1929 (Jour. Geol., vol. 37, p. 46). *Bethel ss.* underlies Renault fm. and overlies Ohara ls. memb. of Ste. Genevieve ls. Although I [originally] included in my conception of the *Bethel* the overlying Cypress ss. shown only by rock waste on the top of the hill just NE. of Bethel School, it is nevertheless true that the conspicuous ledge at the base is really a fair representation of the unit to which the name was intended to apply.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430–442). *Bethel ss.* is same as Sample ss.

See also under *Ste. Genevieve ls.*

Bethel schist.

Upper Cambrian: Southeastern Vermont (Windsor County).

C. H. Richardson, 1924 (14th Rept. Vt. State Geol., pp. 82–83, on Bethel Twp). *Bethel schist.*—Hydro-mica schists, fine-grained greenish, schistose, highly metamorphosed sedimentary rocks, more or less intimately associated with chlorite, and characterized by numerous lenses, or eyes, and stringers of granular quartz. Underlies [igneous] chlorite schist (Lower Camb.) which underlies, with apparent discon., the various members of Missisquoi group. Of Lower Camb. age. [C. H. Richardson in 1927 assigned his Bethel schist to Upper Camb., and stated that it traverses entire W. part of Bethel Twp, from which it derived its name. See also *Bethel group*, of which he treated this schist as a part.]

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 208–246, on Reading, Cavendish, Baltimore, and Chester Twps). *Bethel schist* is present in Chester Twp and to S., but is absent in Reading, Cavendish and Baltimore. Believed to form base of Upper Camb. in Vt. [In table opp. p. 288 *Bethel chlorite schist* is used, and is assigned to base of Upper Camb.]

Bethel group.

Upper Cambrian: Southeastern Vermont (Windsor County).

C. H. Richardson, 1927 (15th Rept. Vt. State Geol., pp. 127–158, describing Barnard, Pomfret, and Woodstock Twps). *Bethel group* (mapped) includes the hydromica schist (*Bethel schist*) of earlier repts and the chlorite schist. Latter schists occasionally conform in dip and strike with the *Bethel schists*, with which they are often intimately associated. In such instances they may be regarded as of sed. origin and as a part of Bethel group. In Roxbury, to N., they are not of sed. origin but are igneous. Narrow beds of chlorite schist may occur in overlying Missisquoi group. [Presumably named for Bethel, Windsor Co.]

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), used *Bethel chlorite schist*, and assigned it to Upper Camb.

Bethel granite.

Devonian: Southeastern Vermont (Windsor County).

See under *Knox Mtn granite.* Presumably named for Bethel, which is in NW. part of Windsor Co., SE. Vt.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this granite to Dev.

Bethel sand.

A subsurface sand, of Miss. age, in western Ky. that has been identified as Aux Vases (?) ss., of Chester group. (See A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932.)

Bethel lime.

A subsurface oil zone, of Miss. age, in western Ky. that has been identified as Renault ls., of Chester group. (See A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932.)

Bethel pyroxene diorite.

Age(?): Eastern New York (Dutchess County).

R. Balk, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pl. 1, etc.).

Bethlehem gneiss.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region).

C. H. Hitchcock, 1872 (Rept. Geol. Surv. N. H. 1871). *Bethlehem gneiss.*—Gneiss abounding in talcoid mineral, perhaps pinite. Underlies whole of Bethlehem.

C. H. Hitchcock, 1873 (Am. Ass. Adv. Sci. Proc., vol. 21, pp. 135–151). *Bethlehem gneiss.*—Characterized by either chlorite or green pinite. Rests uncon. on the porphyritic gneiss. Believed to be younger than White Mtn gneiss.

C. H. Hitchcock, 1873 (Proc. Boston Soc. Nat. Hist., vol. 15, pp. 304–309). *Bethlehem gneiss* believed to be older than White Mtn gneiss.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 104, 348–355, 428, and btw. pp. 658 and 675). *Bethlehem gneiss* assigned to Laurentian. The fine-grained is 5,000 ft. thick and the ordinary gneiss 6,300 ft. thick. Overlies the porphyritic gneiss (Laurentian).

C. H. Hitchcock, 1896 (Jour. Geol., vol. 4, pp. 44–62). *Bethlehem gneiss or protogene.*—Chloritic gneiss. Occurs only on E. slope of Conn. Valley. It does not follow that all of these protogene areas are of same character. Each one must be studied by itself. They are batholiths. Assigned to Archean.

C. H. Hitchcock, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 461–482, map). The porphyritic granite and *Bethlehem granite* are eruptive igneous rocks, of evidently middle or late Paleozoic age.

C. H. Hitchcock, 1905 (Geol. of Littleton, N. H., Univ. Press, Cambridge). *Bethlehem protogene.*—Characterized by chlorite, talc, rotten mica, or other decomposition products. Named for town of Bethlehem.

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78, map), assigned Bethlehem gneiss to Carbf.(?).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad. N. H., p. 9 and map) assigned *Bethlehem granodiorite gneiss* to late Dev. or late Carbf., and to New Hampshire magma series; and in 1935 Billings mapped it in Littleton and Moosilauke quads. (in Geology of Littleton and Moosilauke quads., N. H.), and continued that age designation.

Bethlehem granite.

See under *Bethlehem gneiss.*

Bethlehem moraine.

Pleistocene (Wisconsin stage): Northwestern New Hampshire (Ammonoosuc River region).

J. W. Goldthwait, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 263–284). *Bethlehem moraine* is probably not older than *Carroll moraine.*

I. B. Crosby, 1934 (Jour. Geol., vol. 42, pp. 411–421), also described this moraine.

The Carroll moraine was probably named for town or Twp of Carroll, which adjoins Bethlehem Twp.

Bethpage gravel.

Name applied by late W. O. Crosby, in unpublished rept on western Long Island, to the gravel in the pits at Bethpage, in middle of the island, and believed to be of Mio. age. The name was introduced into print by C. P. Berkey and J. F. Sanborn (Am. Soc. Civil Engrs. Trans., vol. 86, Paper No. 1509, 1923, pl. 3, p. 75), who called the overlying beds *Bethpage clay beds.* According to D. G. Thompson (personal communication) Crosby called these clay beds *Kirkwood clay,* correlating them with the Mio. Kirkwood fm. of N. J. D. G. Thompson, F. G. Wells, and H. R. Blank (Econ. Geol., vol. 32, p. 460, 1937) are inclined to belief the gravel in these pits is Jameco gravel, of Pleist. age, but that, if the gravel is really Mio., it can be only an outlier of comparatively small extent. If the gravel is Pleist., the overlying clay is also Pleist.

Bethpage clay beds.

See under *Bethpage gravel.*

†Bettles group.

†Bettles series.

Silurian: Northern Alaska (Bettles River region).

F. C. Schrader, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 475). *Bettles series.*—Heavy-bedded ls. or marble, usually banded and schistose, but sometimes massive; more or less mica schist is interbedded. Younger than Lake qtzite schist. Is principal capping rock over 2,000 sq. mi. of upper waters of Chandlar and Koyukuk Rivers. Excellent exposures on lower part of Bettles River, where the mtns which these rocks compose rise 2,000 ft. or more above river.

Now regarded same as Skajit ls.

†Beulah shale.

†Beulah clays.

Upper Jurassic: Northeastern Wyoming and western South Dakota (Black Hills).

W. P. Jenney, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, p. 593, fig. 122, map). *Beulah clays.*—Upper Jurassic fresh or brackish water deposits. In Hay Creek coal field, Crook Co., Wyo., consist of: (1) *Atlantosaurus* beds, 25 to 35 ft. of whitish and light-gray clays with some sandy shales and concretions of white calc. clay, the upper layers in many localities carrying fossil wood and the bones of saurians; (2) light-gray, thin-bedded ss., 5 to 10 ft. Underlie Hay Creek coal fm. with greatest uncon. in section, and uncon. overlie Lower Jurassic marine beds. Long outcrops of these clays occur 3 or 4 mi. N. of Beulah, in Red Water Valley [Creek Co., Wyo.].

Same as *Morrison fm.,* which has priority.

†Beulah limestone.

Devonian (?): Eastern Colorado (east side of Front Range).

A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1930 (Kans. Geol. Soc. 4th Ann. Field Conf., Sept. 1930, mimeograph, pp. 84, 86, 88, 90, 94, and 2 tables). *Beulah ls.*—At Beulah, Pueblo Co., and in Priest Canyon, Fremont Co., consists of 20 ft.

of shaly, thin-bedded, light-gray to pink, fine-grained, nonfossiliferous ls., uncon. overlain by Fountain fm. and uncon. underlain by Fremont ls. (Upper and Middle Ord.). On E. side of Williams Canyon, N. of Manitou, El Paso Co., it is 25 ft. thick, contains a few thin beds of ss. and sh., is uncon. overlain by 100 ft. of Madison ls. (Miss.) and uncon. underlain by Manitou ls. (Lower Ord.). In Missouri Gulch section, Manitou Park, Douglas Co., it is 65 ft. thick, underlies 30 ft. of Madison ls. and uncon. overlies Manitou ls. No fossils found. Assigned to Miss. or Dev.

In 1932 (A. A. P. G. Bull., vol. 17, No. 4) Brainerd, Baldwin, and Keyte replaced this name with *Williams Canyon ls.*

Beverly syenite.

Early Carboniferous: Northeastern Massachusetts (Essex County).

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.); B. K. Emerson, 1917 (U. S. G. S. Bull. 597 and map); and C. H. Clapp, 1921 (U. S. G. S. Bull. 704, pp. 85–89).

Named for occurrence at Beverly.

Bevier fire clay.

A fire clay, 1½ to 3 ft. thick, underlying Bevier coal, in Cherokee sh. of northern Mo. (Macon Co.).

†Bexar.

Upper Cretaceous (Gulf series): Southern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 114). [*Bexar* used, in table only, for Navarro fm. in Guadalupe River section of Tex.]

Probably named for Bexar Co.

Bibb dolomite.

Upper Cambrian: Northern central Alabama.

E. O. Ulrich, 1915 (U. S. Nat. Mus. Bull. 92, vol. 1, p. vii, and vol 2, pl. 2). [Fm. not defined, but name used in chart for the rocks in Ala. btw. †Lower Knox above and Ketona dol. below, the succession of fms. being, descending order: Chepultepec ls. (Upper Knox), Copper Ridge chert, †Lower Knox, Bibb dol., Brierfield dol.]

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, p. 83). *Bibb dol.*—Thick-bedded, dark, coarsely crystalline, highly siliceous dol., which yields boulders deeply encrusted with cavernous drusy silica. Weathered layers are deeply pitted. So closely resembles Brierfield dol. that the two would not be separated were it not for fact that the pure Ketona dol. intervenes btw. the two. Thickness 250 to 500 ft. Overlies Ketona dol. (conformably so far as known) and underlies Copper Ridge dol. No fossils found. Named for exposures at old Bibb Furnace, 2± mi. W. of Brierfield, Bibb Co., which is located upon outcrop of fm.

Bickett shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 430). *Bickett sh.*—Usually red and argill., but occasionally sandy, 5 to 30 ft. thick. Underlies Reynolds ls. and overlies Webster Springs ss., all members of Bluefield group [fm.]. Type loc. on NW. angle of Bickett Knob, Monroe Co. Also observed in Mercer and Summers Counties, W. Va., and in Giles Co., Va.

Bickford granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region, Franconia quadrangle).

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78). *Bickford granite (Carbf.?)*.—Fine-grained, even-textured. Forms small bodies in Kinsman granodiorite.

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 10, etc.). *Bickford granite* is scattered through Kinsman quartz monzonite and Talford schist, and is typically exposed on Bickford Mtn, Franconia quad. Is late Dev. or late Carbf. Assigned to New Hampshire magma series.

Bicknell sandstone.

Upper Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Bicknell ss.*—Light-gray or bluish gray ss., sometimes tufaceous above. Thickness 500 ft. Is older than Hinchman tuff and younger than Mormon ss.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Bicknell ss.*—Chiefly red and gray ss. associated with some dark shales and tuffaceous beds. Brownish-red ss. forms earliest part of fm. Middle part is compact, fine, dark-gray ss. interbedded with black shaly beds. Upper part consists of tuffaceous gray ss. Thickness 500 to 1,300 ft. Overlies, probably conformably, Mormon ss. and grades into overlying Hinchman ss. Greatest development on SE. slope of Mount Jura, Plumas Co.

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81, and No. 5, pp. 895–903), included Bicknell ss. in Hinchman ss.

Named for Bicknell's ravine, Mount Jura, near Taylorsville.

† Bicknell tuff.

Name applied by A. Hyatt (Geol. Soc. Am. Bull., vol. 3, p. 407, 1892) to the tuffaceous ss. forming upper memb. of Bicknell ss. of Diller.

Bidahochi formation.

Pleistocene and Tertiary: Northeastern Arizona.

A. B. Reagan, 1924 (Pan-Am. Geol., vol. 41, p. 366 and map on p. 357). For most part the surface of Hopi Buttes volcanic field, on both sides of middle, inner, valley of Pueblo Colorado Wash from Steamboat on N. nearly to Santa Fe Railroad to S., is a sandy, rolling bad-land country. The same fm. also skirts S. edge of Black Mesa, and extends W. to Hopi Buttes, where it has not been removed by erosion. In this paper this deposit will be termed *Bidahochi fm.* [Type loc. not stated, but fm. is mapped 15 to 20 mi. to E. and N. of settlement of Bidahochi (p. 355), near Twin Buttes, NE. Ariz.]

A. B. Reagan, 1932 (Kans. Acad. Sci. Trans., vol. 35, pp. 253–258), gives further information regarding his Bidahochi fm.—lithology, thickness, and geographic distribution. "For convenience the fm. will be considered under 4 subheads, the Ganado, White Cone, Cornfield and Sunrise Springs deposits, the latter 2 being divisions of the same 'conformable' series in the Cornfields-Sunrise Springs dist." He assigned the deposits to Tert. and Pleist., and described them under following headings: *Cornfields-Sunrise Springs series; Ganado (Mesa) series* (capping an irregularly shaped mesa N. of Ganado); and *White Cone series.* The latter "series" is "found in Hopi Volcanic Buttes field and along edge of Black Mesa W. and NW. of that field," and is composed of lava and clastic igneous materials associated with and often interbedded with shales and ss., a typical (detailed) section being at White Cone.

Biddeford granite.

Post-Carboniferous (?): Southwestern Maine.

C. H. Hitchcock, 1861 (Maine Bd. Agr. 6th Ann. Rept., p. 193), mentioned *Biddeford granite.*

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 177). *Biddeford granite.*—Generally even or slightly porphyritic medium-grained biotite granite of light-gray or pinkish buff color. A few very small dikes of pegmatite and aplite are associated with it. Intrudes Kittery qtzite (Penn. ?). Occurs in Biddeford, Kennebunkport, Kennebunk, and Dayton Twps, York Co. Assigned to post-Carbf.

On 1933 geol. map of Maine, by A. Keith, this rock is included in block labeled "mainly Carbf."

Biehl sand.

A subsurface sand in Chester group (Miss.) of Wabash Co., Ill. (See Ill. Geol. Survey Bull. 54, index.)

Big trap.

Pre-Cambrian (Keweenawan): Northern Michigan.

Descriptive term locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Usually immediately overlies † St. Louis cgl. and forms basal part of Central Mine group.

Big lime.

Subsurface term. In western Pa. applied to Greenbrier ls. memb. of Mauch Chunk fm.; also to basal part of Greenbrier ls. The name has also been applied to Benwood ls. memb. of Monongahela fm. and to Loyalhanna ls. In eastern Ky. it has been applied to 800 ft. or more of oolitic and granular oil-bearing lss. of Chester and St. Louis ages. In Ohio it has been applied to Maxville ls., also to rocks extending probably from top of Delaware ls. to Brassfield ls. (basal Sil.). In Texas Panhandle it has been applied to rocks correlated with lower part of Clear Fork group and upper part of Wichita group (both Perm.). In NE. and central eastern Okla. it has been applied to post-Cherokee Penn. rocks lying at different horizons above Oswego lime (Fort Scott ls.).

Big Baldy Mountain type.

Name applied by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 547–550, 1900) to dikes of analcite basalt on Big Baldy Mtn, Little Belt Mtns, Mont.

Big Basin sandstone. (In Cimarron group.)

Permian: Central southern Kansas and northwestern Oklahoma (Harper County).

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 46–48). *Big Basin ss.*—Rather massive, blocky, red and grayish white ss., 0 to 12 ft. thick, forming top fm. of Kiger div. Overlies Hackberry shales and uncon. underlies a remnant of Belvidere beds (Cret.).

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 362–363). *Taloga fm.* is proposed to include Big Basin ss. and Hackberry sh. [See under *Taloga fm.*]

R. L. Clifton, 1930 (A. A. P. G. Bull., vol. 14, pp. 161–172). *Big Basin ss.* is well exposed in Harper Co., Okla., where it is overlain by beds perhaps referable to Cloud Chief gyp.

N. Evans, 1931. (See under *Quartermaster fm.*)

Named for Big Basin, a depression in Clark Co., Kans.

Big Bend gravel.

Pleistocene: Northwestern Pennsylvania (Warren County).

E. H. Williams, Jr., 1917 (Pennsylvania glaciation, First phase) and 1920 (Am. Phil. Soc. Proc., vol. 59, pp. 68–75), used *Early, Middle, and Late Big Bend gravels.*

Named for Big Bend, Warren Co.

Big Bend facies (also Big Bend magnafacies).

Terms applied by K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71) to facies of Chadakoin fm. of Chadwick (late Upper Dev.) in NW. Pa. and SW. N. Y. Named for exposures of the facies along Allegheny River from Kinzua, through Big Bend, Warren Co., Pa., and on to Warren, Pa.

Big Blue series.

Big Blue group.

Permian: Eastern Kansas and southeastern Nebraska.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 5). *Big Blue series.*—Ls.-bearing series, 900 to 1,100 ft. thick, known by its fossils to belong to Perm. Underlies, probably uncon., Cimarron series. Divided into Sumner div. above and Flint Hills div. below. Includes (descending) Wellington shales, Geuda salt measures, Chase lss., and Neosho shales.

This name was not adopted by Kans. Geol. Surv. until 1917 (R. C. Moore and W. P. Haynes, Kans. Geol. Surv. Bull. 3), when it was called *Big Blue group* and defined as extending from top of Wellington sh. to base of Cottonwood ls. This definition of *Big Blue group* was also followed by Moore in his 1920 classification (Kans. Geol. Surv. Bull. 6). R. C. Moore and G. E. Condra in their Oct. 1932 revised classification of Perm. and Penn. rocks of Kans. still further expanded *Big Blue series*, as they called it, by including all beds down to base of Americus ls. G. E. Condra in 1935 (Nebr. Geol. Surv. Paper No. 8) and R. C. Moore in 1936 (Kans. Geol. Surv. Bull. 22) still further expanded their *Big Blue series* by including in it all beds down to uncon. at top of Brownville ls. The U. S. Geol. Survey has never adopted this name, and has not yet given consideration to change in Perm.-Penn. bdy.

Named for Big Blue River, which in northern Kans. cuts deeply into these rocks.

Big Blue serpentinous member (of Temblor formation).

Miocene (middle): Southern California (Diablo Range and Coalinga district).

R. Anderson and R. W. Pack, 1915 (U. S. G. S. Bull. 603). Upper memb. of Vaqueros fm., locally known as *Big Blue*, but in this rept called *Big Blue serpentinous memb.*, is formed largely of small flakes of serpentine, which make up a fine-grained, compact, tough sh., slightly bluish when fresh but weathering to various shades of red, yellow, and brown, owing to oxidation of the iron. Locally this sh. becomes sandy, but through most of its extent it is remarkable for being little else than a compacted mass of serpentine dust, flakes, and pebbles. With the sh. are cgls. formed almost entirely of serpentine boulders, the largest of which are huge blocks many ft. in diam. Thickness 40 to 1,000 ft. In rept on Coalinga dist. (U. S. G. S. Bull. 398, 1910) the Big Blue was tentatively included in Santa Margarita fm. Named for exposures in Big Blue Hills.

The Vaqueros ss. being now restricted to lower part, or *Turritella inezana* zone, of Vaqueros of earlier repts, the Big Blue becomes a memb. of overlying *Turritella ocoyana* zone, or Temblor fm., and is so treated by B. L. Clark, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, map, pl. 89).

Big Branch formation.

Pennsylvanian: Southern Oklahoma (Carter County).

F. W. Floyd and D. C. Nufer, 1935 (Tulsa Geol. Soc. Digest, 1934, pp. 10–11), divided the Penn. of Ardmore Basin into (descending) Pontotoc, Hoxbar, Deese, *Big Branch* ("to replace Goldston's Cup Coral"), and Otterville fms.; and correlated the Big Branch with lower part of Cherokee and the Otterville with Morrow. This is all there is about the Big Branch fm. On p. 10 C. W. Tomlinson stated: The proposed "Big Branch" fm. does not occupy strat. position assigned to it by Floyd and Nufer, relative to previously named members of Dornick Hills fm.

Big Buffalo series.

Lower Ordovician: Northern Arkansas.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), in his general time scale grouped together (descending) the Joachim of Mo., the St. Peter of Minn., and the Everton of Ark. as belonging to an "unnamed epoch" preceding the Chazyan and succeeding the Beekmantown. According to his chart these beds are represented by hiatus in N. Y., the typical Chazy and Beekmantown region. This chart showed this unnamed epoch as antedating Mosheim ls. of Tenn.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pls. 1, 2) and 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51). *Big Buffalo series* of general time scale is older than Chazyan, younger than Beekmantown, and older than Mosheim ls. of Tenn. It includes (descending) Jasper of Ark., St. Peter of Minn., and Everton and Sneeds of Ark.

H. A. Buehler, 1922 (Mo. Bur. Geol. and Mines geol. map of Mo.), used *Buffalo* as a *group* term to include Joachim ls., St. Peter ss., and Everton ls.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, No. 25, p. 1107), included *Big Buffalo group* of Ark. in Chazy epoch.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, pp. 16–17, 34), used *Big Buffalo series* in his general time scale to include beds btw. Chazyan and his Upper Canadian [upper Beekmantown], and included in it the Mosheim ls. of Tenn.

E. O. Ulrich, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 329) and 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73), used *Buffalo River series* as a general time term for rocks said to occur btw. Chazyan and Beekmantown.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, pp. 30–31), used *Big Buffalo* as a time term to include (descending) Joachim, St. Peter, Everton, Kings River, and Sneeds. (The latter 2 are treated as members of Everton by U. S. Geol. Survey.)

G. C. Branner, 1929 (Ark. Geol. Surv. geol. map of Ark.), bracketed *Buffalo River* opposite (descending) Jasper ls., Joachim ls., St. Peter ss., and Everton ls.

Named for exposures on Buffalo River (formerly called Buffalo Fork of White River) in Newton Co., Ark. The river was also formerly called Big Buffalo. U. S. Geographic Board has adopted Buffalo River.

Bigby limestone.

Middle Ordovician (Trenton): West-central Tennessee.

C. W. Hayes and E. O. Ulrich, 1903 (U. S. G. S. Columbia folio, No. 95, p. 2). *Bigby ls.*—Generally nearly uniform, semi-oolitic or granular crystalline, laminated, phosphatic ls, of gray or bluish color; upper part often shaly or aren.; lower part frequently having beds of sh. but never sandy. Thickness 30 to 100 ft. Of Trenton age. Uncon. underlies Catheys fm, and overlies [uncon., according to Ulrich] Hermitage fm., both of Trenton age.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34), and C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, chart opp. p. 80), show Cannon ls. of Tenn. as underlying Catheys ls. and overlying Bigby ls. This is present accepted definition of Bigby ls, which lies uncon. on Hermitage fm.

Named for exposures on Big Bigby Creek, Maury Co.

Big Cave.

A term applied by drillers in western Pa. to the part of Conemaugh fm. that is known as "Pittsburgh Reds."

†Big Clifty sandstone. (In Chester group.)

Mississippian: Western Kentucky.

C. J. Norwood, 1876 (Ky. Geol. Surv., n. s., vol. 1, pt. 6, pp. 10, 13, 15, 16, 51, 73, 369). *Big Clifty ss.*—Heavy-bedded ss. 60 to 130 ft. thick, constituting basal fm. of Chester group in region adjacent to Louisville, Paducah, and Southwestern R. R., Ky. Toward S. and W. borders of coal fields loses its character as a ss. and passes into shales. Equiv. of "ferruginous" ss. of Ill. Underlain by St. Louis group.

C. Butts, 1917 (Ky. Geol. Surv., Miss. fms. of western Ky., pp. 86–90). "Big Clifty" ss. of Norwood is same as true Cypress ss.

Named for exposures on Big Clifty Creek, Grayson Co.

Big Cottonwood quartzite series.

A term applied by S. F. Emmons (U. S. G. S. 16th Ann. Rept., pt. 2, p. 362, 1895) to the basal quartzite series of Wasatch Mtns, consisting of 12,000 ft. of Camb. [and pre-Camb. (?)] qtzites with clay slates at top, underlying Ute ls. [broad sense of King].

Big Cottonwood formation.

Upper Cretaceous: Southwestern Minnesota.

F. W. Sardeson, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 221–242). *Big Cottonwood fm.*—Shales, sss., and cgls., red, green, white, yellow, blue, and brown. Outcrops on Big Cottonwood River and in neighboring parts of Minn. Valley. All strata are fresh-water deposits and are referable to Dakota fm., although they possibly are contemp. with marine Colorado fm. or Niobrara. Represents a river delta or filled valley of a stream which originally descended from E. to W.

Big Creek shale. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Big Creek sh.* to that part of Carbondale fm. of Fulton Co. beneath Herrin (No. 6) coal and above his Cuba ss. Thickness and derivation of name not stated. Probably named for Big Creek, in Canton region, Fulton Co.

†Big Deciper calcareous sands.

Upper Cretaceous (Gulf series): Southern Arkansas (Clark County).

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 77, 79, 188). *Big Deciper calc. sands.*—White unstratified rock, consisting of grains of sand like those of High Bluff blue sands, and containing occasional grains of greensands, full of casts of shells, especially the large *Exogyra costata*, all cemented by a calc. matrix. Has lithologic appearance and weathering of soft, white, chalky marl sometimes found near it and known toward south as "Rotten ls." Thickness 100 ft. Underlies and grades into High Bluff blue sands. Overlies Marlbrook-Columbus marl.

Part of Saratoga chalk. (See C. H. Dane, 1929, Ark. Geol. Surv. Bull. 1, p. 103.)

Named for exposures in bluffs of Big Deciper Creek, 6 mi. S. of Arkadelphia, Clark Co.

†Big De Gray horizon.

Upper Cretaceous (Gulf series): Southwestern Arkansas (Clark County).

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 79, 81, 188). *Big De Gray horizon.*—Blue marls, similar in color to those above Koster "joint clays," but having much finer structure, less sand, and more lime, mica, and perhaps glauconite. Littoral fm. locally present in Clark Co.; older than Koster joint clays and overlying Paleozoic. Do not extend beyond Clear Springs, Clark Co.

Probably a part of Brownstown marl (restricted).

Named for occurrence in bed of Big De Gray Creek, near McCaulley's, Clark Co.

Big Dunkard sand.

A subsurface sand in SW. Pa. and W. Va. that is believed to lie at horizon of Mahoning ss., the basal memb. of Conemaugh fm. (Penn.). Named for Dunkard Creek, Greene Co., SW. Pa.

Big Elk sandstone member (of Colorado shale).

Upper Cretaceous: Central southern Montana (Musselshell Valley region).

C. F. Bowen, 1918 (U. S. G. S. Bull. 691F, pp. 189, 195–198). In W. part of Musselshell Valley the lower 500 ft. of Colorado sh. consists of black fissile shales, for most part sandy, in which are numerous thin qtzitic sss. This is followed upward by a thin but prominent conglomeratic ss.; above which are 300 ft. of shales and thin qtzitic sss. Next comes a sandy div., 200 ± ft. thick, in which there is a coarse ss. at least 100 ft. thick, and at top a conglomeratic bed 4 or 5 ft. thick. This div. is here named *Big Elk ss. memb. of Colorado sh.*, from its exposures in Big Elk dome. It is 1,200± ft. below top of Colorado fm. and in approx. position of Frontier fm., but the two can not be directly correlated. Remainder of Colorado fm. consists chiefly of sh. with a sandy transition zone near top. [Detailed section of Big Elk memb. gives (descending):

1. ss., coarse, slightly conglomeratic; bone fragments, fish teeth, and *Halymenites major*, 5 ft.
2. concealed, probably sh. or sandy sh., 45 ft.
3. ss., qtzitic, in thin beds alternating with sh., 41 ft.
4. ss., coarse, somewhat massive; bone fragments, 157 ft.]

Bigelow formation. (In Council Grove group.)

Permian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 4, 6). *Bigelow ls. fm.*, about 41 ft. thick, includes (descending): Funston ls., Blue Rapids sh., and Crouse ls. of Council Grove group. [Derivation of name not stated.]

Bigford member (of Mount Selman formation).

Eocene (middle): Southern Texas.

A. C. Trowbridge, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 75; U. S. G. S. P. P. 131D, p. 92). *Bigford fm.*—Chiefly clay of many colors with subordinate quantities of gray, green, and brown ss. which at most places is not cross bedded. Contains many beds of lignite, the heaviest 20 inches thick, and some lens-shaped concretionary masses. Contains no paper shales and sands, such as occur in Indio fm., and no thick, cross-bedded, and commonly qtzitic sands, such as occur in Carrizo ss. Thickness 0 to 470± ft. Top fm. of Wilcox group. In part contemp. with Carrizo ss. and in part younger. Underlies Mount Selman fm. Named for Bigford ranch, Webb Co.

The Bigford was formerly treated as a fm. of Wilcox group, based on its fossil plants, but its invertebrate fossils are now generally considered to be of Claiborne age. It is therefore now treated by U. S. Geol. Survey as basal memb. of Mount Selman fm., of Claiborne group, as far N. as Atascosa Co.; and to N. of that Co. the contemp. Claiborne deposits, which differ lithologically, are called *Reklaw memb. of Mount Selman fm.*

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 619–620). Trowbridge's map and description indicate clearly he intended Bigford to be a facies of Carrizo sand—simply a change from sand to clay along the strike. Miss Gardner (prel. ed. geol. map of Tex., 1932) has amended and expanded Bigford fm. of Trowbridge in order to make it a valid fm. and has separated it from Carrizo. Since Reklaw has priority over the amendation of Miss Gardner, and since it is in established usage by geologists of the State, it is preferable to adopt it exclusively, if possible.

Bigfork chert.

Middle Ordovician: Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557; also Slates of Ark., Ark. Geol. Surv., pp. 30, 35). *Bigfork chert.*—Close-textured, even-bedded, siliceous rock in layers 1 to 18 inches thick; of slate to dark-gray color; very friable. In places thickly set with network of fine quartz veins. Weathered portions have appearance of fine-grained, gray weathered ss. Usually layers are crumpled to astonishing degree. Thickness 700 ft. Overlies [uncon.] Stringtown sh. and underlies Polk Creek sh. [Stringtown sh. now abandoned, for Womble sh.]

Named for development over large area around Bigfork P. O., Montgomery Co., Ark.

Big Glass Mountain complex.

Recent: Northern California (Modoc Lava Bed quadrangle).

H. A. Powers, 1932 (Am. Min., vol. 17, No. 7, pp. 280–282). *Big Glass Mtn complex.*—Big Glass Mtn, whose flows cover an area of about 9 sq. mi., is largest accumulation of Recent siliceous lava in Modoc Lava Bed quad. The lava ranges from rhyolite to dacite.

Bigheart sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

L. C. Snider, 1911 (Okla. Geol. Surv. Bull. 7, p. 221). Ss., 175 ft. thick, called *Bigheart ss.* by [L. L.] Hutchison in unpublished thesis (Univ. Okla. Lib., 1907). Overlies Stanton ls. Is separated from the higher Elgin ss. by 85 ft. of sandy and clay shales overlain by Nelagoney ss. (40 ft. thick).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686D, pp. 18, 19). *Bigheart ss. (restricted.)*—The name *Bigheart ss.* was used by L. C. Snider (Okla. Geol. Surv. Bull. 7, p. 221, 1911) for 175 ft. of sss. and shales supposedly exposed at and near Bigheart, but term is here restricted to basal massive ss. of that series of beds, which is useful horizon marker over consideable area, and which is well exposed at Bigheart, forming main ledge in bluffs W. of road btw. Bigheart and Quawpaw. It is a massive, cross-bedded, ledge-making ss., 25 to 50 ft. thick [70 ft. in later repts]. In some places it consists of a single bed; in other places it is separated into two members by a bed of red sh. 4 ft. or more thick. At its base it is slightly conglomeratic, and for several ft. above this basal part it is very coarse grained or gritty. It lies from 70 to 115 ft. above Birch Creek ls.

Is now treated as basal memb. of Nelagoney fm.

Named for exposures W. of Barndall (formerly called Bigheart), Osage Co.

Big Hill beds.

Upper Ordovician (Richmond): Northern Michigan (Delta County).

R. C. Hussey, 1926 (Mich. Univ. Mus., Geol. Contr., vol. 2, No. 8, pp. 115–150). *Big Hill beds.*—Vary from light gray ls., moderately hard, noncrystalline, to dark gray, argill. ls., hard, coarsely crystalline. Thickness 27± ft. Overlie Ogontz memb. of Stonington beds and form top div. of Upper Ord. Richmond fm. of Mich. Belong to late Richmond Arctic submergence. Exposed from crest of Hinkin's Hill (also known as Big Hill) north to E. end of Maywood road. Fauna differs from that of Stonington beds.

Bighorn dolomite.

Upper Ordovician: Wyoming and southern Montana.

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). ***Bighorn ls.***—On E. side of Bighorn Mtns, Wyo., consists of 250–300 ft. of ls., in greater part hard and massive. Top memb. is thin-bedded impure ls. which NW. of Buffalo, Wyo., contains large Richmond fauna. Middle memb. is less massive than basal memb. and in places consists of fine-grained, light-colored lss. containing numerous corals, including *Halysites catenulatus*. Lower memb. is hard, massive, impure ls., light gray or faint buff, with reticulating network of silica, which on weathering gives it a very coarse honey-combed appearance; contains a few late Ord. fossils. [On p. 434 he says the fossils in lower massive memb. are Trenton.] Underlies Little Horn [Madison] ls. [lower Miss.] and overlies Deadwood fm. [Upper Camb.].

See *Leigh memb. of Bighorn dol.*

A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 196–213). [Long discussion of faunas of Bighorn dol., from which he concludes whole fm. is of Richmond age. See under *Lander ss. memb.*]

E. Kirk, 1933 (Am. Jour. Sci., 5th, vol. 26, p. 42). I consider lower part of Bighorn dol. to be pre-Maysville and post-Trenton, and it probably represents a strat. unit not present in eastern United States.

Bighorn formation.

Cretaceous: Alberta.

G. S. Malloch, 1911 (Canada Geol. Surv. Mem. 9, p. 36), applied *Bighorn fm.* to a Cret. fm. in Bighorn coal basin, Alberta.

†Bighorn glacial epoch.

A name applied by W. W. Atwood and K. F. Mather (Sci., n. s., vol. 35, p. 315, 1912; Jour. Geol., vol. 20, p. 388, 1912; and Geol. Soc. Am. Bull., vol. 23, p. 732, 1912) to the time during which a till sheet of pre-Wisconsin age was deposited in San Juan Mtns of SW. Colo. It was expected that the name would be used by E. Blackwelder for a till of corresponding age in Bighorn Basin of Wyo. Atwood and Mather later replaced the name with *Durango glacial stage* (and *Durango drift*), a Colo. name.

†Bighorn moraine.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1912 (Jour. Geol., vol. 20, pp. 392–409), mapped and described *Bighorn moraine* and *Bighorn outwash* in San Juan Mtn region, SW. Colo., the deposits being correlated with glacial deposits of supposedly the same age in Bighorn Mtns of Wyo. Later (U. S. G. S. P. P. 95, p. 14, pl. 1, 1915, and P. P. 166, 1932) they replaced the name with the local Colo. name *Durango till.*

Big Injun group.

Big Injun sand.

Drillers' terms for beds that have been correlated with Burgoon ss. memb. of Pocono fm. (Miss.) of western Pa. and equiv. beds in eastern Ohio and northern W. Va. So called because of their hardness and thickness. In eastern Greene Co., Pa., the top is 1,225 ft. below Pittsburgh coal and thickness 250 to 300 ft. At Mount Morris, Greene Co., the sand is called *Mount Morris sand*, and is 101 ft. thick. In southern Ky. and Tenn. the name is applied to an oil-bearing calc. ss. of Miss. age. According to W. Stout et al (Geol. of nat. gas, A. A. P. G., 1935, p. 903), the Big Injun sand of SE. Ohio and northern W. Va. is Black Hand cgl.

Big Lake lime.

A subsurface gas-bearing ls., 10 ft. thick, in Clear Fork fm. of Big Lake oil pool, Reagan Co., Tex.

Big Lake Big lime.

A subsurface Perm. ls. series, 2,000–3,500+ ft. thick, in western Tex. (Pecos River region), extending from Big Lake to Yates on W. and S. and to N. Mex. line on N. Appears to lie 1,500 to 1,700 ft. higher than Amarillo Big lime.

Big Mountain shale member (of Keyser limestone).

Lower Devonian (Helderberg): Northern West Virginia and western Virginia.

F. M. Swartz, 1929 (U. S. G. S. P. P. 158, p. 29). *Big Mtn sh. memb.*—Greenish to yellowish calc. sh. with some impure lss.; separates upper ls. memb. of Keyser ls. from lower ls. memb. in parts of W. Va. and western Va. as far S. as Bolar Springs, where it wedges out and is replaced by part of the massive Clifton Forge ss. memb. of Keyser ls., with which it intertongues to N. Is 61 ft. thick at Big Mtn, about 1½ mi. W. of village of Upper Tract, Pendleton Co., W. Va., but thins to N. and S., being 45 ft. thick near Franklin and Wardensville, W. Va., and 10 ft. at Strait Creek, Highland Co., Va.

Big Red.

A term that has been applied by drillers in western Pa. to the part of Conemaugh fm. that is known as "Pittsburgh Reds." Also to younger beds of the Conemaugh that are known as "Washington Reds;" also to the still younger Birmingham sh. memb. of the Conemaugh.

Big Red Cave.

Drillers' name for 30 to 125± ft. of beds in Conemaugh fm. (Penn.) of W. Va., that lie in interval btw. Moundsville and Murphy sands and are believed to correspond to the beds known as "Pittsburgh Reds."

Big Shell.

A term applied by drillers of western Pa. to Patton sh. memb. of Pocono fm.

Big Sheep volcanics.

Age (?): British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 78).

Big Snowy group.

Mississippian: Central Montana.

H. W. Scott, 1935 (Geol. Soc. Am. Proc. 1934, p. 367). *Big Snowy group* is made up of Kibbey, Otter, and *Heath* fms. Is mainly variegated shales with intercalated lss. and sss. Overlies Madison ls.

H. W. Scott, 1935 (Jour. Geol., vol. 43, No. 8, pt. 2, pp. 1011–1032). *Big Snowy group.*—New name for lower part of beds heretofore assigned to Quadrant fm. in central Mont. True Quadrant fm. is absent in central Mont., where the rocks heretofore assigned to it are all of Miss. age, are all older than typical Quadrant fm., of Quadrant Mtn, Yellowstone Nat. Park (which is of basal Penn. age and unquestionably a westward extension of Tensleep ss., into which it grades), and are also older than Amsden fm., which is Miss. and underlies the Quadrant of Quadrant Mtn as well as the Quadrant of southern Mont. and overlies Big Snowy group in central Mont. This group has max. thickness of 1,200 ft. and rests on Madison ls. It is named for its extensive distribution and excellent exposures in Big Snowy Mtns. It is also exposed in Little Belt Mtns, Castle Mtns, and Lombard Hills. It is divided into 3 conformable fms., in descending order, Heath fm. (new name), Weed's Otter fm., and Weed's Kibbey fm. It is absent in Yellowstone Park, also in north-central Wyo. and southern Mont. In 1931 (U. S. G. S. P. P. 165, pp. 135–149) F. Reeves, although calling these rocks *Quadrant fm.*, suggested that the upper ls. of the unit is Amsden fm., a suggestion that has been verified by writer's work. In most areas there is uncon. (not angular) btw. Amsden and Quadrant and btw. Amsden and Tensleep, but in Three Forks region there is evidence that would support theory of continuous deposition.

Big Springs limestone. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska, northwestern Missouri, southwestern Iowa, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 47). *Big Springs ls.*—Bluish gray to light gray, massive, jointed, and quite fossiliferous. Thickness 1 to 3 ft. Overlies Doniphan sh. and underlies Queen Hill sh., all included in Lecompton ls. Recognized in Nebr., Iowa, Mo., and Kans. Exposed near Big Springs, Kans. [N. of Big Springs, Douglas Co., Kans.: Condra, 1937.]

Big Spruce Knob sandstone.

Mississippian: Southern West Virginia.

D. B. Reger, 1920 (W. Va. Geol. Surv. Rept. Webster Co., pp. 214, 221–223). *Big Spruce Knob ss.*—Greenish gray flaggy stratum, 0 to 30 ft. thick, lying 370 to 648 ft. below Pluto coal and resting on Big Spruce Knob sh. or on underlying Big Spruce Knob coal. Named for exposure at base of Big Spruce Knob, Pocahontas Co. Lies 750 ft. below Princeton cgl. and 837 ft. above Greenbrier ls. Included in Mauch Chunk.

Big Spruce Knob shale.

Mississippian: Southern West Virginia.

D. B. Reger, 1920 (W. Va. Geol. Surv. Rept. Webster Co., pp. 214, 223–224). *Big Spruce Knob sh.*—Gray sh., 0 to 2 ft. thick, containing plant fossils. Underlies Big Spruce Knob ss. and overlies Big Spruce Knob coal. Exposed on Big Spruce Knob, Pocahontas Co. Included in Mauch Chunk.

Bigstone morainic system.

Pleistocene (Wisconsin stage): South Dakota and western Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 105–111). [Members not named, except that Fergus Falls moraine belongs to it. Southernmost part is in Big Stone and Swift Counties, Minn., and along SW. side of Big Stone Lake, S. Dak.]

Big Stone Gap shale.

Upper Devonian and lower Mississippian: Southwestern Virginia.

G. W. Stose, 1923 (Va. Geol. Surv. Bull. 24). *Big Stone Gap sh.*—Black sh., generally soft, but contains some beds of harder, platy, dry, dull-black argillite. Thickness 320± ft. Has same lithologic character as Chattanooga sh. at Chattanooga. Ulrich identifies fossils from upper 100 ft. as of Sunbury age and those from lower part as of Cleveland and Huron age. Was not found in any section where Chemung rocks are recognized and relation to Chemung is therefore not positively established. Rests on Portage sh. and underlies Price ss. Named for Big Stone Gap, SW. Va.

J. H. Swartz, 1926 (Sci., n. s., vol. 64, p. 226). *Big Stone Gap sh.* contains typical Chemung fossils and is definitely Dev.

J. H. Swartz, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 498). The evidence to be presented later indicates a Miss. age for upper part and a Dev. age for lower part of Big Stone Gap sh. of Stose and Ulrich. The name *Big Stone Gap* is here restricted to uppermost part. (See *Big Stone Gap memb.*)

The U. S. Geological Survey at present adheres to original definition of Big Stone Gap sh.

Big Stone Gap member (of Chattanooga shale).

Devonian or Carboniferous: Southern Tennessee and southwestern Virginia.

J. H. Swartz, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 485–499). The Big Stone Gap sh. of Ulrich and Stose has been shown by direct and continuous tracing to be northward continuation of Chattanooga sh. of type area. Such being the case, the term *Big Stone Gap sh.* must be abandoned for prior term *Chattanooga sh.* Throughout whole area [Chattanooga, Tenn., to SW. Va.] the Chattanooga sh. [restricted] is divisible into 3 members: (1) An upper black sh. memb., to which the term *Big Stone Gap* is here restricted; (2) a middle gray sh. memb., here called *Olinger memb.*; and (3) a lower black sh. memb. here designated *Cumberland Gap memb.* The Big Stone Gap memb. is separated from underlying Olinger memb. by an uncon., which is most marked in SE. Tenn. and which may be absent in NE. Tenn. and SW. Va. The Big Stone Gap memb. extends continuously from Chattanooga area to Big Stone Gap and beyond. At Cameron Hill, Chattanooga, it is ⅝ inch thick; at Apison, 16 mi. away, it is 2 ft. 10½ in. thick; from here to Lafollette it remains approx. 2 ft. thick; btw. Lafollette and Cumberland Gap, on Va.-Tenn. border, it jumps suddenly to 81 ft. in thickness; at Big Stone Gap it is at least 96 ft. 5 in. thick. Is overlain, with sharp contact, by the gray Glendale sh.

J. H. Swartz, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 431–448), assigned his restricted Chattanooga sh., as defined above, to Miss., but U. S. Geol. Survey tentatively classifies these beds as Dev. or Carbf.

Big Thompson schist.

Pre-Cambrian: Central northern Colorado (Larimer County).

M. B. Fuller, 1924 (Jour. Geol., vol. 32, pp. 51–63). *Big Thompson schist.*—A series of metamorphosed sss., shales, and lss. with a small amount of cgl. The strata are a series of interbedded metamorphosed crystalline rocks derived by regional and contact metamorphism against granites which cut through the schists in stocks, bathyliths, and numerous dikes. There is a definite regular gradation of Big Thompson schists from the highly metamorphosed, dense black biotite-sillimanite schists of the Continental Divide and Estes Park region eastward through quartz-biotite and chlorite schists to pure quartz schists in Loveland Canyon. All the diverse phases are interbedded, show transition varieties, and, although clearly graded from W. to E., are undoubtedly parts of same formation. In general the schistosity is parallel to original bedding of the sediments.

Named for Big Thompson River, which, in traversing E. slope of Front Range, has exposed a complete section of the schist.

Big Valley bed. (In Strawn group.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 380). *Big Valley bed.*—In descending order: 150 ft. of bluish and sandy or black and shaly clay; 150 ft. of ss., mostly massive but in part flaggy and a little shaly; and 200 ft. of clay, generally blue, with considerable blackish sh. and a little ss. Is memb. of Strawn div. Underlies Brown Creek bed and overlies Bull Creek ss.

Named for Big Valley, Mills Co.

Bijiki iron-formation member (of Michigamme slate).

Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 596). *Bijiki schist.*—Peculiar schist with some qtzites. Thickness 520 ft. Equivalent in age to Goodrich qtzite of W. part of Marquette dist. Named for exposures near mouth of Bijiki River.

Later repts by C. R. Van Hise and others stated that Bijiki schist overlies Goodrich qtzite, and assigned it to upper Huronian. (See U. S. G. S. Bull. 360, 1909, and U. S. G. S. Mon. 52, 1911.)

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), changed name to *Bijiki iron-fm. memb.* and included it in Michigamme sl.

Billhook formation.

Upper Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, p. 487 and map). *Billhook fm.*—Tuff, 1,800 ft. thick, carrying "Cadoceras" sp. Uncon. underlies Kent fm. (Upper J.) and overlies Mysterious Creek fm. (Upper J.). [Derivation of name not stated and no geographic feature of that name shown on map.]

Billings sand.

A subsurface sand, of Penn. age and 12 ft. thick, in central northern Okla., reported to correlate with basal part of Pawhuska fm.

Bill's Creek beds.

Upper Ordovician (Richmond): Northern Michigan (Delta County).

R. C. Hussey, 1926 (Mich. Univ. Mus., Geol. Contr., vol. 2, No. 8, pp. 113–150). *Bill's Creek beds.*—Largely thin-bedded sh., with a few thin layers of interbedded argill. ls., highly fossiliferous. Chief exposures on Bill's Creek and along E. shore of Little Bay de Noc. Total thickness about 88 ft. The lowest beds of Upper Ord. Richmond fm. of Stonington region of Mich. Discon. overlain by Bay de Noc memb. of Stonington beds. Lower part of the beds may not belong to the Richmond.

Biloxi sand.

Pleistocene: Southeastern Louisiana and southern Mississippi.

L. C. Johnson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 24–25). The coastal sands, or *Biloxi sands*, as the deposits of the strip immediately adjoining the salt water of Mississippi Sound are called, represent now, by reason of modern subsidence, a remnant only of their former extent. The strip varies from zero to a width of several mi., stretching, as usually understood, from the Rigolets (or mouth of Pearl River) to Mobile Bay. Consist essentially of thin alternating layers of sand and yellowish brown or blue clay, similar to deposits now in process of accumulation upon floor of the sound. Thickness from borings at Biloxi, Pass Christian, and other places, 80 or 100 ft. Wanting at Ocean Spring. Younger than Pontchartrain clays.

See further explanation under *Pontchartrain clay* and *Port Hudson fm.*

Named for Biloxi, Harrison Co., Miss.

Bimber Run conglomerate member.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 86, table opp. p. 61). *Salamanca cgl. suite* is usually initiated by a basal cgl. which merits differentiation. Is well developed S. of Warren along Allegheny River. *Bimber Run cgl. memb.* is suggested for it, from its occurrence on this run and S. of its mouth, in Watson Twp, Warren Co., Pa. Max. thickness in type section 100+ ft. In Pa. repts has been called "Venango second B ss.," also "Tanners Hill quarry rock," in contradistinction to overlying upper Salamanca cgl. Is lenticular and not present much E. of Kinzua or Great Bend of Allegheny River; does not extend, so far as known from well logs, W. of Titusville meridian. [See also 1934 entry under *Salamanca cgl.*]

†Bingen formation.

†Bingen sand.

Upper Cretaceous (Gulf series): Southwestern Arkansas, southeastern Oklahoma, and northwestern Louisiana.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 56–58). *Bingen sands.*—Extensive aren. fm., consisting of fine white quartz sand with occasional thin beds of lignite. Can only be classified as isolated outcrops of concealed westward continuation of upper and lower beds of typical Camden series. Includes many nodular concretions of iron ore and often extensive layers of ferruginous ss. Constitutes most of sandy uplands of eastern Howard, western Hempstead, southern Sevier, Little River, Nevada, and Clark Counties, Ark. Occupies same relative position above Arkadelphia shales as does Camden series. Included in Eocene.

A. C. Veatch, 1906 (U. S. G. S. P. P. 46, table opp. p. 16, pp. 23–25). *Bingen sand.*—Near-shore deposits, of white or brown sands and clays containing some greensand and considerable lignite or lignitiferous matter. Max. thickness over 500 ft. Basal fm. of Upper Cret. Time equiv. of Woodbine sand, Eagle Ford clay, and Sub-Clarksville sand [Blossom sand]. Underlies Brownstown fm. and overlies Washita group.

Is now divided into Tokio fm. above and Woodbine sand below. See under *Tokio fm.*

Named for exposures near Bingen, Hempstead Co., Ark.

Bingham quartzite.

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, pp. 33–37, map, sections). *Bingham qtzite.*—Chiefly fine-grained qtzites and sss., more or less silicified. Mostly white and frequently vitreous. In lower portions of the qtzite, especially below the Jordan ls., a slight banding is seen in many places, also cross bedding. In upper part of fm., particularly above Highland Boy ls., are many layers of ripple-marked argill. and slightly calc. sss. In places very thin layers of fine-grained quartz cgl. occur. Thickness exposed in Bingham dist. probably 8,000 or 10,000 ft., but neither top nor bottom of fm. appears in this dist. Is interbedded with many ls. masses, the most prominent of which are here named *Phoenix ls. lentil*, 0 to 300 ft. thick; *Tilden ls. lentil*, 100 ft.; *Yampa ls. lentil*, 0 to 400 ft.; *Highland Boy ls. memb.*, 0 to 400 ft.; *Commercial ls. memb.*, 0 to 200 ft.; *Jordan ls. memb.*, 20 to 300 ft.; *Lenox ls. memb.*, 200 ft.; *Butterfield ls. memb.*, 300 ft.

B. S. Butler, 1920 (U. S. G. S. P. P. 111, p. 348). The important Jordan and Commercial lss. occur in lower part of Bingham qtzite, and the Highland Boy, Yampa, and other lss. possibly considerably higher.

Binnewater sandstone. (In Salina formation.)

Silurian: Southeastern New York.

C. A. Hartnagel, 1905 (N. Y. State Mus. Bull. 80, pp. 342–357), divided *Salina beds* of High Falls region of eastern N. Y. into (descending): Rosendale cement; Wilbur ls.; *Binnewater qtzites* (the so-called Clinton qtzites); and High Falls sh. (red sh.). Of the Binnewater he says: South from High Falls the qtzite below the Wilbur ls. becomes more calc. and of a shaly nature.

In 1906 A. W. Grabau (N. Y. State Mus. Bull. 92) designated these beds as *Binnewater ss.*, by which name they have since been known. C. Schuchert in 1916 (Geol. Soc. Am. Bull., vol. 27, pp 540–542) assigned to them a thickness of 32 to 35 ft. in Binnewater-High Falls region.

Named for occurrence at Binnewater, 7 mi. SW. of Kingston, Ulster Co. See also under *Bertie ls. memb.*

Binney sand.

A subsurface sand, of Penn. age, in Binney–Hohertz field, Stephens and Palo Pinto Counties, north-central Tex., lying at 1,700 ft. depth.

Birch Creek schist.

Pre-Cambrian: Eastern Alaska.

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 140–145, 224). *Birch Creek series*.—Chiefly qtzite schists, generally of light gray color, but locally they pass into darker, finer grained, and even graphitic schists. The typical rock is a qtzite, hard and white in the less-sheared portions. There are also found, although rather sparingly, schists of igneous origin, being dikes which have intruded into the sed. series previous to the shearing. In some places the contact btw. this igneous schist and the sed. qtzite schist was seen, proving its dikelike nature. So far as noted, these intrusions were of granite in its various phases. Thickness of Birch Creek series about 25,000 ft. The Birch Creek series forms the oldest sed. series known. It underlies Fortymile series and rests on the basal granite. Named for exposures in Birch Creek dist.

In subsequent repts the associated igneous rocks, which range in composition from basic greenstones and hornblende schists to acidic intrusives, have been both included in and excluded from Birch Creek schist. The present approved definition restricts the name *Birch Creek schist* to the sed. rocks, although the associated igneous rocks may for convenience be mapped with the Birch Creek. The assemblage is susceptible of subdivision as more detailed work is done. The rocks designated by Spurr as "Fortymile series" are in part Birch Creek schist and in part of Paleozoic age, and that term has been discarded.

Birch Creek limestone bed. (In Ochelata formation.)

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686D, pp. 17–19). *Birch Creek ls.*—Hard, light-gray, crystalline, somewhat dolomitic ls., sparingly fossiliferous. Thickness

4± ft. Laterally it grades into limy ss. Is overlain and underlain by thick sss. Lies 70–115 ft. below Bigheart ss. in T. 24 N., R. 10 E. Named for exposure in bluffs on N. side of Birch Creek, near E. edge of SE. ¼ sec. 25, T. 24 N., R. 10 E.

O. B. Hopkins and S. Powers, 1919 (U. S. G. S. Bull. 686S, p. 239, pl. 38). Above the 55 to 70 ft. of sh. which overlies Clem Creek ss. is another series of sss. which is substantially = Okesa and Torpedo sss. of twps to N. At base, or at some places 12 to 15 ft. above base, of this series of sss. is a sandy ls., 0 to 11 ft. thick, named *Birch Creek ls.* by Bowen. In NE. corner of T. 24 N., R. 11 E. this ls. is replaced by ss.

Is a bed at or near base of Torpedo ss. memb. of Ochelata fm.

Birch Lake sandstone.

Upper Cretaceous: Alberta and Saskatchewan.

S. E. Slipper, 1918 (*Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 8*).

Birch Lake series.

Pre-Cambrian: Ontario.

E. M. J. Burwash, 1922 (Jour. Geol., vol. 30, p. 396).

Bird Creek limestone member (of Buck Creek formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686L, p. 137, pl. XXI). *Bird Creek ls.*—Lowest ls. exposed over any considerable part of area (Tps 24, 25, and 26 N., Rs. 6 and 7 E.; Tps 25 and 26 N., R. 5 E.; T. 26 N., R. 4 E.). Is a dense, fine-grained noncrystalline rock 4± ft. thick. On fresh surface is commonly lead-gray to black and weathers to a dirty buff or yellow. When struck with hammer it breaks along bedding planes with comparatively smooth surfaces. Few fossils. Is hard and fairly resistant to erosion but does not produce a marked topog. effect. Is older than Stonebreaker ls. Named by K. C. Heald (rept in preparation) from exposures in T. 27 N., R. 8 E.

K. C. Heald, 1919 (U. S. G. S. Bull. 686Q, pp. 214, 216). *Bird Creek ls.*—In most places where seen there is but a single bed, 2± ft. thick, but at a few localities there are two beds separated by 6± ft. of sh. The rock is hard and very brittle. Both weathered and fresh surfaces are dark bluish gray, so dark that many samples might be called black. Is characterized by a distinct brachiopod fauna. Lies 50± ft. below *Cryptozoon*-bearing ls., about 70 ft. above Turkey Run ls., and a little more than 100 ft. above "red lime" at top of Pawhuska ls. Named for exposure on valley sides of Bird Creek and tributaries.

Birdhead sandstone member (of Thermopolis shale).

Upper Cretaceous: Central southern Montana (Bighorn and Yellowstone Counties).

W. T. Thom, Jr., G. M. Hall, C. H. Wegemann, and G. F. Moulton, 1935 (U. S. G. S. Bull. 856). *Birdhead ss. memb.*—Rim-forming ss. 0 to 15 ft. thick, lying about 130 ft. above base of Thermopolis sh. in Bighorn Co. and Crow Ind. Res., Mont. Birdhead Coulee cuts across the ss. in T. 3 S., R. 27 E., Yellowstone Co.

Bird Mountain grit.

Upper Ordovician (?): Southwestern Vermont (Rutland County).

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pp. 337–340). There is little doubt that *Bird Mtn grit and cgl.* occupies same strat. relations to schists of Taconic Range E. of it as the upper Sil. Rensselaer grit [Lower Camb. ? now] does to those of same range in Mass. and N. Y. [Bird Mtn is in Castleton quad., W. of West Rutland.]

T. N. Dale, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 15–23). *Bird Mtn grit.*—Grit and cgl. interbedded with muscovite (sericite) schist; pebbles of pre-Camb. granite and gneiss and either Camb. or Ord. crystalline ls., and calc. and micaceous qtzite. Is petrographically different from Rensselaer grit. Probably belongs in upper part of Ord. and later than Calciferous. Overlies Berkshire schist [which is now classified as Upper and Middle (Trenton) Ord.]

†Birdseye limestone.

A descriptive term applied in a titular sense in early N. Y. repts to Lowville ls. It is said to have first been used by Amos Eaton in 1824, the name being suggested by the "eyes" or light-colored specks due in part to a characteristic fossil supposed to be a form of coral and now known as *Tetradium cellulosum*. As defined by L. Vanuxem in 1838 (N. Y. Geol. Surv. 2d Rept., pp. 255, 257, 283) it included all rocks btw. Trenton ls. and "Calciferous sandrock" [Beekmantown], and thus included Black River and Chazy lss. In 1842 (Geol. N. Y., pt. 3) Vanuxem defined it as lower part of Black River ls., as overlain by grey ls. forming upper part of the Black River, and as underlain by Chazy ls. In 1899 Clarke and Schuchert replaced the descriptive term "Birdseye" with *Lowville ls.*, by which name it is known today.

birdseye porphyry.

A descriptive term that has been applied to a local mass of porphyry of pre-Camb. age in Socorro Co., N. Mex., and also to a local mass of porphyry of Tert. age in Stockton and Fairfield region, Utah.

Birdsong shale.

Lower Devonian (Helderbergian): Western Tennessee (Tennessee River Valley region).

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 741). *Birdsong sh.*—Bluish shaly ls. and sh., 35 to 65 ft. thick. Uncon. underlies Decaturville chert and uncon. overlies Olive Hill fm. Typically developed along valley of Birdsong Creek, Benton Co., where it is about 45 ft. thick. Very fossiliferous. Correlated with New Scotland. Included in Helderbergian or Linden group.

Bird Spring formation.

Pennsylvanian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 9, 21, etc.). *Bird Spring fm.*—Gray ls. and dol., in beds ranging in thickness from thinnest laminae to 60 ft., separated by sh. and ss.; from Goodsprings northward a conglomeratic ss. at base; many beds in upper 1,000 ft. were doubtless originally dol., but it appears probable the remaining lower part was made up wholly of ls., sh., and ss. Thickness 2,500± ft. Rests uncon. on Monte Cristo ls. (Miss.) and underlies Supai fm. (Perm.). Large Penn. fauna (listed). Underlies a large area in Bird Spring Range. [Mr. Hewett sent an advance copy of his Goodsprings section, and the names he proposed to apply to the fms., to W. S. Glock, who in 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 326–339) described the *Bird Springs fm.* in east-central part of Spring Mtn Range, Goodsprings quad.]

C. R. Longwell and C. O. Dunbar, 1936 (Geol. Soc. Am. Proc. 1935, pp. 89, 375). Fusulinas collected in Las Vegas quad. indicate upper 2,900 ft. of *Bird Spring fm.* correlates with Wolfcamp and Leonard fms. of west Tex., and the Bird Spring is therefore considered to be Perm. The upper 1,500 ft. correlates with Leonard and the 1,400 ft. next below with the Wolfcamp.

†Birdsville formation (also †Birdsville group).

Mississippian: Western Kentucky and southeastern Illinois.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 109). *Birdsville fm.*—Shales, sss., and thin lss. composing upper fm. of Chester group. Overlies Tribune ls. and underlies [uncon.] Mansfield ss. (Penn.).

E. O. Ulrich, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 157). *Upper Chester or Birdsville group.*—Includes all of Chester series of western Ky. and Ill. above base of typical Cypress ss., which is uncon. on older rocks.

Now divided into several named fms. and discarded. (See Ill. chart.) Named for Birdsville, Livingston Co., Ky.

Birmingham shale member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and northern West Virginia.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K, p. 79). *Birmingham sh.*—A dark thinly laminated sh. nearly 50 ft. thick, which occurs below Morgantown ss. at Pittsburgh. Joints pass through the mass. Outcrops at Birmingham station [just W. of Pittsburgh].

P. E. Raymond, 1909 (Sci., n. s., vol. 29, pp. 940–941). Base of *Birmingham sh.*, of Conemaugh series of western Pa., lies 25 ft. above top of Ames ls.

E. W. Shaw and M. J. Munn, 1911 (U. S. G. S. Burgettstown-Carnegie folio, No. 177, p. 4). *Birmingham sh. memb.* of Conemaugh fm. overlies Berlin coal and extends up to Elk Lick coal (or Elk Lick clay where present). Consists of sh., sandy sh., and some ss. Thickness 50 to 60 ft.

†Birmingham breccia.

Lower Ordovician: Northern central Alabama (Birmingham quadrangle).

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. Cahaba coal field, p. 152). *Birmingham breccia.*—Breccia made up of angular fragments, chiefly from Knox dol., and is of course younger than Knox dol. Occurs in greatest volume in Salem Hills, but also at other places [mentioned], including Birmingham. Has been called Birmingham breccia by Mr. Russell of U. S. Geol. Survey [unpublished] and Salem breccia by State Survey. This breccia belongs perhaps to Trenton or Pelham ls.

Preoccupied by Birmingham sh. memb. of Conemaugh fm., and replaced by Attalla chert cgl. memb. of Chickamauga ls.

Named for exposures at Birmingham.

Birmingham red bed. (In Conemaugh formation.)

Pennsylvanian: Western Maryland and Pennsylvania.

C. K. Swartz 1922 (Md. Geol. Surv. vol. 11, p. 63, pl. 6), applied *Birmingham red bed* to red beds in western Md. and Pa. that occur at strat. horizon of Birmingham sh. and Grafton ss.

Birmingham moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (fig. 7) in U.S.G.S. Detroit folio (No. 205), p. 9, also on moraine map (pl. 32) in U.S.G.S. Mon. 53. Named for Birmingham, Oakland Co.

Bisbee group.

Lower Cretaceous (Comanche series): Southeastern Arizona.

E. T. Dumble, 1902 (Am. Inst. Min. Engrs. Trans., vol. 31, pp. 696–715). *Bisbee beds.*—Consist of (descending): (1) Interbedded sands and clays; (2) interbedded lss., clays, and sands, with oysters at base and *Caprotina* and other fossils at top; (3) lss. and clays containing *Trigonia, Exogyra,* and other fossils; and (4) interbedded sands and clays with cgl. at base. Of Cret. age. Exposed at Bisbee, Ariz. (whence the name) and in Rucker Canyon.

F. L. Ransome, 1904 (U.S.G.S.P.P. 21, p. 56). *Bisbee group.*—Same unit as Dumble's *Bisbee beds*, but in Bisbee quad. is here divided into 4 fms. (descending), Cintura fm., Mural ls., Morita fm., and Glance cgl.

Bisher formation.

Silurian (Niagaran): Southwestern Ohio (Highland and Adams Counties) and northern Kentucky (Lewis County).

A. F. Foerste, 1917 (Ohio Jour. Sci., vol. 17, pp. 189, 190). *Bisher memb.*—Lower memb. of West Union fm. in Highland and Adams Counties. [West Union as here used extended up to base of Cedarville dol.] Typically exposed NE. of Bisher Dam [about 1 mi. S. of Hillsboro]. Contains a very characteristic fossil horizon about 9 ft. above base, and several other layers, less abundantly fossiliferous, occur btw. 12 and 20 ft. farther up. Underlies Lilley memb. of West Union.

A. F. Foerste, 1919 (Ohio Jour. Sci., vol. 19, pp. 367–375). *Bisher memb. of West Union fm.*, 45 ft. thick, corresponds to Lower or West Union Cliff of Orton. Is faunally distinct from overlying Lilley memb., and is of upper Clinton age.

A. F. Foerste, 1923 (Denison Univ., Sci. Lab. Jour., vol. 20, pp. 41–43). *Bisher fm.* corresponds approx. to West Union or Lower Cliff of Prof. Orton, and this name would have been retained if Prof. Orton ever had described any section from West Union area, or had designated at Hillsboro the same boundaries btw. the West Union and Springfield beds as those adopted later btw. the Bisher and Lilley fms. The Bisher fauna can be traced from Hillsboro southward throughout Highland and Adams Counties, Ohio, and Lewis Co., Ky., as far S. as N. part of Fleming Co., Ky. Has not been identified anywhere N. of Hillsboro, Ohio, altho the strata immediately beneath Springfield ls. along creek ½ mi. W. of Port William, NE. of Wilmington, Ohio, appear to contain a somewhat similar fauna. But no trace of overlying Lilley fauna is to be found so far N.

A. F. Foerste, 1935 (Denison Univ. Bull., Sci. Lab. Jour., vol. 30, p. 128). In Lewis Co., Ky., *Bisher fm.* rests on Ribolt sh. and at most places underlies Ohio black sh., but on Ohio River at Vanceburg it is overlain by Greenfield dol., of Cayugan age. [Gives further details on pp. 140–141.]

Bishop conglomerate.

Tertiary (Miocene?): Northeastern Utah, northwestern Colorado, and southwestern Wyoming.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 44, 62, 169). *Bishop Mtn cgl.*—Composed of bowlders and pebbles of ss., qtzite, and crystalline schists, but sss. and quasi qtzites greatly prevail. Found only in isolated patches as remnants adventitiously preserved from general erosion to which this widely spread fm. has been subjected. Thickness 300 ft. [on p. 40, but on p. 170 he says 1,000 ft. at head of Sheep Creek]. Can be seen on summit of Bishop Mtn, where it lies uncon. on eroded beds of Bitter Creek group. A fine exposure can also be seen on summit of Quien Hornet Mtn, where it rests on Lower Green River beds. On N. side of Sage Creek it uncon. overlies beds of Lower Green River age. [In columnar section on p. 40 he shows this cgl. uncon. on Brown's Park group, but in text he does not say that it anywhere rests on Brown's Park, although on p. 62 he says: The Bishop Mtn cgl. is found at different places to lie uncon. upon every group of the table which is represented in Uinta Mtns and adjacent country.]

J. D. Sears, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 279–304) and 1926 (U. S. G. S. Bull. 781B, pp. 16, 22). Writer believes Bishop cgl. is = basal memb. of Browns Park fm. of Uinta Mtn region.

W. H. Bradley, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 11, p. 318) and 1936 (U. S. G. S. P. P. 185–I), demonstrated that Bishop cgl. is older than Browns Park fm., and J. D. Sears accepted Bradley's evidence.

Some workers believe Browns Park fm. is Plio. or includes beds of Plio. age, but U. S. Geol. Survey tentatively classifies it as late Mio. or early Plio.

Caps Bishop Mtn, Sweetwater Co., SW. Wyo., now known as Pine Mtn.

Bishop sandstone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 301). *Bishop ss.*—Sss., 500 ft. thick, underlying Junction lss., overlying Duchesne lss., and composing a middle fm. of Flaming Gorge series in Utah. [Assigned to late Jurassic, but Keyes also states that it may correspond to Unkpapa ss. (Upper Jurassic) and Lakota ss. (Lower Cret.) of Black Hills section. Derivation of name not stated.]

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 40), the Bishop ss. and Duchesne ls. of above rept. are Entrada ss. and Carmel fm., both Upper Jurassic.

Bishop Brook limestone.

Devonian (Lower): Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 27, 32). *Bishop Brook ls.*—Top unit of Manlius group. [See 1929 entry under *Manlius ls.*] Is gray in color; lower portions are in places a mass of crinoid fragments; upper layers appear to be evenly bedded, but cross bedding has been noted in basal portions. Fauna appears to be Helderbergian, but is so far unstudied. Lies uncon. on Pools Brook ls., and at Manlius is uncon. overlain by basal quartz sands of the Onondaga (reworked Oriskany). In Onondaga Co. this fm. is known only from hillside E. of Manlius village. Named for Bishop Brook, NE. of Manlius.

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 80–82). *Bishop Brook ls.*, as I saw it in field with A. E. Brainerd, appears to be essentially topmost Becraft or Alsen, high in Helderbergian, thus emphasizing overlap nature of uncon. seen in eastern N. Y. btw. Manlius and Coeymans lss., first pointed out by writer.

†Bishop Mountain conglomerate.

Tertiary (Miocene?): Northeastern Utah, northwestern Colorado, and southwestern Wyoming.

See *Bishop cgl.*

†Bison beds.

A paleontologic term applied by O. C. Marsh to the beds in Denver Basin, Colo., which were later named *Denver fm.*, the paleontologic name being derived from presence in the beds of *Bison alticornis*, a horned dinosaur.

Bison banded member.

Permian: Central northern Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Bison banded memb.*—The upper 150 ft. of Hennessey sh., consisting largely of rusty red, blocky, non-fissile clay shales, characterized by considerable number of white or greenish bands or streaks of sh., here sandy, there calc. These bands or streaks are thicker and more numerous than in underlying Fairmont memb., being in some cases 3 to 4 ft. thick. Base is placed at lowest heavy white band of Hennessey sh. Named for fact it is exposed on all sides of Bison, Garfield Co.

Bissett conglomerate.

Triassic (?): Western Texas (Glass Mountains).

P. B. King, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 212–221). *Bissett fm.*—Chiefly calc. cgls. derived from underlying beds. In upper part red shales alternate with cgl. and in addition a few layers of ls. and dol. appear. Locally red shales appear beneath the main cgl. Thickness 0 to 500 [720] ft. Underlies Comanche series with angular uncon. and overlaps undoubted marine Permian fms. (Tessey, Gilliam, and upper part of Vidrio). On Bissett Mtn it rests on upper massive memb. of Vidrio fm. Named for exposures on NW. and NE. flanks of Bissett Mtn, SW. part of Glass Mtns. Absent in NE. part of Glass Mtns. No fossils found. May be late Perm., Triassic, Jurassic, or early Cret.; most probably Perm. or Triassic.

P. B. King, 1931 (Univ. Tex. Bull. 3038). *Bissett fm.* is probably upper Perm., but may be Triassic.

R. Roth, 1932 (Jour. Geol., vol. 40, No. 8, p. 701), from field study believes Bissett fm. at type loc. of Bissett Mtn is of Comanche age. Is uncon. on Tessey, Gilliam, and Vidrio fms.

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 738–739), changed name to *Bissett cgl.* (the fm. consisting chiefly of cgl.) and age to Perm. (?).

W. B. Lang, 1935 (A. A. P. G. Bull., vol. 19, No. 2, p. 270). It is believed Bissett cgl. represents an accumulation of lower Triassic sediments of possible Moenkopi time equivalence and therefore considerably older than the terrestrial Dockum and Santa Rosa deposits farther N.

P. B. King, 1935 (A. A. P. G. Bull., vol. 19, No. 10, pp. 1545–1546). Present evidence favors early Triassic, rather than Perm., as age of Bissett cgl. Writer is now inclined to support Lang's suggestion that the Bissett is of pre-Dockum Triassic age.

At present *Triassic (?)* is age classification of U. S. Geol Survey.

†Bitter Creek group.

Eocene: Southwestern Wyoming (Sweetwater County), northeastern Utah, and northwestern Colorado.

E. D. Cope, 1872 (Phila. Acad. Nat. Sci. Proc., vol. 24, p. 279; and Proc. Am. Phil. Soc. 1872, p. 481), in referring to the *coal series of Bitter Creek*, casually used *Bitter Creek coal strata*, *Bitter Creek series*, and *Bitter Creek series of coal*.

F. B. Meek, 1873 (U. S. Geol. and Geog. Surv. Terr. 6th Ann. Rept., pp. 455–462). *Bitter Creek series.*—A vast succession of rather soft, light-yellowish, lead gray and whitish sss. with seams and beds of various colored clays, sh., and good coal. Thickness reaches 4,000+feet. Fresh water, brackish water, and salt water fossils. Either Cret. or Tert., probably latter. Exposed along Bitter Creek (a small tributary of Green River in Wyo.) from Black Butte NW. to Salt Wells Station on U. P. R. R. and at some other points W. of Salt Wells. Conformably underlies Washakie group [Bridger fm.] and rests, apparently conformably, on thin layers of grayish and drab slabby sss. and shales, probably of Cret. age.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 45, 64, 162). *Bitter Creek group.*—Badland sss., often with much gyp.; indurated sss., ferruginous; shell marls; many beds of carbonaceous shales and lignitic coal. To S. the group consists of indurated sss. and lss. Thickness 3,000 ft. Underlies Green River group and rests on Point of Rocks group with erosion uncon. The beds called *Washiki group* are upper part of Bitter Creek series. [Powell mapped these beds in SW. Wyo., NE. Utah, and NW. Colo.]

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Bitter Creek group of Powell in SW. Wyo., as including several Eo. and Upper Cret. fms., in descending order, Wasatch group, Evanston fm., so-called Laramie fm., Lewis sh., and upper part of Mesaverde fm. This reconnaissance term has lost its usefulness and is no longer employed.

†Bitter Creek series.

See under †*Bitter Creek group.*

Bitter Creek formation.

Jurassic or Triassic: Northwestern British Columbia (Portland Canal region) and southeastern Alaska.

R. G. McConnell, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 63), 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 57), 1913 (Canada Geol. Surv. Mem. 32, p. 12).

J. B. Mertie, Jr., 1921 (U. S. G. S. Bull. 714, p. 134), assigned these rocks to Paleozoic or Mesozoic; G. Hanson, 1929 (Canada Geol. Surv. Mem. 159, p. 6), assigned them to Jurassic or Triassic.

Bitter Creek peridotite.

Cretaceous (?): Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 9, 118° to 118° 30'). *Bitter Creek peridotite, Cret. (?).* Occurs near 49th par.

Bitter Rock sand.

A term applied in western Pa. to a subsurface sand in Pocono fm., which some consider lies lower than Murrysville sand, and higher than Hundred-foot sand; others that it lies higher than the Murrysville and lower than Papoose sand, and others that it is=part of Squaw sand.

Bitterroot period.

Pre-Cambrian: Montana.

C. [R.] Keyes, 1926 (Pan-Am. Geol., vol. 46, p. 203). *Cherry Creek* [of Peale] is preoccupied several times over. The time represented may be termed *Bitterroot period*, after the most conspicuous geographic features on top of the continent. *Madisonic period* would be more appropriate, and perhaps more euphonious, and with a periodic ending would not likely be confused with the so-called Madison ls. of Carbonic age in same region, which also is repeatedly preoccupied for distant terranes. Even *Cherrio* might be permissible as a periodic term.

Biwabik iron-formation.

Pre-Cambrian (middle Huronian): Northeastern Minnesota (Mesabi district).

C. R. Van Hise and C. K. Leith, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 353, 358–370). *Biwabik fm.*—Fine-grained and largely non-clastic rocks (cherts, slates, silicate and carbonate rocks, more or less ferruginous), with a film of fine cgl. at base. Thickness 500 to 1,000 ft. Conformably underlies Virginia sl. and conformably overlies Pokegama fm.; all included in upper Huronian. Is called

Biwabik fm. because biwabik is Chippewa word for a piece or fragment of iron, and Biwabik mine is one of earliest and largest mines located on the fm.

C. K. Leith, 1903 (U. S. G. S. Mon. 43), gave thickness of Biwabik fm. as 200 to 2,000 ft., and stated the Virginia sl. grades both vertically and laterally into Biwabik fm.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360) and 1911 (U. S. G. S. Mon. 52) assigned this fm. to upper Huronian.

C. K. Leith, 1933 (16th Int. Geol. Cong. Guidebook 27, p. 9), assigned this fm. to middle Huronian, as did C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184).

Bixby zone.

A subsurface petroliferous zone, about 2,400 ft. thick, forming lower part of Fernando group in Long Beach field of Los Angeles Basin, Calif. Named for fact that the Shell Bixby No. 1 well has produced from this sand.

Bixler sand.

A subsurface sand, 5 to 50 ft. thick, in Ponca City field, Kay Co., Okla. Correlated with upper part of Cherokee sh. Is a higher sand than Markham sand and lies a short distance below Oswego lime.

Blach Ranch limestone member (of Thrifty formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31). *Blach Ranch ls.,* 3 to 5 ft. thick, lies 20 to 40 ft. below top of Thrifty fm. and 17 to 35 ft. below Breckenridge ls. memb. of Thrifty.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 154–158). *Blach Ranch ls. memb. of Thrifty fm.*—Massive light-gray ls.; weathers buff or brown and in large slabs or rounded boulders. Rather unfossiliferous. Thickness 3 to 8 ft. Lies 30± ft. above Ivan ls. memb. of Thrifty and 25 to 45 ft. below Breckenridge ls., the top memb. of the Thrifty. Named for exposures in vicinity of Blach Bros. ranch, E. of Breckenridge, Stephens Co. Is thought to be = Chaffin ls. of Drake in Colorado River section.

†Black shale.

A descriptive term applied in early repts to a widespread deposit of black sh. commonly assigned to Dev. and supposed to be same fm. throughout several States. It is now known by following names in different States:

New York. For many years the upper black sh. has been called Genesee sh. (Upper Dev.) and the lower black sh. has been called Marcellus sh. (Middle Dev.).

Michigan. Antrim sh., Upper Dev.

Ohio. Ohio sh., Upper Dev. (Genesee, Portage, and Chemung).

Indiana. New Albany sh. (Upper Dev.).

Kentucky. Ohio sh. (Upper Dev.) in eastern Ky. as far S. as Somerset, Pulaski Co.; Chattanooga sh. (Dev. or Carbf.) S. of Somerset; New Albany sh. (Upper Dev.) W. of Cincinnati arch adjacent to southern Ind.; Chattanooga sh. in western Ky.

Virginia. Now divided into Big Stone Gap sh. (Dev. and Carbf.), Portage sh. (Upper Dev.), and Genesee sh. (Upper Dev.) in SW. Va. (Wise and Scott Counties).

Tennessee, Georgia, Alabama, Illinois, Missouri: Chattanooga sh., Dev. or Carbf. (Formerly classified as Dev.)

Arkansas. Chattanooga sh. (Dev. where Genesee and Portage (?) fossils are found; elsewhere Dev. (?)).

Oklahoma. Chattanooga sh. (Dev. ?).

Black flint member. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio (Jackson and Vinton Counties).

H. Morningstar, 1922 (Ohio Geol. Surv., 4th ser., Bull. 25, p. 130). *Black flint memb.*—Consists of (1) 0 to 6'' of nodular ore, sparingly fossiliferous, underlain by (2) very fossiliferous black flint or ls. 1 ft. thick. Very local. Outcrop confined to Jackson Co. and SW. part of Vinton Co. Overlain by Brookville coal and underlain by Homewood sh. and ss.

†Black Ledge. (In Powell dolomite.)

Lower Ordovician (Beekmantown): Northern Arkansas (Yellville quadrangle).

E. T. McKnight, 1935 (U. S. G. S. Bull. 853). *†Black Ledge.*—A coarse-grained, massive dol., characterized by quartz-lined druses and in places greenish or gray chert segregations, persistent over Yellville quad. Thickness 7 to 10 ft. Lies 50 to 60 ft. above base of Powell dol. Is called "Black Ledge" because it generally weathers dark. Commonly carries ores. There are other ledges of same type in the Powell but not so thick.

†Black Bear limestone.

Miners' local name for an ore-bearing ls., 80± ft. thick, in middle part of Oquirrh fm. (Penn.) of northern Utah. Exposed in Black Bear claim, Stockton dist. Lies from 120 to 250 ft. above Ben Harrison ls. (See U. S. G. S. P. P. 173, 1932.)

†Black Bluff group.
†Black Bluff clay.
†Black Bluff series.
(In Midway group.)

Eocene (lower): Southern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 61–62). *Black Bluff series.*—Consists of (descending): (1) 20 to 25 ft. of yellowish clay, which makes the basis of the Flatwoods; (2) 40 ft. of black slaty clay carrying marine fossils; and (3) 8 to 10 ft. of brownish sh. or clay. Overlies Midway or Pine Barren beds and underlies Naheola and Matthew's Landing series.

Replaced (E. A. Smith, Sketch of geol. of Ala., Roberts & Son, Birmingham, Ala., 1892) by *Sucarnoochee clay,* which has become established name of the fm. in Ala. Is same as Porters Creek clay of Miss.

Named for exposures at Black Bluff, on Sucarnoochee Creek, at its junction with Tombigbee River, in Sumter Co.

†Black Butte quartzite.

Upper Cretaceous: Southwestern Wyoming (Sweetwater County).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns. p. 160). *Black Butte qtzite.*—A dark, indurated, and exceedingly tough qtzite that caps Black Butte, SW. of Black Butte Station, on Union Pacific R. R. [Sweetwater Co.]. In distance this qtzite has appearance of a bed of extravasated material. Thickness 200+ ft.

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, pl. 1), mapped the rocks of Black Butte as middle part of Mesaverde fm., older than Almond coal group and younger than Rock Springs coal group. The rocks occupying this interval (which have a thickness of 800 to 1,000 ft.) have since been named *Ericson ss.* According to Schultz (unpublished memo.) the qtzite that caps Black Butte belongs to a larger mass, which grades laterally into ss., and the qtzite has no strat. value. The name has therefore been discarded.

Black Buttes coal group.

Name that has been locally applied to Lance fm. and underlying beds of Fox Hills age in Rock Springs uplift, Sweetwater Co., SW. Wyo. (See U. S. G. S. Bull. 702, 1920.)

Black Canyon schist.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). *Black Canyon schist.*—Schists and gneisses of metamorphic complex of Gunnison River region, which show great diversity in composition and texture, including all gradations from biotite schist, quartz-muscovite schist, and granite gneiss to chlorite and amphibole schists and even to amphibolite. The commonest and fundamental rock is biotite schist. The rocks range from black to gray; weathering may give them brownish or yellowish tones, and abundant microcline may add a slight pinkish tint. Most of rocks are well laminated. Occurs throughout area, with many interruptions, from Cochetopa Creek down the Gunnison nearly to mouth of Smiths Fork. Save for the many bodies of igneous rocks that have invaded it and the River Portal schist, which might be regarded as a part of it and which extends from a point E. of Cimarron to N. end of Vernal Mesa, the pre-Camb. area adjacent to Gunnison River is composed almost entirely of *Black Canyon schist.* Best and most accessible exposures are in walls of Black Canyon from Sapinero to the Curecanti granite and up Lake Fork Canyon to granite mass 1 mi. above Vanguard. May be older than River Portal mica schist.

On 1935 Colo. geol. map this fm. was assigned to Gunnison River series, which includes all of oldest exposed rocks in Colo.

Black Canyon formation.

Jurassic: British Columbia.

C. H. Crickmay, 1930 (Calif. Univ., Dept. Geol. Sci. Bull., vol. 19, No. 2, p. 33).

Black Cap phase.

See 1928 entry under *Conway granite.*

Black Crater formation.

Late Tertiary: Central northern Oregon (Cascade Mountains).

E. T. Hodge, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 163). The *Black Crater fm.* underlies glacial drift, covers most of the eastern surface with basalt flows or high volcanoes, and passes under the Deschutes sand, which is probably post-Pleist. [Appears to be next younger than his Mount Jefferson fm. (Plio.).]

E. T. Hodge, 1928 (Pan-Am. Geol., vol. 49, pp. 341–356). *Black Crater fm.*—The basalts of Black Crater cover a large area on E. slope of Cascade Mtns. Are of pre-Glacial, pre-Pleist., origin. Overlie Mount Jefferson fm.

Black Creek formation.

Upper Cretaceous: Eastern South Carolina and western North Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 12, 13, 14). *Black Creek sh.*—Soft shales and black clay, exposed along Black Creek in Darlington and Florence Counties, and along Pee Dee Valley interruptedly from near Society Hill to Jeffries Creek, where it passes under Burches Ferry marl. Its probable equivalent extends easterly through Marion Co., where it is exposed in bed of Little Pee Dee tributaries. Overlies Middendorf clays (Lower Cret.).

As defined above the Black Creek excluded the †Middendorf deposits (present in Ga. and S. C.), which were then supposed to be of Lower Cret. age. Further studies of †Middendorf deposits, however, resulted in proving the Upper Cret. age of their flora, and led to belief that they were = beds composing lower part of Black Creek fm. in some localities. In 1912 (U.S.G.S.P.P. 71, p. 659) L. W. Stephenson redefined Black Creek fm. so as to include, at base, the †*Middendorf arkose memb.* Still later work, however, led to exclusion (C. W. Cooke, U.S.G.S.P.P. 140, pp. 137–139, 1926) of †Middendorf deposits from overlying Black Creek deposits (from which they are now known to be separated by a distinct uncon. and with which they are in sharp lithologic contrast) and to their being treated as a distinct fm. (uncon. overlain by Black Creek fm. and uncon. underlain by crystalline rocks), the Black Creek fm. being restored to its original definition. The Black Creek is overlain (uncon. in S. C. but conformably in N. C., according to L. W. Stephenson) by Peedee fm., and is of Ripley and Eutaw age. Thickness 0 to 400 ft. The name "Middendorf fm." has been abandoned, the beds having proved to be same as Tuscaloosa fm., the older name. (See C. W. Cooke, U. S. G. S. Bull 867, 1936.)

Named for exposures along Black Creek in Darlington and Florence Counties, S. C. C. W. Cooke states (U.S.G.S. Bull. 867, 1936): Although no locality was specified by Sloan as the type, the outcrops of the fm. on Black Creek near the crossing of Cashua Ferry road E. of Darlington may be regarded as typical.

Black Creek coal group.

A group of coal beds in Pottsville fm. (Penn.) of Warrior coal field, north-central Ala., lying 600 to 800 ft. above Boyles ss. memb., and including Black Creek, Jefferson, and Lick Creek coals, also Bremen ss. memb.

Black Diamond coal group. (In Mesaverde group.)

Name locally applied to the group of coal-bearing strata in Iles fm. of NW. Colo., lying 200 to 400 ft. below Trout Creek ss. memb. of the Iles. The Black Diamond mine, in Meeker quad., works one of the coals.

†Black Earth dolomite member (of St. Lawrence formation).

Upper Cambrian: Southern Wisconsin and northern Illinois.

E. O. Ulrich, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 477–478). We are indebted to efforts of Dr. Samuel Weidman and Mr. F. T. Thwaites, of Univ. of Wis., for discovery of a dolomitic ledge in St. Lawrence fm. that in both its lithologic character and faunal contents closely resembles true Mendota dol. This ledge is developed to W. of Madison in hills bordering valley of Black Earth Creek, btw. Black Earth and Mazomanie, Wis. It should be mentioned, further, that the bed lies in middle of the St. Lawrence, beneath *Dikelocephalus minnesotensis* zone, and that the St. Lawrence is second fm. beneath top of Camb. as now defined in Upper Mississippi Valley. The Jordan ss. lies btw. the St. Lawrence and the overlapping and consequently varying base of the Ozarkian. Fauna consists of 13 species, 10 of which are strikingly like species found in nearly every exposure of fossiliferous part of true Mendota, but they occur associated with 3 fossils which, so far as known, have no representatives in true Mendota fauna, and which are for present the real guide fossils from Black Earth dol. zone.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, No. 7, p. 547). Trempealeau fm. is divided by E. O. Ulrich [unpublished at this time] into four members: (1) Norwalk fine-grained dolomitic ss. at top, underlain by (2) Lodi yellow and purple sandy thin-bedded dol., locally called "shale," which in turn rests on (3) the *St. Lawrence* [restricted] or *Black Earth dol.*, a rock almost exactly like the Mendota and which seems to make up bulk of the [†Trempealeau] fm. S. of Wisconsin River, under cover, and which rests on (4) sandy dolomitic shales of local distribution.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 23). All evidence indicates Black Earth, Mendota, and St. Lawrence [restricted] are different expressions of same dol. [which they treat as a memb. of their Trempealeau fm., in which they include Jordan ss.].

F. T. Thwaites, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 118). [See this citation under *Mendota dol.*]

Replaced by *Mendota dol. memb.*, the earlier name, and now considered a synonym.

Blackface Mountain shale.

Devonian: Alberta.

J. A. Allan, P. S. Warren, and R. L. Rutherford, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 234).

Blackfoot formation.

Pre-Cambrian (Belt series): Central western Montana (Mission Range).

C. D. Walcott, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 5, 9, 11). *Blackfoot series.*—Middle subdivision of Algonkian in Camp Creek and Swan Range sections of Mission Range, Mont. In Camp Creek section consists of (descending): Calcareo-aren. beds, 155 ft.; shaly lss., 1,310 ft.; calcareo-aren. shales, 155 ft.; thin-bedded ls., 815 ft.; shaly and thin-bedded ls., 520 ft.; siliceous ls., 1,850 ft. Underlies Camp Creek series and overlies Ravalli series [Ravalli group].

Named for exposures in canyon of North Fork of Blackfoot River, Mont., where entire section is exposed. Is correlated with Wallace fm.

Blackfoot cycle.

Name applied by G. R. Mansfield (Jour. Geol., vol. 32, 1924, p. 485) to an erosion cycle in SE. Idaho, which he had also called *Gibson cycle*.

Blackfootian series.

Pre-Cambrian (Belt series): Alberta and Montana.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, pp. 217, 218), applied *Blackfootian series* to the rocks underlying Striped Peak fm. of NW. Mont., overlying St. Regis ss., and corresponding to Wallace fm. In 1926 (Pan-Am. Geol., vol. 46) he applied the name to Newland ls. and Chamberlain sh., which he excluded from Belt series.

Black Girl limestone.

See entry No. 1 under †*Pony Express beds*.

Black Hand formation.

Mississippian: Central Ohio.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, pp. 216, 217). *Black Hand cgl.*—Generally rather fine pudding stone; in places beds many ft. thick are merely coarse ss. with pebbly partings; chiefly of light yellow or buff color; in some places nearly white, or brick red; highly ferruginous, but less so than Coal Measures cgl.; also contains more earthy matter and less pure silica than latter cgl. Thickness 85 to 90 ft. Overlain by Licking shales [Logan fm.] and underlain by Raccoon [Cuyahoga] shales. All included in Waverly group.

See also under *Black Hand memb.*

Black Hand member.

Mississippian: Central and southern Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 667–682, 757–779). *Black Hand memb. of Cuyahoga fm.*—Massive coarse quartz sss. with occasional shaly beds; usually yellow or buff, sometimes reddish. Thickness 50 to 150 ft. Is a local development of Cuyahoga fm. [expanded definition] and not as important a strat. unit as any one of the three members of the Logan. Underlies Berne memb. In central Ohio overlies Raccoon memb. of Cuyahoga. In Hocking Valley overlies Fairfield memb. of Cuyahoga fm.

Appears to be basal part of Black Hand fm. of Prosser and other geologists.

According to Jesse E. Hyde (Jour. Geol., vol. 23, p. 659, 1915) and C. S. Prosser (Ohio Geol. Surv., 4th ser., Bull. 7, p. 17, 1905) there is difference of opinion regarding the rocks originally included in Logan ss. by E. B. Andrews, also regarding the correct definitions of Black Hand and Cuyahoga. In paper cited Hyde included part of the Black Hand in Logan fm. and the rest of it in Cuyahoga fm., and restricted the name *Black Hand* to a memb. of latter fm., as expanded by Hyde. This memb. was described as consisting of 50 to 150 ft. of coarse pebbly ss. with occasional beds of cgl. lying btw. Berne memb. above and Fairfield memb. below, or to beds older than cgl. 1 of Prosser. This classification was also followed by W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 47), and appears to be present definition of Ohio Geol. Survey. According to Hyde (1915) the Black Hand fm. of Prosser extended from top of Hyde's Allensville memb. to base of his Black Hand memb.

Named for exposures at Black Hand, Licking Co.

Blackhawk formation. (Of Mesaverde group.)

Upper Cretaceous: Central eastern Utah (Wasatch Plateau and Book Cliffs).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, p. 443). *Blackhawk fm.*—A succession of ss., sh., and coal beds of kinds common in Mesaverde group. Thickness 750 to 900 ft. in Wasatch Plateau and 450 ft. in Book Cliffs. Base is normally drawn at base of lowest coal bed. Is middle fm. of Mesaverde group. Underlies (uncon.?) Price River fm. and conformably overlies Star Point ss. Named for prominent exposures near Blackhawk, a mining community on E. front of Wasatch Plateau.

Blackhawk breccia.

Pleistocene: Southern California (San Bernardino County).

A. O. Woodford and T. F. Harriss, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, pp. 267, 279–283). *Blackhawk breccia.*—Chiefly made up of ls. blocks, usually only a few inches or at most a few ft. in diam., but at mouths of Blackhawk and Miles Canyons more or less brecciated ls., hundreds of ft. across, are mapped as part of the fm., because they seem to be landslide blocks inextricably involved in the breccia. Basal part of fm. consists of alternating beds of ls. breccia and ss. Greater part of material is spread out over the desert at foot of the mtns. The fm. is of landslip origin. Thickness 100 to 600 ft. Includes *Heights fangl.* of Vaughan, 1922. Assigned to Pleist. Typically developed at mouth of Blackhawk Canyon.

Blackhawkian.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 54, 1930, p. 377) for the till deposits which have been called *Iowan* but which "should not be called by that name."

Black Hill shale.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1885 (Washburn Coll. Lab. Nat. Hist., vol. 1, No. 3, p. 90). *Black Hill sh.*—Unique deposit of carbonaceous and rapidly decomposing sh., which affords an easily recognized horizon for reference in any studies that may be made of neighboring fms. Assigned to Benton.

F. W. Cragin, 1895 (Am. Geol., vol. 16, p. 379). *Black Hill sh.*—Black carbonaceous clay sh., 15 or 20 ft. thick, forming basal bed of Fullington shales. Overlain by Blue Cut shales (upper bed of Fullington shales) and underlain by Champion shell bed. Is also called *Wafer sh.* Assigned to Comanche Cret.

Named for Black Hill, Comanche Co.

Black Hill rhyolite.

Tertiary: Leadville region, Colorado.

W. Cross, 1886 (U. S. G. S. Mon. 12, p. 349). Almost wholly quartz and feldspar. Forms Black Hill, about 18 mi. SE. of Leadville.

Blackhorse shales.

Upper Cretaceous: Central northern South Dakota and southwestern North Dakota.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 37, No. 1, pp. 63–64). *Blackhorse shales*, 500 ft. thick, underlie Ludlow lignites and overlie Fox [Fox Hills] sss. Are basal shales of Lance fm. in S. Dak. and N. Dak. Blackhorse Butte is conspicuous landmark in Schanasse [?] Co., S. Dak., and overlooks Grand River Valley and the basal shales of the Lance.

Blackjack basalt.

Miocene: Southeastern Oregon.

K. Bryan, 1929 (U. S. G. S. W. S. P. 597, p. 55), and B. C. Renick, 1930 (Jour. Geol., vol. 38, p. 504). *Blackjack basalt.*—Normal augite hypersthene labradorite basalt, interbedded in middle of Payette fm. Thickness 350 to 450 ft. Named for fact it caps Blackjack Butte, Malheur Co. [Named by B. C. Renick.]

Blackjack School sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Blackjack School ss. memb. of Atoka fm.*—Thin to massive bedded ss., medium to fine grained, commonly greenish brown, weathering dirty yellowish brown, but sometimes white to light brown on fresh surfaces; grades downward into sandy sh. Fossils. Thickness 25 to 40 ft. Lies 150 to 220 ft. below top of Atoka fm. and 150 to 350 ft. above Webbers Falls ss. memb. Named for exposures at and around Blackjack School, sec. 9, T. 11 N., R. 19 E.

Blacklead limestone.

Paleozoic? (pre-Permian): Northern Idaho (Orofino region).

A. L. Anderson, 1930 (Idaho Bur. Mines and Geol. Pam. 34). *Blacklead ls.*—Massive, thick-bedded ls. greatly resembling the grayish thick-bedded Paleozoic lss. in Mont. and in Idaho SE. of Salmon River Mtns. Considerably metamorphosed by intrusives, so that no fossils are preserved, but bedding is everywhere distinct. Magnetite in seams and lenses is extensively developed through the ls. along bedding planes and fractures, the result of contact metamorphism. Thickness 400+ ft.; base not exposed. Lies far back in Clearwater Mtns, at head of Cayuse Creek, a tributary of N. Fork of Clearwater River. Forms an engulfed block or pendant 2± mi. long and ½ mi. wide near N. margin of Idaho batholith, in a high glaciated valley btw. Blacklead Peak and Rhodes Creek. Assigned to Paleozoic (?). [Derivation of name not stated, but almost certainly is Blacklead mining dist., Clearwater Co.]

Blackleaf sandy member (of Colorado shale).

Upper Cretaceous: Northwestern and central northern Montana.

E. Stebinger, 1918 (U. S. G. S. Bull. 691E, pp. 154, 158–164). *Blackleaf sandy memb. of Colorado sh.*—An alternation of dark shales and gray to greenish gray sss. in beds 20 to 75 ft. thick, composing lower 600 to 700 ft. of Colorado sh. in Birch Creek-Sun River area, Mont. Is a unit clearly distinguishable from remaining shaly part of Colorado sh. The dark shales throughout Blackleaf memb. are very similar to shales higher in the Colorado, and range from hard fissile sh. to soft, not well bedded, and more nearly clay sh.; colors black, greenish black to bluish gray, and even light gray in more calc. parts. All of this memb. is marine. The sss. are medium to coarse grained, in places ripple marked, and are rather evenly distributed throughout Blackleaf memb. Rests on Kootenai fm. [Fossils listed.]

Named for Blackleaf Creek, along which the beds are well developed.

Black Mesa basalt.

Tertiary: Panhandle of Oklahoma (Cimarron County).

A. C. Shead, 1923 (Univ. Okla. Bull., n. s., No. 271, pp. 108–113). *Black Mesa basalt.*—Olivine diabasic basalt. Called *"Malpais" basaltic lava* by C. N. Gould in U.S.G.S.W.S.P. 148, p. 82. The basaltic cap of Black Mesa, in extreme NW. part of Okla. Panhandle, is easternmost occurrence of Tert. lava flow which is so conspicuous and picturesque a landscape feature in what is known as Mesa de Maya or Raton Mesa region of NE. N. Mex., SE. Colo., and western Okla. Area covered by flow in Okla. is 1.5± sq. mi. Rothrock gives average thickness of flow in Cimarron Co., Okla., as varying from 50 ft. 2 mi. N. of Kenton, Okla., to 66 ft. at Nigger Spring.

R. L. Six, 1930 (Okla. Geol. Surv. Bull. 40WW), assigned this basalt to Plio.

Black Mingo formation. (Broad sense.)

Eocene (lower): Eastern South Carolina (parts of Georgetown, Williamsburg, Berkeley, Clarendon, Summit, Lee, Richland, and Calhoun Counties).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C.). *Black Mingo shales* (lower Eocene) underlie Congaree shales and overlie Burches Ferry marl (Upper Cret.).

E. Sloan, 1907 (Summ. Min. Res. S. C., pp. 12, 16). *Black Mingo shales.*—Laminated shales separated by thin layers of very fine micaceous sands, the whole partly silicified; also contains a thin layer of marl. Underlies Congaree shales and overlies Burches Ferry marl (Upper Cret.). Of lower Eocene age. Exposed along Black River from Brewington Lake, Clarendon Co., to mouth of Black Mingo Creek, up which it is exposed to point btw. Rhems and General Marion Bridge.

E. Sloan, 1908 (Catalogue of mineral localities of S. C., S. C. Geol. Surv., ser. 4, Bull. 2, especially p. 449). *Black Mingo phase (lower Eocene).*— Divided into (descending): (1) Lang Syne beds; (2) *Upper Black Mingo*, which includes (descending) Williamsburg pseudo-buhr and Rhems sh.; and (3) *Lower or Black Mingo sh.* Underlies Congaree phase (middle Eocene) and overlies Burches Ferry phase (Upper Cret.).

C. W. Cooke, 1936 (U.S.G.S. Bull. 867). Sloan's 1908 definition of *Black Mingo phase* included all strata of lower Eocene age E. of Santee River. In present rept *Black Mingo fm.* includes all Eocene strata in S. C. older than McBean fm., of middle Eocene (Claiborne) age. It is of Wilcox age, and correlates chiefly with Tuscahoma sand of Ala.

Black Mountain basalt flow.

Tertiary or Quaternary: Southern California (western El Paso Range, eastern Kern County).

C. L. Baker, 1912 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 7. pp. 121–142). *Black Mtn basalt flow.*—Olivine basalt, both vesicular and compact. Thickness more than 100 ft. Of post-Miocene Tert. age, and younger than Rosamond series.

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95, pp. 20–61). *Black Mtn basalt* is both intrusive and extrusive. Intrudes Rosamond series and Red Mtn andesite. Named for widespread basalt flows on Black Mtn, 7 mi. W. of El Paso Peaks, Kern Co., where they uncon. overlie Tert. sediments. They are probably very late Plio. or early Pleist.

Black Mountain volcanics.

Probably Upper Triassic or Jurassic: Southern California (San Diego County).

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). *Black Mtn volcanics.*—Chiefly volcanic, including aggls., although in certain places sediments are present. Contain rather massive cgls., qtzites, shales, massive andesitic aggls., trachytic and andesitic flows, and tuffs. All metamorphosed. Thickness more than 2,000 ft. Oldest rocks exposed in La Jolla quad. Rest on intrusive rocks, and nowhere is basement exposed. Uncon. overlain by Chico (Cret.). No fossils. Well developed on Black Mtn, N. part of La Jolla quad.

Black Mountain granite.

Age (?): Southeastern Vermont (Windham County).

C. H. Richardson, 1933 (18th Rept. Vt. State Geol., pp. 349–357, in description of Putney Twp). Acid intrusives are not present in this Twp, but in Dummerston Twp, first Twp to S., they include the well-known *Black Mtn granite.* [Black Mtn is in Brattleboro quad.]

†Black patch grit.

Lower Cambrian: Eastern New York and western Vermont.

T. N. Dale, 1893 (U.S.G.S. 19th Ann. Rept., chart opp. p. 178). *Black patch grit* overlies Camb. roofing slates [Mettawee sl.] and underlies Cambric black sh. [Schodack shales and lss.].

See *Eddy Hill grit* of Ruedemann, which replaces it.

Black Point basalt.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Black Point basalt.*—Chiefly basalt and tuff. Composes Black Point (promontory). Included in middle part of Honolulu volcanic series [q. v.]. Overlies Diamond Head tuff.

†Black Prairie series.

Upper Cretaceous (Gulf series): Texas and Arkansas.

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, pp. xiii-xiv). *Upper Cretaceous or Black Prairie series*; a local name for the Upper Cret. deposits of Tex. and SW. Ark.

Same as Gulf series, older name.

Named for Black Prairie of eastern Tex. and Ark. defined by R. T. Hill in Am. Jour. Sci., 3d, vol. 33, p. 294.

Black River group.

Middle Ordovician: New York and Pennsylvania.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 38–45). *Black River ls.*—Underlies Trenton ls. and overlies Calciferous group [Beekmantown]. Includes (descending): (1) Mohawk ls. (base of Trenton ls.); (2) gray ls.; (3) birdseye ls.; and (4) Chazy ls. Named for exposures in cliffs on Black River.

E. Emmons, 1842 (geol. map of N. Y.). Birdseye, Trenton, and Chazy lss. excluded from Black River ls.

J. Hall, 1843 (N. Y. Nat. Hist., div. 4, geol. 4th dist., pp. 18, 28). *Black River ls. group* overlies Calciferous sandrock and underlies Trenton ls. Includes Chazy and Birdseye lss.

J. Hall, 1847 (Pal. N. Y., vol. 1). *Black River ls.* probably rarely or never exceeds 10 ft. in thickness and is absent in places. Is a well-defined mass of grayish blue ls., very compact, and sometimes subcrystalline in texture. Underlies Trenton ls. and overlies Birdseye [Lowville] ls. [Subsequent repts, by different authors, assigned to *Black River ls.* as defined by Hall a thickness of 0 to 75 ft. and to the †Birdseye a thickness of 0 to 85 ft.]

Hall's 1847 definition was used by geologists generally for many years. In 1902 (Bull. Am. Pal. No. 14), however, P. E. Raymond definitely included *Birdseye zone* in *Black River ls.*, but Ulrich (1902), Schuchert (1902), Clarke (1903, 1908), Cleland (1903), Cushing (1905, 1908), Hartnagel (1907), Miller (1909, 1910) followed the 1847 definition and excluded the †Birdseye. In 1910 (N. Y. State Mus. Bull. 145) R. Ruedemann divided *Black River group* into (descending): (1) *Amsterdam ls.;* (2) Watertown ls., 10 ft. (=7-foot tier or Black River ls. of Hall); and (3) Lowville ls., 60 ft., divided into *Leray ls. memb.* (10 ft. of ls. more cherty than that below) and *Lowville ls. s. str.* (22 to 55 ft. of dove and blue dove ls., both thick and thin bedded, and conglomeratic at base). He stated that Watertown and Leray lss. taken together are known in the Thousand Islands region as *Black River ls.* In table on p. 97 he called top fm. of *Black River group,* in Mohawk and Champlain Valleys and at Saratoga, the *Amsterdam ls.*, which he did not define but placed stratigraphically higher than Watertown ls. In further explanation of 1910 classification, H. P. Cushing in 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135–144) stated: It has finally been decided best to revert to Vanuxem's usage (except for inclusion of the Chazy), and to apply *Black River* to entire rock group btw. Trenton and Chazy, the usage which Geol. Survey of Canada has consistently followed. In N. Y. State Mus. Hdb. 19 (1912) C. A. Hartnagel followed the 1910 classification, which is present commonly accepted definition of *Black River group.*

See further details under *Lowville ls.*

In central Pa. the Black River group is divided into Rodman ls. (above) and Lowville ls. In SW. Va. it is divided into Lowville ls. (below) and Chambersburg ls.

G. M. Kay, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 227), divided *Black River group* at *type section* into Chaumont fm. (including Watertown and Leray) and Lowville, and stated: *Pamelia fm.*, commonly classified as Chazyan, may belong in Black River group below the Lowville, according to Alice E. Wilson.

†Black River iron-bearing series (also *schists*).

†Black River Falls iron-bearing schists.

Pre-Cambrian (lower ? Huronian): Southwestern Wisconsin (Jackson County).

C. R. Van Hise, 1892 (U. S. G. S. Bull. 86, pp. 190, 195, and map, pl. 3). *Black River Falls series.*—*The Black River Falls iron-bearing schists* of Wis. have not such observable structural relations as to enable me certainly to determine their position. They are thoroughly crystalline schists, in vertical attitude, and are provisionally placed in lower Huronian. [Probably named for exposures at Black River Falls, Jackson Co.]

R. D. Irving, 1892 (U. S. G. S. Mon. 19, pl. 1), mapped *Black River iron-bearing schists.*

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned these rocks to Huronian, but not to any specific part of the Huronian.

†Black Rock diabase.

Upper Triassic: Central Massachusetts (Mount Holyoke region).

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50, and Mon. 29, pp. 17–18, pl. 34). *Black Rock diabase,* cores and dikes intrusive into the Juratrias sediments [Newark group]. Named for Black Rock, S. of Mount Holyoke.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 272). *"Black Rock" diabase* is not intrusive, as originally supposed, but a part of Hampden diabase flow, of Newark group, which is interbedded in Longmeadow ss.

Black Rock erosion cycle.

Name applied by E. Blackwelder (Jour. Geol., vol. 23, p. 312, 1915) to a pre-Kansan Pleist. erosion interval in Wind River Mtns, Wyo.

Black Rock coal group.

Name locally applied to Wasatch fm. in Rock Springs uplift of Sweetwater Co., SW. Wyo. (See U. S. G. S. Bull. 702, 1920.)

Black Rock limestone.

Lower Cambrian (?): Southeastern Idaho (Pocatello).

A. L Anderson, 1928 (Idaho Bur. Mines and Geol. Pam. 28, p. 4). *Black Rock ls.*—Thick-bedded, massive, relatively pure, gray ls., with some sandy ls. members near top of ridge and minor amounts of calc. sh. in some parts of fm. The ls. is 800+ ft. thick and is *overlain* by 150± ft. of calc. sh., sandy sh., ss., and qtzite, with the sh. near base and the qtzite near top where the fm. merges with Brigham qtzite. Some of ls. beds contain small rounded concretions and other more irregular forms that may be traces of fossils. Underlies Brigham qtzite conformably, and it is therefore believed it must be Lower Camb. Is underlain, probably conformably, by a sh. series. Named because of occurrence along Black Rock Creek, 2± mi. NE. of Portneuf Siding. Best exposed on N. side, where it can be traced up Black Rock Creek for several miles.

Black Rock formation.

Lower Ordovician (Beekmantown): Northern Arkansas (Sharp and Lawrence Counties) and southeastern Missouri (?).

G. C. Branner, 1929 (geol. map of Ark.). *Black Rock ls.*—Lss., 0 to 200± ft. thick, uncon. underlying Everton ls. and uncon. overlying Smithville ls. in Ozark region, Ark. [Mapped at and around Black Rock, Lawrence Co., Ark.] Assigned to Upper Canadian [which is Beekmantown of U. S. G. S.].

H. S. McQueen, 1930 (Insoluble residues as a guide in stratigraphic studies, published March 1930; Reprint of App. I, 56th Bien. Rept., 1931, p. 25). *Smithville-Black Rock fms.* have been shown on recent ed. of geol. map of Ark. Detailed features of each have not yet been published, nor has opportunity for detailed study of their insoluble residues been presented. They occur btw. Powell dol. and St. Peter ss. The Smithville is thought to occur in SE. Mo., for in a few wells ls. and slightly dolomitic ls. yielding a small residue have been found above Powell fm., but overlying *Black Rock ls.* has not been recognized in Mo.

E. T. McKnight, 1935 (U. S. G. S. Bull. 853, on Yellville quad., Ark.). *Black Rock fm.*—Chiefly fine-grained, gray, mag. ls. or dol. that weathers drab or whitish, with minor amounts of ss. and blue gray ls. Thickness in Sharp and Lawrence Counties, Ark., 200± ft. Absent in Yellville quad. Not studied in detail. Uncon. overlies Smithville fm. The Black Rock and Smithville fms. resemble Everton fm. in lithology, but are believed by E. O. Ulrich, on basis of fossil evidence, to occupy an interval btw. Everton fm. above and Powell dol. below, and to be uncon. with Everton and with Powell.

Blacksburg schist.

Cambrian (probably Lower): Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1921 (Limestones and marls of N. C., by G. F. Loughlin et al: N. C. Geol. and Econ. Surv. Bull. 28, pp. 29, 73). *Blacksburg schist.*—A fm., 800 to 1,000 ft. thick, which varies from a fine-grained graywacke (an impure variety of ss.) to sericite schist. Overlies qtzite, cgl. and schist [Kings Mtn qtzite] and underlies Gaffney marble. [See also A. Keith, U. S. G. S. Gaffney-Kings Mountain folio, No. 222, 1931.]

Named for development in Blacksburg, Cherokee Co., S. C.

Blacks Fork member (of Bridger formation).

Eocene: Southwestern Wyoming.

H. E. Wood, 2d, 1934 (Am. Mus. Nat. Hist. Bull., vol. 67, art. 5, May 26, pp. 241–242). By the present somewhat unwieldy terminology, Bridger A+B, Bridger C+D, Uinta A+B, and Uinta C are each essentially members, each containing distinctive fossil mammals. They deserve equal rank with such commonly recognized units as the Lysite, Lost Cabin (=Wind River, sensu stricto) [of NW. Wyo.], and, almost, the Chadron, but are not at present named or fully treated as such. I accordingly propose *Black's Fork memb.* for lower half of Bridger (A+B of Matthew, 1909), the name being taken from Black's Fork of Green River, which flows past most of the best known exposures. Most famous and typical loc. is "Grizzly Buttes" on Smith's Fork, starting ½ mi. S. of town of Mountain View and ending 1½ mi. SW. of the town. I propose *Twin Buttes memb.* for upper half of the Bridger (C+D of Matthew), the name being taken from Twin Buttes, W. of the Green River and E. of Henry's Fork Table. Bridger C and D are both exposed on the slopes of Twin Buttes. Type loc. is Henry's Fork Table and Twin Buttes. I propose *Wagonhound memb.* for the lower Uinta (A+B of Peterson [included in Bridger fm. by U. S. Geol. Survey and others]), the name being taken from Wagonhound Canyon (which opens into White River, Utah), in and near which typical and fossiliferous exposures occur. I propose *Myton memb.* for Upper Uinta (C of Peterson), the "true Uinta" of various authors [and Uinta fm. of U. S. Geol. Survey and others], from town of Myton, Utah; typical exposures occur E., N., NW. of the town at mouth of Lake Fork, and at other points in almost all directions from the town. The Lower and Upper Bridger, as well as Lower and Upper Uinta are distinct from each other geographically as well as faunistically, so that they fully deserve to rank as separate units.

Blacks Fork glacial stage.

Pleistocene: Northeastern Utah and southwestern Wyoming.

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). A glacial stage in Uinta Mtns, NE. Utah and SW. Wyo. Probably of Iowan or Illinoian age. Named for fact extensive moraines were left by its glaciers in valley of Blacks Fork, Utah.

Blacksmith limestone.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 6, 7). *Blacksmith fm.*—Gray aren. ls. in massive layers. Thickness 570 ft. in Blacksmith Fork, Cache Co., Utah, and 23 ft. W. of Liberty, Bear Lake Co., Idaho. Middle Camb. fossils. Underlies Bloomington fm. and overlies Ute fm. Type loc. in Blacksmith Fork Canyon, 8± mi. above its mouth and 15 mi. E. of Hyrum, Cache Co., Utah.

Blacksnake sandstone member (of Hance formation).

Pennsylvanian: Southeastern Kentucky (Cumberland Gap district).

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, p. 80 and pl. 16). [*Blacksnake* (*Cawood*) *ss.* on pl. 16; *Blacksnake* (*?*) *ss.* on p. 80. All of definition.]

†Blackstone series.

Pre-Cambrian: Northeastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 8, 104–109). *Blackstone series.*—A series of lss., chloritic and hornblendic schists, slates, and qtzites, which occur in lower portion of Blackstone Valley and near Providence, R. I. On lithological grounds, which have some support in stratigraphy, the series can be divided into [ascending] Cumberland qtzites, Ashton schists, and Smithfield lss. Uncon. overlain by lowermost Camb. (Olenellus) horizon. Named for typical development in lower course of Blackstone River btw. Woonsocket and Pawtucket, R. I.

A local name for all pre-Camb. sediments of the region, which are now divided into Marlboro fm. (above) and Westboro qtzite.

Blackstone shale.

Upper Cretaceous: Alberta.

G. S. Malloch, 1911 (Canada Geol. Surv. Mem. 9, p. 35).

Blacksville limestone. (In Washington formation.)

Permian: Southwestern Pennsylvania and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 36). *Blacksville ls.*—Quite pure gray ls, 3 to 5 ft. thick. Lies 30 to 50 ft. above Washington coal and underlies Washington "A" coal. Outcrops near bed of Dunkard Creek, in village of Blacksville, Monongalia Co., W. Va. Is ls. III of Stevenson's Greene and Washington Co. (Pa.) Rept.

G. H. Ashley, 1908 (Pa. Topog. and Geol. Surv. Comm. Rept. 1906–1908, p. 145). In Washington and Greene Counties, Pa., the *Blacksville ls.* occurs persistently 30 to 50 ft. above Washington coal.

Blacktail formation.

Pre-Cambrian (Belt series): Northern Idaho (Pend Oreille district).

J. L. Gillson, 1925 (Am. Min., vol. 10, p. 189) and 1927 (Jour. Geol., vol. 35, No. 1, pp. 1–32). New name *Blacktail fm.* is proposed in unpublished rept. on Pend Oreille dist. [by E. Sampson and J. L. Gillson], to include the equivalents of Revett and St. Regis fms. of Coeur d'Alene dist., Idaho.

E. Sampson, 1928 (Idaho Bur. Mines and Geol. Pam. 31, p. 7). *Blacktail fm.*—Is here defined as including all rocks btw. Burke fm. below and Wallace fm. above. Represents undiff. equivalents of Revett and St. Regis fms. of Coeur d'Alene dist. Lower part is prevailingly qtzite; upper part is mostly argillite. Whole fm. is distinguished from all others in dist. by a pinkish or reddish purple color. Lower 5,000 ft., which is mostly qtzite, may have only a faint pink cast, but even in these beds thin partings of red sh. are common. The lowest beds closely resemble Burke fm., but faintly pink color serves to distinguish them. The upper Blacktail beds are alternating red and green argillites, with red predominating. In lower part of fm. the red argillite occurs only as partings. Argillite increases upward in fm. and in upper 3,300 ft. it greatly predominates. Uppermost beds, near transitional bdy with Wallace fm., are green, but those mapped with the Blacktail have a peculiar waxy appearance. Type loc., Blacktail Mtn, near Talache, where fm. is best exposed. The SW. shoulder shows the lower beds and the northerly spurs show the upper argillitic portion.

†Blacktail Deer Creek beds.

Oligocene? (upper?): Southwestern Montana (Beaverhead County).

E. Douglass, 1902 (Am. Phil. Soc. Trans., vol. 20, n. s., pt. 3, pp. 237–245). *Blacktail Deer Creek beds,* the beds on Blacktail Deer Creek, which are probably White River Olig.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 106). Beds on Blacktail Deer Creek, Mont., doubtfully included in upper Olig. White River group. They are more probably lower Mio.

Blackwater formation.

Pennsylvanian: Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Blackwater fm.* (also *Blackwater ss.*).—Three poorly defined ss. and cgl. beds, separated by two zones of softer argill. ss. and sandy sh. containing variable and impure coal beds. The upper ss. is conglomeratic and 110 to 200 ft. thick; the medial ss. is 125 ft. thick; and the lower ss. is 30 to 155 ft. thick and banded with cgl. Overlies Canaan fm. and underlies Savage fm. Thickness of fm. 290 (at Piedmont) to 645 (on Blackwater River below Davis, W. Va.).

Blackwater shale and limestone.

Pennsylvanian: Northeastern West Virginia.

D. B. Reger, 1923 (W. Va. Geol. Surv. Rept. Tucker Co., pp. 198, 209–210). *Blackwater sh. and ls.*—A marine memb. of Kanawha group (upper Pottsville), consisting of 15 ft. of dark sh. underlain by 7 inches of ferruginous ls., and containing marine fossils of familiar Kanawha types in the ls. and in lower part of the sh. Base lies 280 ft. below top of Homewood ss. and 115 ft. below Quakertown coal horizon. Probably correlates with Dingess ls. of Mingo Co., but this correlation is not decisive.

Named for exposures on N. side of Blackwater River, 2 mi. SW. of Davis and ½ mi. below Blackwater Falls, Tucker Co.

Blackwell sand.

A subsurface sand in Blackwell pool, Kay Co., central northern Okla., correlated with a part of Garrison sh. (Perm.). In that pool it lies at 750 ft. depth and Newkirk sand at 1,450 ft. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 180, this sand is of Penn. age.

†Bladen formation.

Upper Cretaceous: Coastal Plain of North Carolina and South Carolina.

L. W. Stephenson, 1907 (Johns Hopkins Univ. Circ. No. 71, pp. 93–99). *Bladen fm.*—Sands and clays, for most part thinly laminated and often highly cross bedded; everywhere more or less lignitic. Name used tentatively, since future investigations may prove equivalency with other fms. elsewhere. A few fossil plants indicate equivalency with Tuscaloosa fm. Grades into overlying Ripley fm. [Peedee] and rests uncon. on Capefear fm. [Tuscaloosa]. Thickness 500 to 700 ft.

Replaced by Black Creek fm., which has priority.

Named for exposures in Bladen Co., N. C., especially along Cape Fear River.

Blaine gypsum (also **formation**).

Permian: Western Oklahoma, Panhandle of Texas, and central northern Texas.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 47). *Blaine div.*—Red shales, with interbedded strata of gyp. and dol., averaging 75 ft. in thickness, divided into following members (descending): Shimer gyp.; Altona dol.; red sh. (Jenkins clay of Cragin); Medicine Lodge gyp.; Magpie dol.; red sh.; and Ferguson gyp. Overlies Norman div. (Enid group) and underlies Woodward div. (group). Where Ferguson gyp. memb. disappears the underlying Norman (Enid) div. extends up to base of Medicine Lodge gyp.

In Tex. the top memb. has been called *Acme dol.* and basal memb. *Quanah gyp.* The fm. underlying the Blaine in Okla. was named *Chickasha fm.* by Gould in 1924.

H. D. Miser, 1926 (geol. map of Okla.), modified the definition of *Blaine gyp.* so as to include beds above Shimer gyp. and below Ferguson gyp., and discarded †*Greer fm.* The Blaine as mapped included all beds from top of Chickasha fm. up to base of Dog Creek sh.

R. L. Clifton, 1930 (A. A. P. G. Bull., vol. 14, pp. 161–172). Evidences in field seem to indicate *Blaine* should be dropped and some new fm. name be adopted to include what now comprises Blaine and Dog Creek beds.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 168, 178). *Blaine fm.* as now used in Tex. includes more than does Blaine of type loc. in Okla. Not only is underlying Chickasha, or a part of it, merged with the Blaine in Tex. usage, but overlying Dog Creek of Okla. is included in part or entirely. Childress dol. and gyp. is top memb. of Blaine in Tex. and Quanah gyp. lies near base.

J. L. Muir, 1934 (A. A. P. G. Bull., vol. 18, No. 10, p. 1300), gave detailed section of Blaine fm. at type loc., in Salt Creek Canyon, Blaine Co., Okla., showing it as underlying Dog Creek shales, overlying Flowerpot shales, and including Lovedale gyp. at top, Shimer gyp. in middle, and Medicine Lodge gyp. 2 ft. above base.

Named for exposures in Blaine Co., Okla. Type loc. is in Salt Creek (Henquenet's) Canyon in northern Blaine Co.

Blair formation. (In Mesaverde group.)

Upper Cretaceous: Southwestern Wyoming (Sweetwater County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Blair fm.*—Drab, yellow, and brown sss. and interbedded sh. and shaly ss. with little or no bituminous matter; massive sss. are grouped near top of fm., giving rise to the "golden wall," and are the "Golden-wall ss." of Powell. Thickness 1,000 to 1,200 ft. In previous repts. included in Mesaverde fm. May possibly belong to the Mesaverde, but seems to be older, and for present at least the base of Rock Springs coal group is regarded as base of Mesaverde. The Blair constitutes a distinct lithologic unit. Overlies Baxter sh. Named for exposures at Blair ranch, E. of Aspen Mtn.

Blairmore formation.

Upper and Lower Cretaceous: Southern Alberta, Canada.

F. H. McLearn, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 112). Uncon. overlies Ellis fm. and underlies Colorado sh.

F. H. McLearn and G. S. Hume, 1927 (A. A. P. G. Bull., vol. 11, No. 3, p. 241). *Blairmore fm.* of Blairmore-South Fork areas consists of sss., sh., and, a little above middle, a bed of cgl., and another bed of cgl. at base. It discon. overlies Kootenay fm. and underlies Crowsnest volcanics. The upper part of fm. contains a Cenomania[n] flora, according to E. W. Berry, and is of Upper Cret. (Colorado) age. The flora of lower part is Lower Cret. (Aptian or Albian), according to Berry. The lower part of the Blairmore corresponds to upper part of Kootenai fm. of Mont. The flora of the pre-Blairmore Kootenay beds is Barremian, according to Berry.

Blairsville.

See *Sub-Blairsville red shale memb.*

Blakeley formation.

Oligocene: Western Washington (Puget Sound region) and southwestern Washington.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). *Blakeley fm.*—Alternating shales and sss. overlain by nearly 1,000 ft. of nonfossiliferous cgls. Thickness of fm. 8,000 ft. Fossils listed. Been considered Olig. or at least in part Olig., but writer now places them in Lower Mio., until definite understanding has been reached as to what is to constitute Olig. Type section is at Restoration Point, Kitsap Co., opp. Seattle.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). *Blakeley horizon* is characterized by *Acila gettysburgensis* zone, and is assigned to Olig. Fossils listed. The highest strata outcrop on N. shores of Blakeley Harbor. Type section is at entrance to Bremerton Navy Yard. Is younger than Porter horizon and older than Wahkiakum horizon (lower Mio.).

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 245, 261–264). *Seattle* and *Twin River fms.* of Arnold and Hannibal's Astoria series seem to be = Weaver's *Blakeley fm.* While later studies may show *Blakeley beds* (*Acila gettysburgensis* zone) to be younger, they are at present considered to be Upper Olig.

Blakely sandstone.

Lower Ordovician: Southwestern Arkansas and southeastern Oklahoma.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 676). *Blakely ss.*—Name proposed by A. H. Purdue (in letter) for ss. recently discovered, which is absent W. of Womble but locally developed to thickness of 500 ft. E. of that town. The discovery of this intercalated ss. tends to confirm high value of strat. hiatus btw. Ouachita and Stringtown shales, which hitherto was inferred chiefly on paleontologic evidence. Underlies Stringtown sh. [restricted sense] and overlies Ouachita sh.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 67). *Blakely ss.*—Sh., in alternating black and green layers, and hard gray ss. The sh. constitutes 75 per cent of whole fm., but the ridge-forming ss. is the prominent feature. Thickness 0 to 400 ft. Underlies Womble sh. and overlies Mazarn sh. Named for Blakely Mtn, Garland Co., Ark., from which it is continuously exposed as far W. as Womble, where it thins out and permits Womble sh. to rest on Mazarn sh. W. of that town. In 1909 this ss. was regarded by A. H. Purdue as upper part of Crystal Mtn ss., but it has since been determined by Purdue and writer to occur in middle of "Ouachita sh." [A broader use of "Ouachita sh." than as defined by Purdue in 1909.]

Is of Beekmantown and probably Chazy age, according to classification of U. S. Geol. Survey.

Blanca tuff.

Miocene: Southern California (Santa Cruz Island).

W. W. Rand, 1931 (Mining in Calif., vol. 27, No. 2, p. 217). ***Blanca tuff.***—Distinctly bedded, water deposited, acid to intermediate crystalvitric tuffs and cgls., with thin flow of andesite near top. Included in Monterey group, which, on Santa Cruz Island, consists of (descending) (1) siliceous sh., (2) volcanics, (3) ***Blanca tuff,*** (4) Temblor fm., and (5) Vaqueros fm. [Derivation of name not stated.]

†Blanchard moraine.

Replaced by Defiance moraine (Pleist.) in U. S. G. S. Mon. 41, p. 581. *Blanchard* has priority but *Defiance* has usage. Named for a stream in Ohio.

Blanchester division. (In Richmond group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, p. 291). ***Blanchester div.***—Includes upper part of Waynesville bed of Richmond fm., or beds btw. top of upper *Hebertella insculpta* horizon and base of lower *Hebertella insculpta* horizon. Is overlain by Liberty beds and underlain by Clarksville div.

Named for Blanchester, Clinton Co., Ohio.

Blanco formation.

Pliocene (middle): Panhandle of Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., p. lxxi, pl. 3). ***Blanco Canyon beds.***—White clays, infusorial earth, etc., containing fossil remains of turtles and large animals. Forms upper portion of Staked Plains. Probably corresponds to upper part of Fayette beds, which it closely resembles in some lithologic features.

W. F. Cummins, 1890 (Tex. Geol. Surv. 1st Ann. Rept., p. 190). ***Blanco Canyon beds.***—Red clay, white sandy clays, white clays, and a hardened clayey ls., fronting to E. and forming bold escarpment 200 ft. high. Constitute Staked Plains. Uncon. overlie Dockum beds. Later than Cret. [Name changed by W. F. Cummins in 1892 (Tex. Geol. Surv. 3d Ann. Rept., p. 134) to *Blanco beds*.]

H. F. Osborn (1907 and 1918) assigned ***Blanco fm.*** to middle Plio.

Named for Blanco Canyon, Dickens Co., and Mount Blanco P. O., Crosby Co. Included in *Ogallala fm. (Plio.)* on 1937 geol. map of Tex.

Blanco Basin formation.

Tertiary (Oligocene ?): Southwestern Colorado (San Juan Mountains).

E. S. Larsen, 1935 (U. S. G. S. Bull. 843). In many places on S. slopes of San Juan Mtns, in San Cristobal, Pagosa Springs, Summitville, and Conejos quads, a series of arkosic sss., cgls., and other sediments, lacking in volcanic material, uncon. overlies Cret. fms. and Animas fm. (Eocene ?), and are overlain, with apparent conformity, by Conejos andesite (Mio.). The name ***Blanco Basin fm.*** is proposed for these beds, from their prominent development about Blanco Basin, in central part of Summitville quad. Is in general a thin, soft fm., overlying in many places Mancos sh. and overlain by great thickness of volcanic breccia. It is imperfectly known and only approx. mapped. East of Chama River, near S. bdy of Summitville quad., it is 575 ft. thick, is overlain by several hundred ft. of beds belonging to Conejos andesite, and rests with angular uncon. on Mancos sh.

† Blanco Canyon beds.

Pliocene: Panhandle of Texas.

See *Blanco fm.*

†Blan[d]ford limestone.

Pre-Cambrian: Western Massachusetts.

E. Hitchcock, 1833 (Rept. Geol., Min., Bot., and Zool. of Mass., p. 305). *Blanford ls.*—Coarsely granular, white, crystalline ls. exposed in NW. part of town of Blan[d]ford. [According to B. K. Emerson (unpublished communication) this is a large boulder of Coles Brook ls.]

Blandford serpentine and pyroxenite.

Age (?): Massachusetts.

B. K. Emerson, 1898 (U.S.G.S. Mon. 29, p. 85).

Blankenship sand.

See *Sallyards sand.*

Blaydes sand.

A subsurface sand, of Penn. (?) age, in Stephens Co., southern Okla., lying at 2,200 ft. depth in Empire pool, the Brown sand lying at 2,100 ft. and the Kagay at 2,300 ft.

Blaylock sandstone.

Silurian (early): Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557). *Blaylock ss.*—Ss. uncon. underlying Slatington sh. [Missouri Mountain sl.] and overlying Polk Creek sh.

A. H. Purdue, 1909 (Slates of Ark., Ark Geol. Surv., pp. 30, 36). *Blaylock ss.*—Fine-grained to medium-grained ss. of dove, dark gray, or green color, interbedded with dark-colored, often black, and fissile sh. Thickness 1,500 ft. In parts, through 100 or more ft., consists almost wholly of ss.; in other parts is made up of alternating beds of ss. and sh. The ss. is usually in layers 1 to 6 inches thick and bedding is very even. Some of layers are qtzitic and contain numerous quartz veins; other thin layers closely resemble chert. Overlies Polk Creek sh. Underlies, probably uncon., Missouri Mtn sl.

Named for Blaylock Mtn, Montgomery Co., Ark.

Bledsoe limestone.

Silurian (Niagaran): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402). *Bledsoe ls.*—Top bed (0 to 32 ft. thick) of Clifton ls. in Tenn. Overlies Newsom (Waldron) shaly clay and uncon. underlies Pegram ls. (Dev.) or Chattanooga sh. Same as Louisville ls. of Ind.

Named for Bledsoe, Sumner Co.

Bliss sandstone.

Upper Cambrian: Western Texas and southern New Mexico.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 27). *Bliss ss.*—Massive, compact, fine-textured, fossiliferous gray ss., about 300 ft. thick, varying in color from almost white to brown; toward top locally cross bedded and some of beds hard. Overlies coarse red granite and uncon. underlies El Paso ls. (Ord.).

Named for Fort Bliss, El Paso Co., Tex.

Bliss basalt.

Pleistocene: Southern Idaho (Twin Falls and Gooding Counties).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Bliss basalt.*—Brecciated subaqueous flow composed chiefly of vitreous porphyritic basalt, containing pillow structures. May be subaqueous facies of McKinney basalt or, possibly, of Sand Springs basalt. Thickness 100±ft. Exposed at Bliss Cone and Bliss Bridge, sec. 11, T. 6 S., R. 12 E., Twin Falls Co., also at Bliss Spring, Gooding Co.

Block porphyry.

A descriptive term formerly applied by miners to the White porphyry of Leadville dist., Colo., because of its tendency to split into angular blocks.

Block limestone.

Pennsylvanian: Eastern Kansas, northern Missouri, and Iowa(?).

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 97). *Block ls. memb. of Cherryvale sh.* overlies Fontana sh. memb. of Cherryvale and underlies Wea sh. memb. of Cherryvale.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 35, 37). *Block ls.* here introduced for fine-grained, bluish gray, thin-bedded ls, with a few thin fossiliferous sh. partings. Thickness 3 to 8 ft. Underlies Wea sh. and overlies Fontana sh., all fms. in Kansas City group. Named for a hamlet in Miami Co., Kans. Has considerable persistence throughout NE. Kans. and adjoining parts of Mo.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Blomidon shale.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

Blood Reserve sandstone.

Cretaceous: Alberta.

L. S. Russell, 1932 (Canada Geol. Surv. Rept. 1931, pt. B, p. 32).

Bloody Run zone.

Upper Devonian: North-central Iowa (Floyd County).

C. L. Fenton and C. L. Webster, 1924 (Univ. Mich. Pub., Contr. Mus. Geol. vol. 1, frontispiece, map), divided Cedar Valley ls. of Floyd Co. into Nora above and Shell Rock below, and divided Shell Rock into (descending): *Pachyphyllum* zone, *Aulopora* sh., *Bloody Run zone*, Lithographic beds, and mud-crack zone, and gave no further explanation of *Bloody Run zone.*

Bloomfield sandstone. (In Cayuga group.)

Silurian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 54, 401). *Bloomfield ss.*—Soft friable ss., breaking up into rectangular brick-shaped fragments. Of dull reddish and greenish colors. About 10 ft. thick. Underlies New Bloomfield, and exposed on road to Newport, ½ mi. E. of town. Overlain and underlain by variegated shales, all of which are included in Onondaga red and variegated shales. [On pp. xi–xvi of above rept. J. P. Lesley made Bloomfield ss. the top div. of Onondaga red sh.]

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2 pp. 761–777). *Bloomfield ss.* replaced by *Landisbury ss.* [See under *Landisbury ss.*]

Bloomfield sand.

Eocene: Southeastern Missouri (Stoddard and Scott Counties).

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4, p. 30). *Bloomfield sands.*—Sands of Eocene age, 85 ft. thick. [Name used in table on p. 30. On p. 88 the Eocene deposits of Mo. ("probably Bloomfield sands") are described as chiefly brown sands and blue clays with some iron ores, best exposed in bluffs of Mississippi River in Scott and Stoddard Counties.] Named for Bloomfield, Stoddard Co.

Is a part of Wilcox fm.

Bloomfield limestone. (In Conemaugh formation.)

Pennsylvanian: Southeastern Ohio (Muskingum County).

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 242). *Bloomfield ls.*—Nodular, hard, dense, non-fossiliferous light-gray ls., in places stained with iron oxide. Of fresh-water origin. Thickness 0 to 2½ ft. Lies 3 ft. 9 in. below Anderson coal and 8 ft. 8 in. above Cambridge ls. in Muskingum Co. (Harrison, Bluerock, Salem, and Highland Twps). Named for exposures W. of Bloomfield.

Bloomingdale limestone member.

Upper Cambrian: Eastern Tennessee.

C. R. L. Oder, 1934 (Jour. Geol., vol. 42, No. 5, pp. 478–479, 492, 496). *Bloomingdale ls. memb.*—Upper memb. of Conococheague-Copper Ridge fm. in eastern Tenn. Overlies Morristown dol. (lower memb. of Conococheague-Copper Ridge fm.) and underlies the thin ss. at base of Chepultepec fm. Consists of 170 to 650 ft. of thin to heavy-bedded, light to dove-gray, dense to medium crystalline, fine to coarsely laminated ls. and dol.; dol. is minor in amount in E. sections, but composes practically all of western sections. Color and texture closely resemble underlying Morristown memb. Thin aren. zones occur at numerous levels, 10 sometimes occurring in thickness of 100 ft. Base is formed of 3 to 15 ft. of aren. and shaly dol. and qtzitic ss. The Bloomingdale chert is scarcely distinguishable from that in Morristown memb.; its quantity is nil to abundant. [Details.] Belongs to Ozarkian series of Camb. system. Type section is along a branch of Reedy Creek, 1½ mi. NW. of Bloomingdale, 4 mi. NE. of Kingsport.

Bloomington formation.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 6, 7). *Bloomington fm.*—Bluish gray, more or less thin-bedded lss. and argill. shales Small rounded nodules of calcite are scattered irregularly through many layers of ls. Thickness 1,320 ft. in Blacksmith Fork Canyon, Cache Co., Utah, and 1,162 ft. W. of Liberty, Bear Lake Co., Idaho. Overlies Blacksmith fm. and underlies Nounan fm. Abundant Middle Camb. fauna. Type loc. about 6 mi. W. of Bloomington, Bear Lake Co., Idaho. Bloomington Creek, near type loc., passes through fm.

Bloomington morainic system.

Pleistocene (Wisconsin stage): Across central Ohio, Indiana, and Illinois. Shown in part on moraine map (pl. 32) of U.S.G.S. Mon. 53, 1915, and in part on moraine map in U.S.G.S.P.P. 106. In some earlier repts called *Bloomington moraine*. Named for Bloomington, Ill.

Bloomsburg redbeds. (Of Cayuga group.)

Silurian: Central and southern Pennsylvania, western Maryland, northern West Virginia, and western Virginia.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, p. 252). *Bloomsburg red sh.*—A series of dark, deep or dull red shales, somewhat sandy and blotched with a few thin layers of bright green sh. Thickness 245 to 750 ft. About 440 ft. visible in vicinity of Bloomsburg [Columbia Co.] along E. bank of Fishing Creek at N. line of town of Bloomsburg. Represents basal memb. of Salina series as defined by N. Y. geologists. Underlies Middle Salina group, which consists of 407 ft. of green, buff, and bluish lss. and shales with some red sh. Overlies Clinton series.

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523–537). In central Pa. (Blair and Huntingdon Counties) the *Bloomsburg red memb.* forms basal 50 to 150 ft. of Wills Creek sh.

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 4, pp. 622–660), treated *Bloomsburg red beds* as a distinct fm., underlying Wills Creek fm. and overlying McKenzie fm., and on pp. 651 to 660 they extended the name into SE. N. Y. as far as Otisville, Orange Co. On p. 657 they stated: It has been shown [pp. 622–660] *Bloomsburg red beds* can be followed continuously from type loc. in NE. Pa. southward into Md. and eastward through central and eastern Pa. to Delaware Water Gap, where it was called *Clinton* by Chance and *High Falls* by Stose. It is continuous with Medina-Longwood red ss. of N. J. and High Falls red beds of Hartnagel in SE. N. Y. It is manifest it is same fm. throughout this entire area and should have one name to avoid confusion. The term Bloomsburg has priority. It is manifest the Bloomsburg is a lithological phase—not a geological age. It accumulated on the continental margin to E. while different marine deposits were formed to W. On p. 660 they show *Bloomsburg red beds* to NE. to be the time equiv. of lower part of Tonoloway ls., Wills Creek sh., and upper part of McKenzie, its basal bed to S. (called *Rabble Run red bed*) interfingering with middle part of McKenzie, while a higher heavy bed of the Bloomsburg wedges in btw. the McKenzie and the Wills Creek. This higher bed, however, they show as representing an early part of the Bloomsburg to E.

C. Butts and G. W. Stose, 1932 (16th Int. Geol. Cong. Guidebooks of Appalachian region). Wills Creek sh. restricted to beds above Bloomsburg sh., the latter to hereafter be treated as distinct fm. This is present approved definition of *Bloomsburg*.

Bloomsbury formation.

Carboniferous or Devonian: New Brunswick.

G. F. Matthew, 1895 (Roy. Soc. Canada Trans., vol. 12, sec. 4, p. 89).

Originally assigned to Dev.; later repts assign it to Carbf.

Blossburg formation. (In Chemung formation.)

Upper Devonian: Central northern Pennsylvania (Tioga County).

M. L. Fuller, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, pp. 585, 593). The term "Blossburg fm." has been applied by drillers to the source of supply of the oil of the wells of the Manhattan group, 1 mi. E. of Gaines [Tioga Co.]. It is a series of alternating sands, shales, and shaly lss., of which certain of the more sandy members have produced oil. Top, though somewhat variable, is about 200 ft. above horizon of Atwell sand. Included in Chemung fm.

Blossburg.

Upper Devonian: Central northern Pennsylvania (Tioga County).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 99, 279, 282, 357). Back in 1842 T. A. Conrad (Jour. Acad. Nat. Sci. Phila., vol. 8, p. 234) applied name *Blossburg* to these red-beds ("Cattaraugus" of the folio) [U.S.G.S. Elkland-Tioga, No. 93], now found to be of pre-Cattaraugus age, and his name has precedence over drillers' use of "Blossburg fm." for an oil-producing zone down in the Chemung. I have therefore revived it (Geol. Soc. Am., Bull., vol. 43, p. 273, 1932) to cover these supposed Girard-Chadakoin beds, which overlie Wellsburg ss. [On p. 357:] "The Blossburg now appears to be older than the Girard-Chadakoin." [In book cited Conrad used *red ss. of Blossburg*. The reference to Bull. G.S.A., vol. 43, p. 273, is an error, as *Blossburg* is not mentioned in the abstract on that page. The listing of *Blossburg ss.* in U.S.G.S. Bull. 191 is also an error, as Conrad, although describing the sandstone, did not name it *Blossburg ss.*]

Blossburg Monkey ledge.

See under *Scranton ss.*

Blossom sand.

Upper Cretaceous (Gulf series): Northeastern Texas.

C. H. Gordon, 1909 (Am. Jour. Sci., 4th, vol. 27, pp. 371, 373). *Blossom sands.*—Glauconitic sands, brown and red at surface from oxidation of iron, interlaminated with and grading into clay. Thickness 80 to 100 ft. Top memb. of Eagle Ford fm. in NE. Texas. Underlies Brownstown marl. Same as Sub-Clarksville sands of Veatch.

Later work by L. W. Stephenson showed that Blossom sand is younger than Eagle Ford clay, and in 1917 it was treated by U. S. Geol. Survey as a distinct fm. overlying the Eagle Ford. The 1925 and 1926 work of L. W. Stephenson established fact that the clay underlying Blossom sand and formerly called Eagle Ford in NE. Tex. is younger than true Eagle Ford clay and = lower part of Austin chalk, and he named it Bonham clay—later changed to *Bonham marl.*

Named for Blossom, Lamar Co., which is located on an outcrop of the sand.

Blossom oil sand.

A name that has been applied in Smackover oil field of Ouachita and Union Counties, SW. Ark., to 10 ft. of subsurface sand said to lie a short distance below Brownstown fm. and at supposed horizon of Blossom sand (Upper Cret.). Locally called *2,600-foot sand.* (See H. G. Schneider, Am. Inst. Min. and Met. Engrs. Trans., vol. 70, pp. 1078-1099, 1924.)

Blount group.

Lower Ordovician (Chazy): Alabama, eastern Tennessee, western Virginia, and West Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 379, 382, 413, 567, 576, 627, pl. 27). *Blount group.*—Ls., sh., and ss., with max. thickness in Grainger and Blount Counties, Tenn., of at least 3,500 ft., not less than 1,500 ft. of which is ls. Underlies Black River group and overlies Stones River group. Included in Chazyan. Includes (downward) Ottosee [Sevier], Tellico, Athens, and Holston.

Named for Blount Co., Tenn.

Blowing Rock gneiss.

Pre-Cambrian: Western North Carolina.

A. Keith, 1903 (U.S.G.S. Cranberry folio, No. 90, p. 3). *Blowing Rock gneiss.*—Wholly gneiss of two varieties, one with large porphyritic feldspar crystals, the other of very fine, even grain. In places the two varieties grade into each other; in other places they are repeatedly interbedded. Cuts Carolina gneiss and appears to cut the still younger Cranberry granite.

Named for Blowing Rock, in Cranberry quad., Watauga Co.

†Blowout Mountain sandstone. (In Double Mountain group.)

Permian: Central northern Texas (Runnels and Taylor Counties).

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pl., pp. 95, 96, 98). *Blowout Mtn ss.*—Massive, dark red, coarse-grained, cross-bedded ss., 40 to 105 ft. thick. Lies 0 to 25 ft. above base of Greer fm., being in places underlain by 20 to 25 ft. of red clay, but in most places forms basal memb. of Greer fm. Named for exposure in Blowout Mtn, SW. of Merkel, Taylor Co.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 7, 8). *Blowout Mtn ss.* of Wrather is same as San Angelo beds of Lerch (named in 1891), and San Angelo will replace Blowout Mtn as name of this fm. It connects with San Angelo beds.

J. W. Beede and D. D. Christner, 1926 (Univ. Tex. Bull. 2607). *Blowout Mtn ss.* is northern extension of San Angelo fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). *Blowout Mtn ss.* is discarded for *San Angelo ss.*

Bloyd shale.

Pennsylvanian (Pottsville): Northwestern Arkansas.

A. H. Purdue, 1907 (U.S.G.S. Winslow folio, No. 154). *Bloyd sh.*—Upper fm. of Morrow group. With exception of Brentwood and Kessler ls. lentils and a bed of coal consists almost entirely of thin, fissile, black, carbonaceous clay sh. of uniform character, with locally small amount of ss. in lower part. Brentwood ls. lentil lies 5 to 10 ft. above base; Kessler ls. lentil lies usually 60 to 75 ft. below top. Underlies [uncon.] Winslow fm. and overlies Hale fm. Of Pottsville age.

Named for Bloyd Mtn, Washington Co.

†Blue limestone.

A name applied in a titular sense in some early repts to the Upper Ord. rocks of SW. Ohio, northern Ky., and southern Ind.

†Blue limestone.

A descriptive term applied to the blue lss. of Miss. and Upper Dev. age in Leadville dist., Colo. Later named *Leadville ls.* The name *Leadville* is now, however, restricted to the Miss. lss., while the Dev. lss. (now called *Dyer dol. memb.*) and underlying Parting qtzite (also Upper Dev.) are now included in Chaffee fm.

†Blue chert series.

Devonian (?): Northwestern California (Klamath Mountains).

O. H. Hershey, 1906 (Am. Jour. Sci., 4th, vol. 21, pp. 58–66). *Blue chert series.*—A great series of black shales, lss., and blue cherts, 5,000 ft. thick, of which 3,000 is chert. Is presumed to be Dev., because similar rocks elsewhere in Klamath region carry Dev. fossils. Is thoroughly intruded by dioritic and diabasic materials. Uncon. overlain by volcanic rocks. Must be pre-Bragdon. Named for its most characteristic constituent, blue chert.

Blue Ball fire clay. (*In Allegheny formation.*)

Pennsylvanian: Central Pennsylvania (Clearfield County).

H. M. Chance, 1884 (2d Pa. Geol. Surv. Rept. H7). *Blue Ball fire clay,* 0 to 10 ft. thick, underlies Brookville coal and overlies Pottsville cgl. in Clearfield Co.

Bluebell dolomite.

Ordovician (Upper to Lower): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Bluebell dolomite.*—Alternating beds of medium to dark-gray or bluish-gray dol., mostly fine-grained but some beds medium- to coarse-grained. Between 100 and 200 ft. above base of fm. throughout the dist. the beds contain a number of small nodules and thin seams of chert. Thickness 700 to 1,100 (?) ft. Conformably underlies Pinyon Peak ls. and overlies Opohonga ls. with sharp contact. Is most extensively exposed fm. in Tintic dist. Named for Bluebell mine. Fossils indicate that it ranges in age from Lower to Upper Ord., and it is possible the upper 400 ft. include Sil. or Dev. strata.

Blueberry Mountain argillite.

Devonian (Lower? Dev.): Northwestern New Hampshire (Ammonoosuc River region).

C. H. Hitchcock, 1905 (Geol. of Littleton, N. H., Univ. Press, Cambridge). *Blueberry Mtn argillites.*—Bluish and black slates of Helderberg (Upper Sil. or Dev.) age. Underlie glacial till and overlie coarse cgls.

Appears to be upper part of Blueberry Mtn series of Lahee. Blueberry Mtn is N. part of ridge 2 mi. W. of Littleton, the S. part of which is called Bald Hill. (Lahee, 1913.)

Blueberry Mountain series.

Devonian and Silurian: Northwestern New Hampshire (Ammonoosuc River region).

F. H. Lahee, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 231–250, being a description of parts of Littleton and Lyman Twps, N. H.). *Blueberry Mtn series.*—Divided into (descending):

Devonian (?):

1. dark-gray ss. with dark sh. layers. Forms top of Blueberry Mtn.
2. banded argillite, 450–500 ft. Forms part of Blueberry Mtn. Marine fossils of Dev. age (probably Lower Dev.) found in fine-grained banded argillites 3,000 ± ft. above base of Upper Sil. [On pl. 13 he assigns these rocks to Helderberg. This argillite appears to be the Blueberry Mtn argillites of Hitchcock.]

Silurian:

1. basic sill, 200 ft.
2. basal series. The lower members of this sed. series are known to be of Niagaran (Upper Sil.) age. They were formerly called Helderbergian. Consist of (descending): (a) Fitch Hill arkose, 200–300 ft.; (b) basic sill (not a part of the series); (c) nonfossiliferous ls. and sl., 150 ft.; (d) calc. sl. with Niagaran fossils, 6–10 ft.; (e) ls. with Niagaran fossils, 30–40 ft.; (f) basal arkose, which may grade locally into qtzite beds, 2–80 ft. Rests uncon. on Fitch Hill granite gneiss, which intrudes Lyman schists (pre-Sil.).

Blueberry Mtn is N. part of ridge 2 mi. W. of Littleton, the S. part of the ridge being called Bald Hill.

†Bluebird aplite.

A name that was applied by W. H. Weed to the aplite in Butte dist., Mont., in Jour. Geol., vol. 7, 1899, pp. 744–747, and U. S. G. S. Bull. 213, 1903, p. 170, but which he mapped as *aplite*, without the geographic name, in U. S. G. S. Butte Special folio, No. 38, 1897. The geographic name is not considered necessary and is not now used by U. S. Geol. Survey.

Bluebird dolomite.

Cambrian (Middle?): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Bluebird dol.*—Dark bluish-gray fine-grained dol. spangled with short white rods averaging 10 mm. (⅖ inch) in length and 1 or 2 mm. in width. Thickness 175 to 200 ± ft. Underlies Cole Canyon dol. and overlies Herkimer ls. North of Eureka Gulch and W. of Cole Canyon is well exposed along backbone of Bluebird Spur for nearly 1,000 feet.

†Blue Bluffs division.

Upper Cretaceous (Gulf series): Central Texas.

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, p. xiii). *Exogyra Ponderosa marls or Blue Bluffs div.*—Underlies Glauconitic div. and overlies Austin-Dallas chalk.

Same as Taylor marl.

Named for blue bluffs of Colorado River, Travis Co.

Blue Canyon formation.

Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66). *Blue Canyon fm.*—Black and fissile clay slates and dark-gray fine-grained qtzitic sss.; only one occurrence of cgl. noted in the fm.; a few ls. lenses and some chert occur in it in E. part of area, including a belt of gray or brown chert referred to as *Duncan chert*. Corresponds to lower part of Calaveras fm. Few fossils not diagnostic, but fm. assigned to Carbf. Underlies Relief qtzite. Oldest fm. exposed in Colfax quad. Named for exposures at village of Blue Canyon, Placer Co.

According to later work by H. G. Ferguson (Am. Inst. Min. and Met. Engrs. Tech. Pub. 211, p. 4, 1929) two fms. (Tightner below and Kanaka above), composed of interbedded sed. and igneous rocks, are now discriminated btw. Relief qtzite and Blue Canyon fm.

Bluecastle sandstone bed. (In Price River formation.)

Upper Cretaceous: Central eastern Utah (Book Cliffs).

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). Cross-bedded ss., medium-to fine-grained, weathering buff to gray. Thickness 0 to 100±ft. Included in Nelson coal-bearing memb. of Price River fm., lying 200±ft. above base of that memb. Is younger than Thompson Canyon ss. bed, and younger than Chesterfield coal zone and Sulphur Canyon ss. bed to E. Named for Bluecastle Canyon. Caps Bluecastle Butte.

†Blue Cliff limestone.

Descriptive term which in early Ohio repts was applied in a titular sense to Springfield ls. (Sil.) of current nomenclature.

Blue Creek series.

Cambrian: Southwestern Oklahoma.

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 138–140). *Blue Creek series.*—Cgls., qtzites, and sss. conformably underlying Rainy Mtn ls. and uncon. overlying older rocks in Wichita Mtns.

Probably same as Reagan ss., later but better established name.

Named for Blue Creek, Comanche Co.

Blue Cut shale.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 380). *Blue Cut shales.*—Alternating blue-black and gray argill. shales, with minor beds of sandy sh., ferruginous ss., and shell ls. The zone of typical and abundant *Gryphaea roemeri*. Forms top bed of Fullington shales. Overlies Black Hill sh. (lower bed of Fullington shales) and underlies Tucumcari shales.

Named for the Blue cut, a deep railway cut a few mi. S.-SW. of Belvidere, Kiowa Co.

Blue Earth siltstone.

Lower Ordovician: Southeastern Minnesota (Lesueur County).

L. H. Powell, 1935 (St. Paul Inst. Sci. Mus., Sci. Bull. 1). From Ottawa to Mankato, along Minn. River, the Kasota ss. seems to be everywhere overlain by a thin bed of white to greenish (sometimes red) laminated argill. siltstone—the Blue Earth siltstone—, which seems to spread beyond limits of underlying Kasota ss. and to then rest, apparently conformably, on Jordan ss. The siltstone underlies Oneota dol., or fills irregular solution cavities along more or less vertical joints in Oneota dol. There is sharp break in sedimentation btw. Blue Earth siltstone bed and Oneota dol. Relations of Blue Earth siltstone bed to overlying and underlying fms. are unknown. Because of historical significance of term "Blue Earth," this siltstone is here called *Blue Earth siltstone bed.* It occurs for some distance up Blue Earth River. Thickness at Kasota and Ottawa a few inches (Stauffer found 6 inches at Kasota); Winchell found 3 ft. of the siltstone along Blue Earth River near Mankota; it probably is never much thicker. Assigned to Ord.

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1), list *Blue Earth siltstone* and *Kasota ss.* as "local fms. in Minn." and place them opposite basal part of Oneota dol.

The U. S. Geol. Survey at present recognizes Oneota dol. as resting on Jordan ss.

Bluefield shale.

Mississippian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 3). *Bluefield sh.*—Transition series from underlying Greenbrier ls. to overlying sandy Hinton fm. Varies from prevailingly calc. at base to sandy at top. Limited above by heavy bed of qtzite forming basal memb. of Hinton fm. Thickness 1,250 to 1,350 ft.

The 1928 prel. ed. of Va. Geol. Surv. geol. map. of Va. redefined Bluefield sh. and Hinton fm. by restricting Bluefield to the prevailingly calc. beds and transferring to overlying Hinton fm. about 200 ft. of shaly or sandy beds included in Bluefield as defined. This is present definition of U. S. Geol. Survey.

Named for exposures at Bluefield, Mercer Co., W. Va.

Bluefield group.

A term applied by W. Va. Geol. Surv. to *Bluefield sh.* of U. S. Geol. Survey repts.

Blue Gate sandstone member (of Mancos shale).

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology Henry Mtns, pp. 4+). *Blue Gate ss.*—Heavy-bedded yellow ss., 500 ft. thick, underlying Masuk sh. and overlying Blue Gate sh. in Blue Gate Plateau.

Is now treated by U. S. Geol. Survey as a memb. of Mancos sh. in Henry Mtns region.

†Blue Gate shale. (In Mancos shale.)

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology Henry Mtns, pp. 4+). *Blue Gate sh.*—Blue black argill. sh. weathering to a fine gray clay. Thickness 1,000 ft. Underlies Blue Gate ss. and overlies Tununk ss. in Blue Gate Plateau.

Is a part of Mancos sh., but name conflicts with *Blue Gate ss.*, the adopted name.

Blue Grass group.

Middle Ordovician: Central Kentucky.

S. S. Lyon, 1873 (Ohio Geol. Surv. vol. 1, pt. 1, pp. 119–120). *Blue grass group.*—Includes those strata which immediately underlie surface in Blue grass region about Lexington. Consists of thin-bedded lss., abundantly fossiliferous. Underlies Cincinnati group and overlies Birdseye ls. group.

W. M. Linney, 1882 (Ky. Geol. Surv. Mercer Co. Rept., pp. 14–16). *Blue Grass beds.*—Thin-bedded gray lss., with interbedded shales, and near base a layer of dark-gray hydraulic ls.; thickness 90 ft. Underlain by 30 ft. of siliceous ls. and overlain by 25 ft. of granular ls. correlated with Capitol ls. of Tenn. All included in Trenton group.

Named for part of State where the blue grass grows, as these lss. furnish the soil for that grass.

Blue Hill granite porphyry.

Devonian or Carboniferous: Eastern Massachusetts (eastern Norfolk County).

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers No. 3, with map), mentioned *Blue Hill granite.*

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, No. 4, p. 100), mentioned *Blue Hills porphyry.*

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 191–194 and map). *Blue Hill granite porphyry.*—Forms all of higher hills of Blue Hills range as far E. as Pine Hill, in Quincy, and their southern slopes, down to margin of Carbf. Norfolk Basin. Is regarded as peripheral zone or shell of Quincy granite stock. Overlies main mass of the granite, into which it grades in places, and from which in other places it is abruptly separated. It also underlies Pondville cgl., to the composition of which it has contributed.

L. LaForge, 1932 (U. S. G. S. Bull. 839). The Quincy granite intrudes Lynn volcanic complex, which is probably contemp. with Mattapan volcanic complex (Dev. or Carbf.).

Blue Hill shale member (of Carlile shale).

Upper Cretaceous: North-central Kansas.

W. N. Logan, 1897 (Kans. Univ. Geol. Surv. vol. 2, pp. 218, 225, 228, 229). *Blue Hill shales.*—Dark-blue, loosely coherent, nonfossiliferous shales, 100 ft. thick, overlying *Ostrea* shales and forming top div. of Victoria clays and of Benton group. Overlain by *Septaria* layer, included in Niobrara.

W. N. Logan, 1899 (Jour. Geol., vol. 7, pp. 83–91), included *Septaria* layer in Blue Hill sh., and subsequent writers, including U. S. Geol. Survey, have followed that definition.

C. H. Dane and W. G. Pierce, 1933 (U. S. G. S. Press Notice, June 8, Geol. and oil and gas prospects in part of eastern Colo.), restricted *Blue Hill sh. memb.* to beds beneath Codell ss. bed of previous repts, and elevated Codell ss. to rank of a memb. of Carlile sh. This is definition at present used by U. S. Geol. Survey and Kans. Geol. Survey.

Apparently named for the Blue Hills, in Mitchell, Russell, and Republic Counties, Kans., which Logan stated "rest upon the *Ostrea* beds and are composed of the Blue Hill shale, capped by a layer of Ft. Hays limestone," and probably also for Blue Hill Twp, Mitchell Co. *Ostrea shales* has been replaced by *Fairport chalky sh. memb.*

†Blue Hills complex.

Cambrian and later and older?: Eastern Massachusetts (Boston Basin).

W. O. Crosby, 1900 (Boston Soc. Nat. Hist. Occ. Papers, vol. 1, pt. 3). *Blue Hills complex* is an area of granitic rocks and associated Camb. strata which includes the Blue Hills proper and extends thence eastward across Quincy and N. parts of Braintree and Weymouth. Includes Middle Camb. slates or *Paradoxides* beds and Lower Camb. or *Olenellus* zone.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks of area described above as *Blue Hill granite porphyry, Quincy granite, Braintree sl.* (Middle Camb.), and *Weymouth fm.* (Lower Camb.).

Bluejacket sandstone member (of Cherokee shale north of Arkansas River and of Boggy shale south of Arkansas River).

Pennsylvanian: Northeastern and central eastern Oklahoma and southeastern Kansas. This name was first used in unpublished ms., by D. W. Ohern, on Nowata and Vinita quads.

A. W. McCoy, 1921 (A. A. P. G. Bull., vol. 5, No. 5, pp. 541–550). *Bluejacket ss.* of eastern Okla., which outcrops just W. of Pryor, has been traced S. and SE. and mapped by E. A. Trager, W. R. Berger, F. L. Aurin, and D. K. Greger as a ss. near Warner which occurs in lower part of McAlester sh. A small trilobite horizon about 70 ft. below Bluejacket ss. near Pryor was found below Warner ss. in several places.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 64). *Bluejacket ss. memb.*, 50 to 60 ft. thick, occurs near middle of Cherokee sh. It consists sometimes of a solid mass of ss. but is usually separated into several beds by intervening shales. *It was named by D. W. Ohern in unpublished mss.*, for exposures near Bluejacket, Craig Co. It is basal sand of Bartlesville group of oil sands. Its base is shown on Miser's geologic map of Okla.

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). Uppermost ss. memb. of Savanna ss. S. of Arkansas River, Okla., is same as Bluejacket ss. memb. of Cherokee sh. N. of the river, and is here designated *Bluejacket ss. memb. of Savanna ss.*

C. H. Dane and T. A. Hendricks, 1936 (A. A. P. G. Bull., vol. 20, No. 3, pp. 312–314). Data obtained during 1934 show that *Bluejacket ss.* (the surface equiv. of Bartlesville sand) is = lowest ss. memb. of Boggy sh., instead of uppermost ss. memb. of Savanna ss.

Blue Jay oil sand.

See under *Sheffield oil sand.*

Bluelick limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Castleman Basin).

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 114). *Bluelick ls.*, 2 ft. thick, underlies fire clay beneath Lonaconing coal and is separated from underlying Upper Hoffman coal by 13 ft. of sh.

Blue Monday sand.

Drillers' name for an oil sand of Upper Dev. or early Carbf. age in NW. Pa. Considered same as Snee sand. Lies lower than Nineveh 30-foot sand.

Blue Mountain series.

Upper Cretaceous and Eocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 41–69).

Blue Mountain formation.

Ordovician: Ontario.

W. A. Parks, 1928 (Roy. Soc. Canada Proc. and Trans., 3d ser., vol. 22, sec. 4, p. 53).

Bluepoint limestone.

Mississippian (upper): Southeastern Nevada (Muddy Mountains).

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 46) and 1928 (U. S. G. S. Bull. 798). *Bluepoint ls.*—Dark-gray to nearly black heavy-bedded ls., with finely granular or dense texture is common rock; heavy beds of lighter gray are not uncommon; gray chert in layers or nodules at some horizons, but less abundant than in underlying Rogers Spring ls., and contains larger percentage of very dark, extremely carbonaceous rock and less coarse granular ls. than the Rogers Spring. Thickness 900± ft. Neither top nor bottom accurately located. Underlies Callville ls. with probable uncon. and there must be uncon. at base but writer failed to detect it. G. H. Girty says fossils are of Brazer age. Named for town in Clark Co.

Blue Rapids shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 22). *Blue Rapids sh.* is new name for basal part of Speiser sh. as originally defined. It includes the beds btw. Crouse ls. below and Funston ls. above. Thickness in Nebr. 23 ft. or more, decreasing southward to about 16 ft. at Okla. line.

From Junction City, Kans., southward to Okla. the lower part of the Blue Rapids is a slabby sandy sh. Type loc. in cuts of highway 77, about 1¼ mi. N. of Blue Rapids, Kans.

G. E. Condra, 1935. (See under *Bigelow ls.*)

Blue Rapids sh. as used on p. 66 of Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, Sept. 4 to 7, 1936, is a misprint for *Blue Springs sh.*

†Blue Ridge shale.

Ordovician: Northeastern West Virginia and adjacent parts of Virginia and Maryland.

A. Keith and H. R. Geiger, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 155–164). [In one place the Martinsburg sh. is (evidently inadvertently) called *Blue Ridge sh.*]

†Blue Ridge sandstone.

Silurian and Ordovician: Northeastern West Virginia and adjacent parts of Virginia and Maryland.

A. Keith and H. R. Geiger, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 155–164). [In two places the †Massanutten ss. is (evidently inadvertently) called *Blue Ridge ss.*]

Blue Ridge conglomerates.

See under *South Mountain slates.*

Blue Springs shale. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 38). *Blue Springs sh.*—Top memb. of Matfield fm. Thickness in Nebr., 28 or 29 ft.; 25 ft. in section E. of Burden, Kans., where it consists of upper and lower shales and a ls. below middle. These units extend N. to beyond Florence and S. to Okla. The ls. is herein named *Bruno ls.*, from exposures on Bruno Creek, a few mi. NE. of Florence, Kans. Type loc. in foot of Blue River bluffs SE. of Blue Springs, Gage Co., Nebr. Overlies Kinney ls. and underlies Florence flint.

Bluestone formation.

Mississippian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 3). *Bluestone fm.*—In general red sh., but contains many beds of impure ls., sometimes conglomeratic, and red ss. of varying thickness and character. At Pocahontas extends upward to coal-bearing series whose base is generally marked by a heavy bed of ss. Probably throughout area of Pocahontas quad. this heavy ss. marks upper limit of red shales, but eastward the red shales extend several hundred ft. higher. Thickness 800 ft. Overlies Princeton cgl. and underlies Pocahontas fm.

Named for Bluestone River, Tazewell Co., Va.

Bluestone group.

A term used by some geologists to include same rocks as Bluestone fm. of U. S. Geol. Survey repts.

Blue Water basalt flow.

See under *Laguna basalt flow.*

Bluff bed. (In Trinity group.)

Lower Cretaceous (Comanche series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 727, 736). *Bluff bed.*—Consists of (descending): (1) *Caprotina* ls. (third horizon) with *Monopleura;* (2) massive foraminiferal ls., 40 to 100 ft. thick; (3) alternating bands of ss. and siliceous shell brecciate ls., 65 ft. thick, with last *Exogyra texana* horizon 15 ft. above base. Underlies Quitman bed and overlies Yucca bed; all included in Washita div.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745, p. 21). Mountain bed of Taff belongs to Cox ss.; his *Bluff bed* and Quitman bed belong to overlying Finlay ls.

[On p. 25 is statement that Bluff Mesa is capped by *basal* Finlay ls., 200 ft. thick.]

Named for Bluff Mesa, El Paso Co.

Bluff bone bed. (In Wichita group.)

Permian: Central northern Texas (Wichita County).

J. A. Udden and D. M. Phillips, 1912 (Univ. Tex. Bull. 246, pp. 35–42). *Bluff bone bed.*—Calc. bed, 0 to 5 ft. thick, consisting of sand, fragments of fish scales and bones, and rolled lumps of marly clay, embedded in matrix of lime and ocherous material. In some places horizon is marked by ss. containing much calc. material and many fish scales and bones, or by cgl. of rolled lumps of calc. and clayey material embedded in sandy matrix containing fragments of bones and fish scales. Memb. of Wichita fm., lying 32 ft. below top in SW. part of Wichita Co. [Fossils listed.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 173), included this bed in Belle Plains fm.

Named for Bluff Creek, S. of Electra, Wichita Co.

Bluff limestone.

Middle Oligocene: Cayman Islands, British West Indies.

C. A. Matley, 1924 (Pan-Am. Geol., vol. 42, pp. 313–315). Massive, white, recrystallized, fossiliferous ls., closely resembling the White ls. of Jamaica, and forming an inner and more elevated platform than Ironshore fm.

Bluff sandstone member (of Morrison formation).

Upper Jurassic: Southeastern Utah (San Juan County).

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, p. 21). At Bluff the lower part of Morrison fm. is composed of thin red and gray sss. and red shales with highly contorted bedding, overlain by a massive gray ss. that forms the cliffs along San Juan River and is locally known as "Bluff ss."

H. E. Gregory (U. S. G. S. P. P. 188, in press). *Bluff ss. memb.*—White to gray-brown, massive or thick-bedded, cross-bedded ss.; in places thin-bedded; includes quartz aggregates, clay balls, and mudstones. Thickness 100(?) to 350 ft. Is basal memb. of Morrison fm. Rests, with uncon. (?), on Summerville (?) fm. in the San Juan country. Is outstanding topog. feature on both sides of the San Juan at town of Bluff, San Juan Co.

†Bluff formation.

Descriptive term used in early repts on Gulf Coastal Plain and Central States to designate the Pleist. loess, which has a tendency to form bluffs.

Bluff sand.

Drillers' name for Waynesburg ss. memb. of Washington fm. in parts of W. Va. and western Pa. The term has also been applied to 9 other sands in the Greene, Washington, Monongahela, Conemaugh, Allegheny, and Pottsville fms. of western Pa.

Bluff Creek shale member (of Graham formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 400). *Bluff Creek bed.*—Bluish or yellowish sandy clay, 10 to 75 ft. thick, with 2 to 25 ft. of ss. near top. Fossiliferous. Memb. of Canyon div., near top. Underlies *Campophyllum* bed and overlies Home Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 127, 130–137). *Bluff Creek sh.*—Sandy clay and thin calc. sss. 74 ft. thick to N., 30 or 40 ft. thick to S. In places a thin yellow ls. has been mapped in middle portion of the sh., and this may be=Bunger ls. of Young and Stephens Counties. The Bluff Creek bed is lower memb. of Graham fm. in Colorado River valley. Upper part is in places very fossiliferous and fauna is similar to that of Wayland sh. at Gunsight. Overlies Home Creek ls. memb. of Caddo Creek fm. and underlies Gunsight ls. memb. (=Campophyllum bed of Drake).

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 221–225). *Bluff Creek* of Drake is here (McCulloch Co.) divided into (descending): (1)

Upper Bluff Creek sh., 50 to 70 ft.; (2) Bunger ls. lentil, 23± ft.; (3) sh., 15 to 20 ft.; (4) White Ranch ls. (new), 2 to 3½ ft.; and (5) Lower Bluff Creek sh., 35 to 45 ft. The latter rests on Home Creek ls.

Named for Bluff Creek, McCulloch Co.

Bluff Dale sand. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Central northern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 152, 154, 462, 463, 464, 474, 491). *Bluff Dale sands.*—Sands, 40 ft. thick. Form top memb. of Basement sands at Glen Rose and vicinity. Underlie Glen Rose fm. Northern equiv. of Hensell sands of Colorado River section.

Named for Bluff Dale, Erath Co., where the sands supply artesian wells.

Bluff Point flagstone.

Name used by P. D. Torrey on a cross section (from Tyrone gas field to Penn Yan, Schuyler, and Yates Counties, N. Y.) on p. 976 of Geol. of nat. gas, A. A. P. G., 1935, for a bed in Standish sh., lying some distance above Crosby ss. Not defined.

†Bluff Springs granite.

Post-Carboniferous: Eastern Alabama (southeastern part of Clay County).

W. F. Prouty, 1923 (Ala. Geol. Surv. County Rept. No. 1, pp. 16, 51, 52, 53, 62, 65). Biotite granite of same character as Pinckneyville granite, exposed in SE. part of Clay Co., and locally designated as *Bluff Springs granite.* Reaches max. width a little N. of Bluff Springs. [Mapped as *Pinckneyville granite* by Prouty in rept. above cited, also by G. I. Adams, Ala. Geol. Surv. geol. map of Ala., 1926. Is intrusive.]

Named for development around Bluff Springs, Clay Co.

Bluffton moraine.

A Pleist. moraine (of Wisconsin stage) in northern Ind. (See U. S. G. S. Mon. 53, 1915, table opp. p. 30.)

†Blufftown marl.

Upper Cretaceous: Western Georgia.

J. O. Veatch, 1909 (Ga. Geol. Surv. Bull. 18, pp. 86, 88–89). *Blufftown marl.*—Black lignitic clays, gray calc. and argill. sand, and thin layers of nodular calc. rock. Thickness 200 ft. Basal div. of Ripley fm. Underlies Cusseta sand. Overlies Eutaw fm. Below Florence, Stewart Co., it probably merges with the younger Renfroes marl.

According to later studies of J. O. Veatch and L. W. Stephenson, the lower part of Blufftown marl was considered to belong to Tombigbee sand memb. of Eutaw fm. and upper part to Ripley fm., and the name was discarded. (See Ga. Geol. Surv. Bull. 26, pp. 135, 152, 1911, and U. S. G. S. W. S. P. 341, p. 65, 1915. Also see under *Cusseta sand memb.*) The "Blufftown" is now considered to be = Tombigbee sand memb. only. Named for exposures at Blufftown, Stewart Co.

Bob crystalline limestone member (of Brownsport formation).

Silurian (Niagaran): Western Tennessee.

W. F. Pate and R. S. Bassler, 1908 (U. S. Nat. Mus. Proc. vol. 34, pp. 410–432). *Bob fm.*—Basal 5 to 30 ft. (*Uncinulus* zone) red ls. and shales in lower two-thirds, overlain by gray massive ls.; very similar lithologically to Dixon fm. Middle 25 to 42 ft. white, yellow, blue, and grayish shales and lss. holding abundance of brachiopods and called *Dictyonella* zone. Uppermost 15 ft. massive nodular cherty ls. or hard sh., called *Conchidium* zone, because brachiopods of genus *Conchidium* are most characteristic fossil. Is middle fm. of Brownsport group. Overlies Beech River fm. and underlies Lobelville fm.

Now treated as middle memb. of Brownsport fm.

Named for Bob Landing, Decatur Co.

Bob Wright coal group.

A group of coal beds in Blackhawk fm., of Mesaverde group (Upper Cret.), in Castlegate region, Utah.

Bodcaw sand lens.

A Lower Cret. subsurface sand, few ft. to 20 ft. thick, belonging to Davis oil and gas horizon in Webster Co., NW. La. Named for lease on which first producing well was drilled. (See under *Davis oil and gas horizon.*)

Bodega diorite.

Jurassic? (pre-Franciscan): Western California (Marin County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, p. 43). *Bodega diorite.*—Bodega Peninsula is made up almost wholly of this rock, which is a biotite diorite. The E. shore of Bodega Bay, however, is entirely Franciscan. Point Reyes Peninsula, to S., is composed largely of this diorite and granite. There are two varieties, one biotite diorite and the other quartz diorite. Best exposures of this diorite occur on ocean side of Bodega Peninsula, at S end, where it forms steep cliffs 50 to 80 ft. high.

Bodega Bay deposits.

Quaternary: Western California (Marin County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, p. 76). *Bodega Bay deposits.*—At Bodega Bay similar deposits [to those described as Tomales Bay deposits] occur on both sides of bay, but only in small patches, most of them having been removed by erosion. Near Bodega Point, on bay side, is a remnant resting upon a wave-cut shelf just about at high-water mark and extending up to 113 ft. above it, consisting principally of diorite sands and occasional pebbles showing very indistinct horizontal stratification and cross bedding. On ocean side of peninsula occasional still smaller patches, some 20 to 30 ft. thick, may be seen resting on a very evenly worn diorite surface, which about 3 mi. S. of mouth of Salmon Creek dips gently to N. and passes under the beach and eolian sands. On E. side of bay is a broad, flat terrace about ¼ mi. wide and some 75 to 90 ft. above sea level at its back. In most places only a thin veneer of gravel covers this terrace, but at one point on shore, at N. end of bay, a remnant of gravel some 50 ft. thick rests on worn Franciscan surface, which is here only 20 ft. above sea level. It is composed chiefly of Franciscan pebbles, and loosely coherent sands showing cross bedding. Is somewhat distorted, and dips slightly to N.

†Bodeville series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvi, 255–267). *Bodeville series.*—Mica and chloritic schists, chiefly acidic, forming top div. of Burnetan system. Probably overlies Long Mtn series. Uncon. underlies Valley Spring gneiss.

A part of either Packsaddle schist or Valley Spring gneiss of present nomenclature.

Named for Bodeville, Mason Co.

Bogachiel formation.

Cretaceous (?): Northwestern Washington.

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22, p. 160). *Bogachiel fm.*—Several thousand ft. of soft to hard green sl. (talc) interbedded with gray ss. and some sh. Greatest development in Bogachiel Valley, near headwaters of that stream. Is pitched nearly to vertical position, with trend of dip btw. SE. and NW. and E. and W. The Bogachiel and Hoh Rivers have cut channels in it. No fossils, but believed to be Cret. Uncon. underlies Soleduck fm.

Boggs member. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio (Muskingum County).

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 70). *Boggs memb.*—Hard, dense, bluish gray, fossiliferous, rather siliceous, marine ls.; in places represented in part or wholly by flint and iron ore. Thickness 1 to 3 ft. Lies 9 ft. 4 in. below Flint Ridge coal and 0 to 5 ft. above Lower Mercer or No. 3 coal in Muskingum Co. Is correlated with confidence with Boggs iron ore of Scioto Co., hence name.

Boggy shale.

Pennsylvanian (Allegheny): Central southern and eastern Oklahoma and western Arkansas.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 438). *Boggy sh.*—Alternating shales and sss., nearly 3,000 ft. thick, overlying Savanna ss. and underlying Thurman ss. Contains not less than 16 beds of ss., 20 to 150 ft. thick, separated by sh. beds 100 to 600 ft. thick.

Named for exposures along North Boggy Creek, Pittsburg and Atoka Counties, Okla.

The base of Boggy sh. in McAlester dist. is now drawn by U. S. Geol. Survey at base of or 20± ft. below Lower Witteville coal.

Bogue Island formation.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 103).

Bogus tongue (of Cutler formation).

Permian: Central eastern Utah (Moab region).

A. A. Baker, 1933 (U. S. G. S. Bull. 841). *Bogus tongue of Cutler fm.*—Red arkosic ss. and red mudstone forming top part of Cutler fm. in Moab region S. of Indian Creek. Max. thickness 100± ft. Overlies Cedar Mesa ss. memb. of Cutler, which consists of massive cross-bedded white to pale red ss. Uncon. underlies Moenkopi fm. (Lower Triassic). Crops out in Bogus pocket, SW. corner of T. 30 S., R. 21 E., San Juan Co. May or may not be continuous with Organ Rock tongue of Cutler fm. in Monument Valley.

Bohemia conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 3, 30, 52, 66, 72, 83, 99, plates 4 and 7). Beginning near end of the [Keweenaw] Point, at bottom of the series as exposed, at contact with Potsdam or Eastern ss., we find in Bohemian Range a succession of both basic and acid volcanics, frequently in alternation with detrital beds of similar composition, the whole capped by an extensive and rather persistent bed of fairly coarse and rather acid cgl. This bed, which in following pages I shall provisionally call "Bohemia" cgl., skirts N. side of this range near its summit. Above it comparatively few cgls. occur until we reach the so-called Ashbed group above the Greenstone. It is a triple complex cgl. and is same as St. Louis cgl.

Is top fm. of Bohemian Range group.

Named for fact it caps Bohemian Range, in Keweenaw Co.

Exposed N. of Mount Bohemia.

Bohemia porphyrite.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 40 and 72). Mapped as older than Bohemia cgl. and younger than Lac la Belle cgl.

Belongs to Bohemian Range group.

Named for fact it occurs N. of Mount Bohemia, Keweenaw Co.

Bohemian Range group.

Pre-Cambrian (Keweenawan): Northern Michigan and probably northern Wisconsin.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 179–187, pls. 17 and 18). A series of flows, consisting of diabase, diabase amygdaloid, melaphyr, diabase porphyry, and orthoclase gabbro, including cgl. beds and quartz porphyry and granite porphyry. Underlies Central Valley beds. Forms lower part of Keweenawan series of Keweenaw Point, Mich. Thickness 10,000 ft.

According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, 1911) the Bohemia (No. 8) cgl. is top fm. of the group, which is uncon. underlain by Huronian series.

Named for fact its rocks compose Bohemian Range, Keweenaw Co., Mich.

†Bohicket marl sands.

Pleistocene: Southern South Carolina (Charleston County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv. ser. 4. Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 12, 20, 21). *Bohicket marl sands.*—A bed of exceedingly fine grained sands about 5 ft. thick. The color is rendered gray-green and yellow-red, probably by fine glauconitic inclusions, portions of which have been more or less weathered, with effect of rendering the mass semi-plastic with residual clay; the iron has in part leached out, and cemented to "hard pan," a thin portion of the material immediately above the phosphate rock. Immediately overlies Wadmalaw marls and extends over Wadmalaw shell-marl, into which it grades. It overlaps typical Wadmalaw shell-marl and extends over a great portion of the phosphate rock area as far N. as Ten Mile Hill. Is overlain by Accabee gravels. Is a marine deposit.

C. W. Cooke, 1935 (personal communication). Is a facies of Pamlico fm.

Named for exposures in Bohicket Creek, near Rockville, Charleston Co.

Bohio limestone.

Eocene (upper): Panama.

E. Howe, 1907 (Isthmian Canal Comm. Rept., pp. 108, 139). [Contains upper Eocene fossils.]

Bohio conglomerate.

Oligocene (?): Panama Canal Zone.

D. F. MacDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 708).

Bois d'Arc limestone.

Lower Devonian (Oriskany and Becraft?): Central southern Oklahoma.

C. A. Reeds, 1911 (Am. Jour. Sci., 4th, vol. 32, pp. 256–268). *Bois d'Arc ls.*—Thin-bedded, crystalline and noncrystalline ls., with occasional chert lentils and thin beds of intercalated yellowish sh. Lower part has New Scotland aspect, but is more nearly Becraft than New Scotland of N. Y. It may yet be determined that upper 40 ft. is Oriskany in age. Thickness 0 to 90 ft.; average 60 ft. Originally included as top div. of Hunton fm. Overlies Haragan sh.

C. Schuchert, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 667). *Bois d'Arc ls.* contains upper Oriskany fossils in upper 5 to 8 ft., and Helderberg fossils in lower part. In all probability it does not pass unbroken into the Haragan. All lower Oriskanian is absent in Arbuckle Mtns.

C. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470–474). Top fm. of Hunton group is here named *Frisco ls.*, 0 to 20 ft. thick. It rests on Bois d'Arc ls. [restricted], 0 to 90 ft. thick, which contains abundant fauna that indicates Becraft age. Fauna of Frisco ls. is Oriskany. The Frisco is best exposed in bed and bank of Bois d'Arc Creek and in vicinity of Coal Creek, 7 mi. S. of Frisco.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 32). *Bois d'Arc ls.* is evidently of early Oriskany age.

Named for exposures along Bois d'Arc Creek, Pontotoc Co.

Boise granite.

Jurassic or Cretaceous: Southwestern Idaho (Boise Mountains).

I. C. Russell, 1902 (U. S. G. S. Bull. 199, p. 39). The terrane named "Boise granite" by Lindgren, from which the rugged mtns which lie to N. and E. of Boise have been sculptured, extends eastward from this area and occupies an extensive and exceedingly rugged region lying N. of Mountain Home. As stated by Lindgren, the granite is intrusive and of ancient date (perhaps pre-Algonkian). [The compiler has been unable to find where Lindgren named this granite. In U. S. G. S. 18th Ann. Rept., pt. 3, 1898, he mapped and described the *granite of Boise Mtns.* He also mapped the granite in U. S. G. S. 20th Ann. Rept., pt. 3, pl. 8, 1900, but did not apply a geographic name to it. The granite is a part of the enormous Idaho batholith (which is now regarded as probably of Jurassic or Cret. age, but possibly younger) and a special geographic name for it does not appear to U. S. Geol. Survey to be necessary.]

Boise sandstone.

Pliocene (?): Southwestern Idaho.

V. R. D. Kirkham, 1928 (Idaho Bur. Mines and Geol. Pam. 29, p. 1). Massive grit or ss. locally known as *Boise ss.* This fm., along with a varying thickness of sandy and shaly layers, is assigned to Poison Creek fm., of probable Plio. age.

Boissevain sandstone.

Tertiary: Winnipeg region, Canada.

W. A. Johnston, 1934 (Canada Dept. Mines, Geol. Surv. Mem. 174, p. 11).

Bokchito formation.

Lower Cretaceous (Comanche series): Southeastern and central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Bokchito fm.*—Chiefly clay and sandy clay, with beds of friable ss., siliceous shell ls., and iron-stone segregations and concretions. Thickness 140 ft. Underlies Bennington ls. and overlies Caddo ls.

Named for Bokchito Creek, near Bokchito, Bryan Co.

Bolin sandstone member (of Roubidoux formation).

Lower Ordovician (Beekmantown): Central Missouri (Miller and Morgan Counties).

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., p. 50). *Bolin Creek ss. memb.*—Heavy deposits of ss., 1 to 50 ft. thick, occurring as massive beds and as a number of thinner beds in uninterrupted succession in St. Elizabeth [Roubidoux] fm. to S. of Osage River, in Miller Co.

E. R. Buckley, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., pp. xii–xv). St. Elizabeth fm. includes all of so-called Second ss. and parts of Second (Jefferson City) and Third (Gasconade) Mag. ls. fms. Ball and Smith found that in some places the ss. has a development of 6 to 50 ft. over sufficient area to warrant distinguishing and mapping it as a memb. or lentil in St. Elizabeth fm. On map all these lenses have been called *Bolin Creek ss.*, although it is not known that they all constitute a part of same horizon. In fact, in some instances the evidence gathered by Mr. Smith indicates such is not the case. However, the name *Bolin Creek ss.* has been made to apply to any of the several ss. lenses occurring in St. Elizabeth fm. in Miller Co.

C. F. Marbut, 1908 (Mo. Bur. Geol. and Mines vol. 7, 2d ser.), described Roubidoux fm. of Morgan Co. as consisting of (descending): (1) "Cotton rock" (fine-grained ls.); (2) *Bolin ss. memb.* (persistent, consisting of 10 ft. of gray and reddish sand, 8 to 15 ft. of ls. and chert, and 10 ft. of gray and reddish sand); (3) cherty mag. ls. and chert; (4) ss. in some places, heavy-bedded brecciated chert in other places.

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser.), described Roubidoux fm. of Mo. as consisting of (descending): (1) dol. and sss.; (2) *Bolin Creek ss. memb.*, 0 to 50 ft., cross bedded and ripple marked; (3) dol. and sss.

C. L. Dake, 1922 (Pan-Am. Geol., vol. 37, No. 4), described Roubidoux ss. as a succession of beds in which lateral gradations from ss. into chert or ls. are the rule, and while one section may be almost wholly ss., another may be over three-fourths ls., the lss. becoming more abundant to E., W., and probably to S. The fm. is notably cross bedded and ripple marked.

Named for exposures on Bolin Creek, Miller Co.

This name as used by U. S. Geol. Survey is applied locally to a ss. memb. of Roubidoux fm. in Miller and Morgan Counties, the typical region.

Bolinas sandstone.

Jurassic (?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Bolinas ss.* (volcanics), 2,000 ft. thick. A div. of the Franciscan. [Shown in table as underlying Sausalito cherts and overlying volcanics that are younger than Calera ls.]

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). [The Franciscan rocks of Bolinas Ridge, also of shore of Bolinas lagoon and shore of Bolinas Bay (all in Marin Co.), are mapped as undiff. sss. of Franciscan group, with radiolarian chert lentils of undet. horizons, but in other parts of region the rocks btw. Sausalito chert and Calera ls. are mapped as upper part of Cahil ss.]

†Bolin Creek sandstone member (of Roubidoux formation).

See under *Bolin ss. memb.*

Bolivar sandstone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). *Bolivar ss.*, 25 ft. thick in Fayette and Westmoreland Counties, lies 31 ft. below Lower Kittanning coal and 5 ft. above Clarion coal.

This ss. has been correlated with Kittanning ss. memb., but B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M7, p. 273), places it beneath Vanport ls. memb.

Bolivar fire clay. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 159–160). *Bolivar fire clay.*—Where Upper Freeport ls. is absent or only slightly developed, there usually comes into the section at this horizon a bed of excellent fire clay, which from having long been mined near Bolivar, Westmoreland Co., Pa., is generally known as Bolivar clay.

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. vol. 3, pt. 2). The Freeport upper fire clay, occurring a short distance below Freeport upper ls., is known as "Bolivar fire clay."

G. H. Ashley, 1908 (Topog. and Geol. Surveys Pa.). *Bolivar fire clay* lies short distance below Upper Freeport ls.

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M7, pp. 261, 316). *Bolivar fire clay* underlies Upper Freeport ls.

Bolivar sandstone.

Lower Ordovician (Beekmantown): Southwestern Missouri.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 42). *Bolivar ss.*—Used in table only, as = Marshfield ss., First ss., Pacific ss., and Crystal City ss.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12), doubtfully correlated *Bolivar ss.* with Roubidoux fm.

E. M. Shepard, 1907 (U. S. G. S. W. S. P 195). Marshfield and *Bolivar ss.* are commonly believed to represent St. Peter ss., but Ulrich regards them as lenses in Jefferson City ls. [broad sense].

The 1922 geol. map of Mo. shows Jefferson City dol., Cotter dol., and Powell dol. to be the surface rocks at and around Bolivar, Polk Co.

J. Bridge, 1930 (personal communication), stated that this ss. is either equiv. to Marshfield ss. or represents some of the basal Penn. sands.

Bolivar sand.

Name applied by drillers in some early repts. to Richburg or Allegany oil sand of Allegany Co., N. Y.

Bolsa quartzite.

Middle Cambrian: Southeastern Arizona.

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, pp. 28–30). *Bolsa qtzite.*—Consists of (descending): (1) Thinner bedded [than below], more vitreous, fine-grained qtzites showing no feldspathic material; (2) hard pebbly grits in beds 10 to 20 ft. thick, cross bedded in lower part; (3) cgl. at base, ½ to 1 ft. thick. Thickness 430 ft. Rests uncon. on pre-Camb. schists and is conformably overlain by Abrigo ls. Is without much doubt = Tonto ss. of Grand Canyon. Well exposed in newly named Bolsa Canyon, on SW. side of Escabrosa Ridge, Bisbee quad. [For reason for introduction of name see entry No. 2 under *Dragoon qtzite.*]

Bolsa zone.

An oil-producing zone, 600 to 800 ft. thick, in Huntington Beach oil field of Orange Co., Calif. Consists of sands, sandy shales, and thin sands. Its top lies at depth of about 1,914 ft. H. S. Gale (A. A. P. G. Bull., vol. 18, No. 3, 1933, p. 330) assigned it to Repetto siltstone (lower Plio.).

Bolsa Chica oil sand.

A subsurface sand, lying at 7,670 ft. depth, in Kettleman Hills, King Co., Calif., sec. 24, T. 22 S., R. 17 E.

Bolton schist.

Carboniferous (?): Central northern Connecticut.

J. G. Percival, 1842 (Conn. Geol. Surv. Rept., pp. 229–233 and map). *Bolton mica sl. fm. (No. 3 of group C of Eastern Primary system).*—Appears as a narrow micaceous band btw. two parallel granitic ranges. Throughout whole extent the predominant rock is a soft dark or light bluish (lead) gray mica sl., with garnets and staurotides and, more rarely, with kyanites. Is prevailingly coarse grained, thin and uneven, but thicker and more even quartzose varieties occur in different parts of the range. Occupies W. part of town of Bolton [Tolland Co., Conn.].

The rocks in Mass. that have been called "Bolton schist" were divided by B. K. Emerson (U. S. G. S. Bull. 597, 1917) into Quabin qtzite and Amherst schist.

Bolton mica slate.

See under *Bolton schist.*

†Bolton gneiss.

Late Carboniferous or post-Carboniferous: Eastern Massachusetts (Worcester County).

B. K. Emerson and J. H. Perry, 1903 (Geol. of Worcester, with map, p. 79). *Bolton gneiss.*—Passes into Paxton schist to W., and is the Carbf. micaceous qtzite made gneissoid by abundant injection of granite btw. its laminae. Named for town of Bolton, which it extends through. Includes Millbury ls. and other lss.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 80–87, 219). *"Bolton" gneiss.*—A complex of mica gneiss, chiefly biotitic, but in places containing muscovite, with which is associated some hornblende gneiss. Has been closely folded, and greatly squeezed, and much of it is closely and intricately plicated. Is certainly in part sedimentary and almost certainly in part igneous, but the two sorts of rock are so complexly interbedded and folded that in many places they can be distinguished with difficulty, if at all, and in most places to map them separately is out of question. This complex has been called Bolton gneiss, but that name is preoccupied by a fm. in Conn., and its use in this connection is discontinued. Adoption of a new name postponed until the rocks have been studied more closely and an agreement has been reached, if possible, regarding their age and correlation. Are typically exposed in towns of Bolton and Berlin. Correlated with Brimfield schist and Paxton quartz schist. [Explains conflicting views regarding age and correlation.]

Bolton moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), 1913, p. 17.

Bolton igneous series.

Late Devonian or post-Devonian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

Bolza quartzite.

Cambrian: Mexico (Sonora).

N. L. Taliaferro, 1933 (Jour. Geol., vol. 41, No. 1, p. 18).

Bomoseen grit.

Lower Cambrian: Eastern New York (Washington and Rensselaer Counties) and southwestern Vermont (Bennington and Rutland Counties).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 160, pp. 67–70 and map). *Bomoseen grit.*—Olive green grit, nearly a pale brick red, in places associated with a bed of qtzite 12 to 55 ft. thick. Underlies Mettawee sl. in Washington Co., N. Y.; in Rensselaer Co. it underlies Diamond Rock qtzite and overlies Nassau beds—all Lower Camb. Thickness 50 to 200 ft. Type loc. on W. side of Lake Bomoseen, Vt. [Castleton quad., Rutland Co.].

Bonair sandstone. (In Lee group.)

Pennsylvanian (lower Pottsville): Central Tennessee.

M. R. Campbell, 1899 (U. S. G. S. Standingstone folio, No. 53, p. 3). *Bonair cgl. lentil of Lee fm.*—Coarse ss. or cgl., 100 to 200 ft. thick, forming massive cliffs along W face of table-land from Bonair to Monterey, where it suddenly disappears, apparently breaking down into sandy sh., which can not be distinguished from underlying and overlying shales. At Bonair it rests on 110 ft. of sh., which overlies Bonair coal and forms basal part of Lee fm. Where this sh. is absent the cgl. rests on Bonair coal or on underlying Pennington sh. Separated from younger Rockcastle cgl. lentil of Lee fm. by about 125 ft. of sh.

Belongs to Lee group, of lower Pottsville age. Underlies Vandever sh. and overlies Whitwell sh., all fms. of Lee group. (See C. Butts and W. A. Nelson, Tenn. State Surv. Bull. 33D, 1925.)

Named for Bonair, White Co.

†Bon Air Measures.

Pennsylvanian: Southeastern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 148–151, 167, 168). *Bonair or Lower Coal Measures.*—Alternating shales and sss., with coal beds, and with Sewanee cgl. (70 ft. thick) at top. [Later studies by C. Butts show that this cgl. is Bonair ss. and that †Bon Air Measures are all above true Sewanee cgl.] Thickness 250 to 500 ft. Underlies Tracy City Measures. Overlies Mountain ls.

Preoccupied by Bonair ss. Included part of Lee group, of lower Pottsville age.

Named for important mines in White Co.

Bon Ami beds.

Devonian: Quebec.

J. M. Clarke, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 89).

Bon Ami andesite.

Devonian: New Brunswick.

W. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 477).

Bonanza latite.

Tertiary: Southern Colorado (Bonanza district, Saguache County).

H. B. Patton, 1916 (Colo. Geol. Surv. Bull. 9, pp. 21–63). *Bonanza latite.*—Usually gray, grayish black when fresh, sometimes brown, fine-grained, with phenocrysts of feldspar and often biotite. Is country rock of most of Bonanza dist.

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Bonanza latite.*—Mostly flows; some tuff and breccia in upper part. Overlies Rawley andesite. Thickness 500 to 1,000 ft. The Bonanza latite of Patton applied to only the lower flow or series of flows of this fm. The name as here applied includes all lavas that lie stratigraphically btw. Rawley andesite and Squirrel Gulch latite.

Bonanza group.

Upper Triassic and Lower Jurassic(?): Vancouver Island, British Columbia.

H. C. Gunning, 1933 (Canada Geol. Surv. Summ. Rept., pt. A2, p. 34).

Bonanza King formation.

Middle Cambrian: Southeastern California (San Bernardino County).

J. C. Hazzard and J. F. Mason, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 2, pp. 229–240). *Bonanza King fm.*—Consists of (descending): (1) Sandy dol. and platy sh., thin; (2) light-gray, fine- to medium-grained dol., 200 to 225 ft.; (3) *Silver King dol. memb.*, 200 to 250 ft.; (4) nodular and lenticular chert underlain by light- and dark-gray dol., 900± ft.; (5) sandy, reddish, platy dol., 25 to 30 ft.; (6) light- and dark-gray dol. and partially dolomitized ls., 600 to 650 ft. Thickness of fm., 2,000± ft. Poorly preserved fossils in lower 100 ft. in Providence Mtns indicate Middle Camb. Overlies Cadiz fm. (Middle Camb.) and underlies Cornfield Springs fm., in part at least Middle Camb. Occurs in Providence and Marble Mtns. Named for Bonanza King Mine, on E. side of Providence Mtns.

Bonaparte marble.

Mississippian: Southeastern Iowa.

C. H. Gordon, 1895 (Iowa Geol. Surv. vol. 4, p. 211). A few ft. of ls. appears at Des Moines River level on S. side, about half way btw. Bentonsport and Bonaparte [Van Buren Co.], which may represent uppermost part of Upper Burlington ls. These beds have been penetrated at Bonaparte and are there called "Bonaparte marble."

Bonaventure formation.

Bonaventure conglomerate.

Bonaventure series.

Mississippian or Pennsylvanian: Quebec and New Brunswick.

E. J. Chapman, 1863 (Canada Inst., n. s., vol. 8, pp. 450–451). *Bonaventure fm.*, Carbf., Canada.

All writers appear to have classified *Bonaventure fm.* as Carbf. until R. W. Ells (Canada Geol. Surv. Rept. 1880–82, p. 3D, 1883) stated that in New Brunswick it is partly Dev. G. A. Young (Canada Geol. Surv. Summ. Rept. 1909, p. 220, 1910; and Mem. 18, p. 52, 1911) assigned it to Dev., J. M. Clarke, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 91) and 1915 (N. Y. State Mus. Bull. 177, p. 152) assigned *Bonaventure cgl. to* Devono-Carbf.; H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 212) assigned *Bonaventure fm.* to Carbf.; J. M. Clarke, 1920 (N. Y. State Mus. Bull. 219, 220, p. 147) assigned *Bonaventure cgl.*, to Dev.; F. J. Alcock, 1922 (Canada Geol. Surv. Summ. Rept., 1921, pt. D, p. 82) assigned *Bonaventure series* to Devono-Carbf.; J. M. Clarke, 1924 (N. Y. State Mus. Bull. 251, pp. 123–127) assigned *Bonaventure fm.* to early Carbf. or late Dev.; C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 53) assigned *Bonaventure series* to Dev.; C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 175) assigned it to late Lower Carbf.; W. A. Parks, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 795) assigned *Bonaventure fm.* to Miss.

See also E. M. Kindle, 1930 (Canada Geol. Surv. Dept. Mines Summ. Rept. 1928, pt. C, pp. 82C–89C, pl. opp. p. 82C).

C. H. Kindle, 1936 (Eastern Geol., No. 1, April 1936, p. 5). *Bonaventure fm.* consists mainly of red sss. and ls. cgls. West of Mal Baie (where it is flat) and on S. border of it (where it is upturned and in places overthrust) the fm. is thinner than elsewhere and may be divided into a lower cgl., a middle red sh. zone, and an upper light-colored ss. In this upper ss. occur carbonized logs and tree stumps and also casts of smaller plants, such as *Calamites*, which Dr. Bell of

Canadian Geol. Surv. has examined and concluded represent lower Penn. or possibly upper Miss. time. [In heading, *Penn.* (?) is used; on maps, *Penn.*, without a query.]

Bonavista formation.

Lower Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Bonavista fm.*—Red and green shales with ls. nodules. Contains *Coleoloides*, etc. Basal fm. of Etcheminian series. Underlies Brigus fm. and uncon. overlies Algonkian Random fm. (Keweenawan). [Derivation of name not stated.]

Bond sand.

A subsurface sand in Strawn fm. (Penn.) of Bryson oil field, Jack Co., Tex.

†Bone Canyon member.

†Bone Canyon limestone.

Permian: Western Texas (Guadalupe Mountains, Sierra Diablo, etc.).

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 921, 922, 925). *Bone Canyon memb.*—Black ls. containing fossils of Leonard age, uncon. underlying Delaware Mtn ss. (restriction of name) in Bone Canyon, on W. side of Guadalupe Mtns. A short distance N. of Bone Canyon a wedge of gray ls. (here named *Victorio Peak memb. of Leonard fm.*) appears beneath the uncon. at base of Delaware Mtn ss., and separates Bone Canyon memb. from that ss. Thickness 500 to 1,000 ft. Conformably overlies 500 ft. of massive ls. containing rich Hess fauna.

See *Bone Spring ls.*, the approved name.

†Bone Lake crystalline schists.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Crystal Falls district).

J. M. Clements, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 60+). *Bone Lake crystalline schists.*—Certain crystalline schists which are best developed in N. part of Crystal Falls dist., in vicinity of Bone Lake. They are fine to medium grained, and vary in color from moderately light green for the more chloritic phases to very dark green or purplish black for those in which hornblende, mica, and iron ores are prominent. They are but extremely metamorphosed members of Hemlock volcanic fm. Outcrops scarce except in vicinity of Bone Lake.

Bone Spring limestone.

Permian: Western Texas (Guadalupe and Delaware Mountains).

W. G. Blanchard, Jr., and M. J. Davis, 1929 (A. A. P. G. Bull., vol. 13, p. 962, pls. 10, 11). The basal dark ls. series in Guadalupe and Delaware Mtns is here designated *Bone Springs ls.*, although its correlatives elsewhere will continue to be called *Leonard fm.* Named for Bone Springs Canyon, which opens in sec. 2, Blk 66, NW. part of Culberson Co. The series will not here be included in Delaware Mtn fm., because of faunal difference, lithologic dissimilarities, and angular uncon. that separates the two. Upper part is gray ls., lower part is black ls. Cross bedding is noticeable at many points in both black and gray phases along Guadalupe scarp. North of Bone Springs Canyon a mass of hard, gray hackly ls., which evidently has been removed at Bone Springs Canyon, comes into the series. It lies conformably on top of the black ls. The gray and black phases seem to grade into each other from point to point. Total thickness exposed in Guadalupe Mtns 1,600± ft. From Guadalupe Pt. the Bone Springs ls. has been traced southward along W. base of Delaware Mtns for approx. 25 mi. Correlated with Leonard fm. of Glass Mtns, on similarity of fossils and lithology.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 921–922, 924, 925), treated this ls. as basal memb. of Delaware Mtn fm., and named it *Bone Canyon memb.* (See under *Delaware Mtn fm.*)

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 731, 755–768), redefined *Bone Springs ls.* by including, at top, Victorio Peak massive memb., and changed name to *Bone Spring ls.*, because there is only 1 spring present in Bone Canyon, although the place is locally called *Bone Springs*. This is present approved usage of U. S. Geol. Survey. He stated: The Bone Spring ls. was included by Richardson as a memb. in Delaware Mtn. fm., but the unit has a greater extent and thickness than was originally supposed, and the faunas, as first pointed out by Girty, are not entirely like those of the beds above, so that it is now generally recognized as a distinct fm. Also: The definition of King and King applied only to the black lss. of the fm.; in present paper the name is given the broader usage of Blanchard and Davis and applied to lss. of various sorts, of same general age and strat. position.

These beds were included in Delaware Mtn fm. as originally defined and subsequently used, but they are now treated as a distinct fm., underlying (in places uncon.) Delaware Mtn fm. and=Leonard fm.

See also †*Bone Canyon memb.* and W. B. Lang, 1937 (A. A. P. G. Bull. vol. 21, No. 7).

Bone Springs limestone.

See *Bone Spring ls.*, the approved name.

Bone Valley gravel.

Pliocene (lower?): Southern central Florida.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 138–141). *Bone Valley gravel.*—Light-colored gravel and marl, containing phosphatic pebbles. Consists of a fine-grained matrix containing pebbles of phosphate or chert, fragments of bone and other organic remains. Matrix is commonly a marly clay, though sand is not uncommon, especially in upper part of fm. The finer grained material is soft and plastic when wet, but upon exposure to the air hardens to a firm mass. The fm. comprises nearly all of the pebble phosphates now being mined in Fla. Thickness not more than 30 ft. Rests, probably uncon., on Plio. marls or older rocks. Overlain, uncon., by Pleist. sands. Is believed to be younger than "Arcadia marl" and older than upper beds of Caloosahatchee marl. Is a nonmarine deposit, probably in part contemp. with Alachua clay.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept., p. 162). The "land-pebble" phosphate deposits make up large part of *Bone Valley gravel,* which rests uncon. on Hawthorn fm. (from which it is in part derived) and is uncon. overlain by Quat.

Named for exposures at town of Bone Valley, W. of Bartow, Polk Co.

Bonham marl.

Upper Cretaceous (Gulf series): Northeastern Texas (Fannin, Lamar, and Red River Counties).

L. W. Stephenson, 1927 (A. A. P. G. Bull., vol. 11, p. 8). *Bonham clay.*—A partly calc. and partly non-calc. clay, which toward W. in Fannin Co. merges into Austin chalk and toward E. extends through Fannin, Lamar, and Red River Counties. In Fannin Co. it conformably underlies Brownstown marl and conformably overlies Ector tongue of Austin chalk. In Lamar and Red River Counties the upper part of Bonham clay is replaced by Blossom sand, which is conformably underlain by the lithologically persistent lower part of Bonham clay, which there rests uncon. on Eagle Ford clay. In previous repts has been confused with Eagle Ford. Named for exposures a short distance N. of town of Bonham, Fannin Co., and for fact that the town, especially the part N. of the railroad, is located on the clay.

Name changed (at request of L. W. Stephenson) to *Bonham marl* April 7, 1936.

Bonilla formation.

Miocene: Costa Rica.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 365).

Bonita sandstone. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Bonita ss.*, 1,400 ft. thick, top fm. of Franciscan. [Shown in table as overlying San Miguel cherts and uncon. underlying Knoxville.]

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Bonita ss.*—Massive, obscurely bedded ss. of dark greenish gray color and medium texture, with subordinate amounts of sh. and cgl. Thickness about 1,400 ft. Top fm. of Franciscan group. Conformably overlies Ingleside chert.

Named for exposures at Point Bonita, on N. shore of Golden Gate.

Bonnellian series.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 64, No. 2, 1935, pp. 138–139), to include Pawpaw sss., Main Street marls, Grayson shales, and Buda ls. of central Tex. "These are usually placed in Washita div., by Tex. geologists, but they are, more properly, seemingly, to be grouped by themselves." Named for Mount Bonnell, near Austin, Tex.

Bonner Springs shale.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Bonner Springs sh.*, new name; underlies Plattsburg ls. and overlies Farley ls.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 93, 97). *Bonner Springs sh.* includes the strata btw. top of Wyandotte ls. and base of Plattsburg ls. [Derivation of name not stated. On p. 46 *Bonner Springs sh.* is described as consisting of 20.2 ft. of gray aren. sh. with plant fossils.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 65, 67–69). The term *Bonner Springs* is here applied to sh. btw. underlying Plattsburg ls. and overlying Farley ls., and generally erroneously referred to as "upper Lane sh." It is much younger than true Lane sh. Consists of sh. (olive-green, argill., maroon layer near top) underlain by soft greenish buff micaceous ss. or aren. sh. In places includes at top a 5-ft. bed of ls. and shell breccia, as ½ mi. W. of Bonner Springs. One-half mi. E. of De Soto the breccia bed of the Bonner Springs lies on Farley ls., through absence of the sh. of the Bonner. Thickness of fm. 0 to 35± ft. Named for town in Wyandotte Co. Type exposure at cement plant NE. of the town.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Bonneterre dolomite.

Upper Cambrian: Southeastern Missouri.

F. L. Nason, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 358–361). *Bonne Terre or St. Joseph ls.*—Non-cherty lss., 300 ft. thick; some fossiliferous strata; contains upper and lower lead zones. Overlies La Motte ss. and uncon. underlies Potosi slates and cgls., the basal bed of which consists of 6½ ft. of cgl.

E. O. Ulrich and H. F. Bain, 1905 (U. S. G. S. Bull. 267, pp. 21–26). *Bonneterre ls.*—As a rule consists of more or less heavily bedded, granular, and highly mag. lss., generally compactly crystalline and often minutely vesicular, with dol. crystals lining the cavities; a few beds are fine grained; color light or dark gray; usually weathers yellowish; locally contains beds of a pink or more decidedly red color; chert and drusy quartz seem to be entirely absent; some beds, especially in lower part, contain much chlorite, in places sufficient to give them a decidedly green color; toward base much silica occurs as grains of sand in the ls. Thickness varies from 200 to 250 ft. in vicinity of Mine La Motte and Fredericktown to nearly 500 ft. in St. Francois Co., to N. It seems to wedge out on old hillsides. Appears to grade into underlying La Motte ss. Where top of Bonneterre has suffered least from widespread erosion that took place prior to deposition of Elvins fm., it grades upward from the massive lss. into a thinly bedded zone, and this finally into a bed of blue sh.; locally the thinly bedded and shaly zones appear to be absent. [See also under *Elvins fm.*]

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1). *Bonneterre fm.*—Consists of (descending): (1) Argill. dol.; (2) 250 to 300 ft. of dark and light-gray dol. with thin sh. partings; (3) 50 to 100 ft. of buff or gray dol., aren. buff or yellowish dol., thin green, gray, or brownish black sh. beds, chloritic dol. Grades into underlying La Motte ss. Is overlain by Davis fm. (lower part of Elvins fm. of Ulrich), 150 to 190 ft. thick.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., p. 39). Nason placed upper limit of Bonneterre at edgewise cgl. horizon, which is about

6 ft. below "Central" marble boulder memb. of Davis fm. From sections given by Ulrich in 1905 it would appear that he similarly revised the Bonneterre, as defined by Nason, his Elvins fm. being above the cgl., just below the "Central" marble boulder memb. of Buckley's Davis. Therefore Davis fm. as recognized in latest repts contains probably 100 ft. or more of sh. and shaly dol. that had been included in Bonneterre in earlier repts.

Named for exposures at Bonneterre, St. Francois Co.

†Bonneville beds.
†Bonneville group.
See *Lake Bonneville beds.*

Bontour Point.
Oligocene: Trinidad.
C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 701).

Booch sand.
A subsurface sand, of early Penn. (Cherokee) age, in Okla., lying lower than Bartlesville sand, higher than Dutcher sand, and correlated with Tucker and Taneha sands. In type area (Booch field, Muskogee Co.) it lies at 1,075 ft. depth.

Boone limestone (Oklahoma and Missouri).
Boone formation (Arkansas).
Mississippian (Warsaw and Osage): Northern Arkansas, eastern Oklahoma, and southwestern Missouri.

J. C. Branner and F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. xiii, 27-37). [According to p. xiii the fm. was named by Branner; the description is by Simonds.] *Boone chert and cherty ls.*—Characterized by layers of ls., usually hard, compact, and gray, interbedded with chert, white or gray on freshly broken surface but becoming brownish on exposure. Thickness 150 to 200 ft. in Washington Co., Ark. Underlies Wyman [Batesville] ss. and overlies Dev.(?) Eureka sh. [Chattanooga sh.].

R. A. F. Penrose, Jr., 1891 (Ark. Geol. Surv. Ann. Rept. for 1890, vol. 1). In Batesville region, Ark., *Boone chert* underlies Fayetteville sh. [Moorefield sh.] and overlies Sylamore ss.

T. C. Hopkins, 1893 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 4). Basal memb. of *Boone chert* is here named St. Joe ls.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24). Correct strat. succession in northern Ark. is (descending): (1) Wedington ss.(=Batesville ss. of Simonds); (2) Fayetteville fm.; (3) Batesville ss. (=Wyman ss. of Simonds); (4) Moorefield sh. (=Fayetteville sh. in part of Branner); (5) Spring Creek ls. (local); (6) *Boone ls.*, including St. Joe ls. memb. at base. Wedington ss. may belong to Fayetteville fm. [The Wedington ss. has for many years been treated as a memb. of Fayetteville sh.]

E. T. McKnight, 1935 (U. S. G. S. Bull. 853), described *Boone fm.* of Yellville quad., Ark., where St. Joe ls. memb. (20 to 45 ft. thick) lies 0 to 18 ft. above its base.

A. W. Giles, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 12, pp. 1815-1867), made a detailed study of the chert of the Boone ls., and divided the fm. into the following members in NE. Okla. and N. Ark. (descending order): Green ls. and Short Creek oolite (both of Warsaw age); Keokuk ls.; Burlington ls.; Fern Glen ls.; and St. Joe ls. (of Fern Glen age).

Named for extensive development in Boone Co., Ark.

Boone Creek limestone member (of Palo Pinto limestone).
Pennsylvanian: Central northern Texas (Jack and Wise Counties, Brazos River region).

J. M. Armstrong, 1929 (Tex. Bur. Econ. Geol., geol. map of Jack Co.). *Boone Creek ls.*, 5± ft. thick, is in Palo Pinto fm., and *Willow Point ls.* is in Graford fm., 40± ft. above Bridgeport coal.

E. H. Sellards (September 1931, News Letter from Bur. Econ. Geol. Univ. Tex.). In Wise Co. the Palo Pinto ls. has been found to be divided into 2 thin lss. separated by sh. The lss. are named *Boone Creek* and *Willow Point*.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 23). *Boone Creek ls.* included in Palo Pinto fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 105). *Boone Creek ls.* in Palo Pinto fm., is named for Boone Creek, Jack Co.

Booneville stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow and H. M. Chance, 1896 (N. Y. Acad. Sci. Trans., vol. 15, pp. 51-52). *Booneville stage.*—Interbedded shales and sss., with coal beds, 400 to 2,500 ft. thick, underlying Norristown stage [Hartshorne ss.] and overlying Appleton stage. Includes Grady coal at base. [Not Grady (Hartshorne) coal but a lower coal.]

Represents upper part of Atoka fm.

Probably named for Booneville, Logan Co., Ark.

Booth zone.

A petroliferous zone, about 270 ft. thick, included in Alamitos zone of Fernando group. Named for San Martinez Booth No. 1 well, in Long Beach field, Los Angeles Basin, Calif.

Bopesta formation.

Miocene (upper): Southern California (northeastern part of Kern County).

J. P. Buwalda, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 310). *Bopesta fm.*—Wholly different from underlying Kinnick and Witnet fms., being continental in origin. Many hundred ft. thick in type section along Cache Creek, NE. of Monolith [NE. part of Kern Co.]. Contains the upper Mio. Cache Peak fauna. Moderately folded. Rests (probably uncon.) on Kinnick fm. [Derivation of name not stated.]

Boquilla slate.

Pre-Cretaceous: Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 292) and 1910 (Soc. geol. mexicana, Bol., t. 7, p. 89).

Boquillas flags.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 29-33). *Boquillas flags.*—Thin-bedded, closely jointed, fossiliferous flaggy strata, separated by delicate seams which may not appear on freshly exposed surfaces. Upper 100 ft. of chalky texture. Color variable but characteristically cream grayish white; in Boquillas region faint ferruginous red stain; in other areas some ledges are dark and almost black on fresh fractures. Thickness 585 ft. Basal fm. of Upper Cret. Western equiv. of Eagle Ford shales. Grades into overlying Terlingua beds and overlies Buda ls.

Named for Boquillas, Brewster Co., on Tornillo Creek, Chisos Mtns quad.

Borden sandstone. (In Monongahela formation.)

Pennsylvanian: Western Maryland (Georges Creek Basin).

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 7). *Upper Sewickley ss.* (*Borden ss.*).—Lies a short distance above Borden coal. [In text this ss. is called *Upper Sewickley ss.*, which is said to be 6 ft. thick in Borden shaft.]

Borden group.

Mississippian: Indiana.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 408, 470 (footnote), 487-490, 492, 531, and chart). *Borden group* (also *series*).—Great group of shales and sss. of Burlington and Keokuk age well exposed about village of Borden (formerly called New Providence). Overlain by Harrodsburg (Warsaw) ls. and underlain by Rockford ls., or, where that is absent, New Albany sh. Includes Riverside ss., Rosewood sh., Kenwood ss., and New Providence sh. Replaces obsolete name "Knobstone."

P. B. Stockdale, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170). *Borden (Knobstone) group*, 500 ft. thick in Ohio River localities; 750 or more ft. in central Brown Co. A sharply delimited strat. unit of predominately clastic material. Underlies Harrodsburg (Warsaw) ls. and overlies Rockford (Kinderhook) ls. Work of previous investigators has been incomplete and disconnected, and attempts to subdivide the group into strat. units have been made only locally. The results are, therefore, not applicable thruout entire outcrop area. Writer's studies reveal that Borden group consists of five geol. fms., each recognizable thruout entire area. The fms. carry sharply defined members which are locally traceable. In order of superposition the names of the fms., all but lowest one of which are suggested by the writer, are as follows, *Edwardsville, Floyds Knob, Carwood, St. Joseph*, and *New Providence*. The chief source of confusion in past has been failure to fully realize that each fm. displays numerous facies. There is much lithologic dissimilarity in a given fm. btw. areas not widely separated. Perhaps outstanding case is *Carwood fm.*, which displays 7 distinct facies over the 125 mi. outcrop strip. In addition to lithologic facies, faunal facies add difficulty to recognition of the different fms. The various facies have been appropriately named.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 85, 109, 120, 310, 311, etc.). The 2 Borden fms. that generally display greatest lithologic contrast with the rocks which dominate Borden group are New Providence fm. and Floyds Knob ls. The group is here divided into (descending) Edwardsville fm., Floyds Knob ls., Carwood fm., Locust Point fm. (replaces St. Joseph, preoccupied), and New Providence fm. (redefined to include Kenwood ss.). The Edwardsville and Floyds Knob replace Warsaw fm. of Butts. The Carwood includes "Holtsclaw ss." of Butts (which is abandoned) and upper part of "Rosewood sh." of Butts (also abandoned). The Locust Point fm. corresponds to lower part of "Rosewood sh." of Butts. Borden group underlies Harrodsburg ls. and overlies Rockford ls. (where present) or New Albany sh. [See further under the several fms. On pp. 310–311 he suggests redefining top of Borden group, as explained under *Harrodsburg ls.*]

†Border conglomerate. (In Newark group.)

Upper Triassic: Eastern Virginia.

J. K. Roberts, 1923 (Pan-Am. Geol., vol. 39, pp. 185–200). *Border cgls.*—Cgls. of same age, occurring on both sides of Triassic basin of northern Va. Represent oldest Triassic sediments of basin. Are older than Manassas ss. and Bull Run shales.

J. K. Roberts, 1928 (Va. Geol. Surv. Bull. 29, pp. 24–25, 38–43). The [nongeographic] term "Border" for the cgls. is proposed because it is about the only appropriate term which could be applied. It is particularly applicable because the cgls. lie exposed along E. and W. borders, especially along the latter. The Border cgl. extends in a broken manner from Potomac River at Point of Rocks to Carolina line. Manassas ss. is for most part intercalated with Bull Run shales. Where not disturbed by faulting and not covered by Recent material or soil the Border cgls. underlie Manassas ss.

D. B. McLaughlin, 1932 (Mich. Acad. Sci. Arts and Lett., vol. 16, pp. 421–427). Writer concludes *Border cgl.* is for most part of Brunswick age, and is, therefore, among the youngest of the Triassic fms. On other hand it lies directly on pre-Triassic in places, showing that Newark series has overlapped the older rocks from SE. to NW. The same general conclusions were reached by Wherry (Proc. Acad. Nat. Sci. Phila., vol. 65, p. 114, 1913) as a result of studies near Reading and elsewhere. Stose (U. S. G. S. folio 225, 1929) finds Border cgl. the youngest Triassic fm. in Fairfield-Gettysburg area. Kummel (U. S. G. S. folio 191, 1914) finds that in Raritan area not only the Brunswick, but the Stockton and Lockatong as well, pass along the strike into Border cgl. Thus, though the cgl. is in the main of Brunswick age, local bodies of it may be of any age within Newark series.

Boscabel boulder beds.

Upper Triassic: Eastern Virginia (Richmond Basin).

N. S. Shaler and J. B. Woodworth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, pp. 424–425). *Boscabel boulder beds.*—Local deposits, boulders of gneiss and granite. Thickness 0-50± ft. Believed to be associated with Newark rocks and included in Tuckahoe group, basal div. of the Newark. Best exposed at Boscabel Ferry.

Bosche formation.

Cambrian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 290, 300). *Bosche fm.*—At Roche Miette consists of (ascending): (1) Green sh., poorly exposed, no fossils; (2) impure nodular gray ls. with fragments of trilobites suggesting Middle Camb., 300 ft.; (3) massive, dark-gray, unfossiliferous, mag. ls., forming cliff which slopes off northwestward toward the road, 200 ft., which lithologically and for purposes of mapping should be united with Nos. 1 and 2. Name taken "from across the Athabaska, for lack of a more local designation." Overlain by 150 ft. of shaly blue and gray ls. containing Upper Camb. trilobites.

†Bosque division.

Lower Cretaceous (Comanche series): Texas and Oklahoma.

J. A. Taff, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 272–273, 281–325). The *Bosque, or lowest div.* of Lower Cret. of Tex., has been formed to bring together three beds which have hitherto been placed in separate divisions, but which, for reasons that will appear as details are brought out, must be considered and treated as a continuous series of deposits from the Paleozoic upward to the Fredericksburg. These three beds are (descending) Paluxy sand, Glen Rose (Alternating) beds, and Trinity sands. Is succeeded by rocks more homogeneous in nature, namely the *Texana* bed [Walnut clay] of Fredericksburg div.

Same as Trinity group, older name.

Named for Bosque River.

Bossardville limestone. (In Cayuga group.)

Silurian: Northeastern Pennsylvania (Monroe, Carbon, and Schuylkill Counties) and northern New Jersey.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 77, 141–145). *Bossardville ls.*—The main quarry lime through Monroe Co., Pa. Almost nonfossiliferous. Upper 65± ft. mostly bluish black layers with thin veins of calcite intersecting in all directions. Basal 25± ft. is dark grayish slaty ls., finely laminated with gray, whitish, blue, etc., and often exhibiting columnar structure. Total thickness 75 to 100 ft. Underlies Decker's Ferry shales and overlies Poxono Island sh.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7), extended this name to counties NW. of Pike and Monroe Counties and gave thickness of 50 to 120 ft.

Top fm. of Cayuga group in Monroe, Carbon, and Schuylkill Counties.

Named for Bossardville, Monroe Co., Pa., where it has been quarried.

Boss Point formation.

Pennsylvanian: Nova Scotia.

W. A. Bell, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 333) and 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 366).

†Boston group.

Pennsylvanian and Mississippian: Northwestern Arkansas and northeastern Oklahoma.

J. C. Branner, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, p. xiii). *Boston group.*—[Name proposed, in table only, for equiv. of Genevieve group of H. S. Williams.] Approx. equiv. of H. S. Williams' "Chester," "St. Louis," and "Warsaw." Includes (descending) Kessler ls., Coal-bearing sh., Pentremital ls., Washington sh. and ss., Archimedes ls., and Marshall [Fayetteville] sh.

Named for Boston Mtns, Washington Co., Ark.

†Boston conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

See †*Albany and Boston cgl.* and *Allouez cgl.*

Boston Bar group.

Carboniferous or Triassic: British Columbia.

J. W. Dawson, 1872 (Canada Geol. Surv. Rept. 1871–72, pp. 62–63).

Boston Basin series.

See *Boston Bay group.*

Boston Bay group.

Carboniferous or Devonian: Eastern Massachusetts (Boston Basin).

W. E. Hobbs, 1899 (Am. Geol., vol. 23, pp. 109–113). To E. [of W. rim of Boston Basin] we have the well known *Boston Basin series,* consisting of Roxbury cgl. and Cambridge sl., with various intrusives. It rests uncon. on Algonkian metamorphic sedimentary terrane, which consists (descending) of Lincoln sl., Kendall Green sl., and Stonybrook qtzite.

L. La Forge, 1932 (U. S. G. S. Bull. 839). *Boston Bay group.*—Comprises the late Paleozoic stratified rocks, which, with the interbedded Brighton melaphyr, occupy Boston Basin, including most of Boston Lowland, a part of Southwestern Upland, and a strip along the South Shore. These rocks are not found except in Boston Basin. Includes Roxbury cgl. below, Cambridge sl. above, and Brighton melaphyr, which is intruded into and interbedded with lower part of Roxbury cgl. Is not older than Dev. and not younger than Carbf., with a slight balance of probability in favor of Carbf. Is overlain by Quat. The sed. rocks seem to be wholly nonmarine and largely terrestrial.

According to B. K. Emerson (U. S. G. S. Bull. 597, p. 50, 1917) "the Boston Basin is a roughly triangular area that occupies the coast of Boston Bay between Revere and Hull and extends westward to Sherborn."

Boston Neck granite.

Late Carboniferous or post-Carboniferous: Southern Rhode Island (north of Narragansett Pier).

F. H. Lahee, 1912 (Am. Jour. Sci., 4th, vol. 33, pp. 365, 449, 454–469). *Boston Neck granite.*—The granitic rocks of South Kingstown, which are especially prominent on Boston Neck and are probably intrusive into the Carbf. sediments. Occurs at various places along W. coast of Narragansett Bay from Watson's pier southward, and inland on Little Neck, Boston Neck, and Tower Hill. Is typically medium grained, white, pinkish or cream colored; predominantly microcline, with quartz, micropegmatite, microperthite, a coarsely twinned plagioclase, and orthoclase. Same as Sterling granite to W.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the granite of Boston Neck as *Sterling granite gneiss.*

Bostwick member (of Dornick Hills formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 14). The most resistant part of Dornick Hills fm. is a massive ls. cgl. with associated lss. and sss. known as *Bostwick memb.* It disappears northward from Ardmore. Above Bostwick memb. occur 3 or more very fossiliferous lss., including the coarsely crystalline and oolitic *Lester ls.* The Bostwick memb. lies higher in fm. than Otterville ls.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 30–32). *Bostwick memb.* forms Bostwick Ridge. Type loc. is on Bostwick dairy farm, in W½NE¼ sec. 11, T. 5 S., R. 1 E., whose buildings stand upon the ridge. It lies 750 ft. above Otterville memb. as here defined, and 400 to 500 ft. below Lester ls. memb. to N. of Ardmore, and 800 to 1,000 ft. below to S. Included in this interval are 2 or 3 other highly fossiliferous lss. from a few inches to 2 ft. thick. Max. thickness of Bostwick memb. 300 ft. It disappears within a mi. along the strike in each direction from Dornick Hills Country Club, due either to strike faulting or to uncon. within Dornick Hills fm. or to a combination of these two factors. Has not yet been identified certainly anywhere N. of that locality.

C. W. Tomlinson, 1934. (See 1934 entry under *Confederate ls. memb.*)

Bosworth formation.

Upper Cambrian: British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 3). *Bosworth fm.*—Aren. dolomitic lss., massive, thin bedded, and shaly, with bands of purple and gray siliceous shales. Thickness at Mount Bosworth, 1,855 ft. No fossils observed, but referred to Upper Camb. Underlies Upper Camb. Paget fm. and overlies Middle Camb. Eldon fm. Type loc. ridge extending NW. from Mount Bosworth, and SE. base of Paget Peak and Mount Daly.

†Bosworth sandstone and shale.

Devonian: Mackenzie, Canada.

E. M. Kindle, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 48). *Bosworth ss. and sh.*

G. S. Hume, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 58).

E. M. Kindle, 1936 (Sci., n. s., vol. 83, No. 2140, pp. 14–15). *Bosworth ss. and sh.* (preoccupied) replaced by *Carcajou Mtn beds.*

†Bosworthian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). Shales, 1,200 ft. thick, underlying Sullivanian series, uncon. overlying Eldonian series, and composing basal fm. of Late Cambric section of Alberta. [Apparently same as lower part of Bosworth fm., the upper or dolomitic part being here removed and christened *Thompson dolomites.*]

Boulder drift.

Boulder clay.

Descriptive terms that have been applied to Pleist. deposits in different parts of United States and Canada.

Boulder sand.

Drillers' name for a sand of late Upper Dev. or early Carbf. age in western Pa. Is younger than Gordon Stray sand.

Boulder granite.

Jurassic: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 108).

Boulder Creek granite gneiss.

Pre-Cambrian: Central northern Colorado (Boulder region).

M. F. and C. M. Boos, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 2, pp. 305–306). Oldest observed intrusive pre-Camb. rock in Front Range is gray granite and gneissoid granite that crops out widely on Boulder Creek, on E. flank of Front Range, W. and SW. of Boulder, Colo., and is known as *Boulder Creek granite gneiss.* It intrudes Coal Creek qtzite, Ralston fm., and the schist. Is=Archean quartz monzonite of Georgetown region.

Boulder Pass formation.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southern Alberta (Waterton Lakes National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Boulder Pass fm.*—Section made up from near Boulder Pass, S. of Ahern Pass (Glacier Nat. Park), and in Waterton Lakes Nat. Park, includes (descending): Kintla memb., 890 ft.; Sheppard memb., 520 to 650 ft.; Purcell lava, 100 to 200 ft.; Hole-in-the-Wall memb., 391 to 441 ft. Overlies Siyeh ls.

Boule limestone.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 294–296, 300). *Boule dolomitic ls.,* 1,600 ft. thick; well exposed at tunnel at SE. end of Boule Range, but northern end of Miette Range should be accepted as type section. Overlies Perdrix sh. and underlies Coronach sh., all Upper Dev.

Bouleaux formation. (In Chaleur series.)

Silurian (Niagaran): Quebec (Gaspé Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 49).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). Bouleaux, West Point, and Indian Point fms. of middle Sil. Chaleur series contain faunas of Lockport and Guelph age.

Boundary argillites.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 80, map). *Boundary argillite.*—Chiefly argillites, with lss. and carbonaceous argillites interbedded. In places black carbonaceous argillites and quartz mica schists are interbedded with the true argillites; in places the latter become calc. In vicinity of Int. Bdy the schists and argillites are intruded by a complex of dikes so numerous that nearly half of area is composed of this igneous complex. Thickness of fm. 4,000± ft. Probably in part at least=Mission argillites. [Seems to be named for Int. Bdy.]

Boundary granodiorite.

Jurassic or Cretaceous: Southeastern Alaska (Hyder district).

A. F. Buddington, 1929 (U. S. G. S. Bull. 807, pp. 32–33, 55–59, maps). *Boundary granodiorite.*—Granodiorite forming upper part of Coast Range intrusives. Named for exposures along both sides and at head of Boundary Glacier from about 1 mi. above its foot.

Boundary Bay formation.

Tertiary: British Columbia.

W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 30).

Boundary Peak granite.

Age (?): Central eastern California (Inyo Range).

See under *Pellisier granite.*

Bouquet Cañon breccia.

Probably Miocene: Southern California (30 miles north of Los Angeles).

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, p. 212). *Bouquet Cañon breccia.*—These may well be correlatives of San Onofre (breccia facies of Temblor fm.) N. of San Gabriel Mtns. A suggestion of this is given by a specimen of fine schist breccia furnished by Prof. F. P. Vickery and Mr. S. W. Harris. This is from lower Bouquet Cañon, 30 mi. N. of Los Angeles and 5 mi. NE. of Saugus. It may be Mio. The rock is made up of 1–4 cm. fragments of white quartz, quartz-muscovite schist, hornblende-epidote schist (hornblende close to karinthine), etc., in a carbonate cement, almost without fine clastic grains.

Bourbon series.

A term proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 55, p. 231, 1931) to replace Lexington ls. of Ky., because of prior use of Lexington for a Carbf. unit in Mo. Named for Bourbon Co., Ky.

Bourbon group.

Bourbon formation.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). *Bourbon group.*—Consists almost wholly of sh. and ss., that lie beneath Swope fm. and above the pre-Missouri uncon. Thus defined the group has thickness of 150± ft. Considerable field study is needed on these beds. At present they include (descending) Ladore sh., *Uniontown ls.*, and unnamed sh. and ss. The Ladore sh. corresponds to that at Ladore type loc. [Derivation of names not stated.]

J. M. Jewett, 1932 (p. 99 of book cited above). *Bourbon group* contains at least one very persistent fm.—"Uniontown ls.," which is generally less than 1 ft. thick, of dark, earthy ls. bearing bellerophontids and ammonites, and everywhere overlying black sh. containing phosphatic concretions and ranging up to several ft. in thickness. Has been traced from Linn Co., Kans., to vicinity of Delaware, Nowata Co., Okla., and is reported to be widespread in NE. Mo. Named for Bourbon Co., Kans.

R. C. Moore, May 1, 1935 (Univ. Kans. Bull. 20, table opp. p. 14). *Bourbon group* underlies Hertha ls., rests uncon. on Lenapah ls., and includes (descending): Undiff. sh. and ls., "Uniontown" ls., unnamed sh., and Warrensburg channel ss. [This definition excludes Ladore and underlying ls. of 1932 definition.]

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21). [*Bourbon fm.* shown as basal fm. of *Bronson group* on p. 19; as distinct from Bronson group on p. 21; and as a *group* on p. 20. The ls. separating Bourbon fm. from overlying Ladore sh. is here called *Sniabar ls. memb. of Hertha ls.*]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 41). *Bourbon fm.*, at base of Missouri series, includes the deposits, chiefly sh. and ss., btw. post-Des Moines uncon. below and base of Hertha ls. above. Conformably underlies Bronson group. [On pp. 73–75 are following statements:] Most of Bourbon fm. consists of bluish gray and yellowish brown silty to sandy sh.; locally at base there is thick, irregularly bedded or massive yellow-brown ss., and in places there are extensive sss. in middle and upper parts. Prominent channel sss. belong to Bourbon throughout much of west Mo. The Warrensburg and Moberly sss. in central Mo. and several other channel sss. in that State are in part certainly and in part questionably classed as belonging to Bourbon fm. Local deposits of cgl. also belong to the Bourbon. The Critzer ls. occurs near top of fm., but for present recognition of the "Critzer" as a named memb. of the Bourbon is withheld; much additional study is needed. Thickness of fm. probably 100+ in most places; in Kansas City region appears to be 150+ ft. Because lower bdy of fm. is difficult to trace, except where fairly prominent ss. occurs at base, it may be necessary in geol. mapping to combine the Bourbon with the discon. underlying upper Des Moines sh., but this does not invalidate strat. definition of Bourbon fm. Much detailed work remains to be done on this part of section.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Bow formation or group.

Name suggested by A. C. Veatch (Jour. Geol., vol. 15, p. 548, 1907, and Am. Jour. Sci., 4th, vol. 24, pp. 18–22, 1907) as appropriate substitute for "Lower Laramie." From Medicine Bow River, Wyo. In 1918 (U. S. G. S. P. P. 108, p. 229) C. F. Bowen introduced *Medicine Bow fm.* to replace "Lower Laramie" of Hanna Basin.

Bowden formation.

Miocene: Jamaica.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 340).

Bowdoin sand.

A productive subsurface sand lying 445± ft. below top of Colorado sh. in Bowdoin dome, NE. Mont., and lower than Martin sandy zone.

Bowers sand.

A subsurface Perm. oil and gas sand in Hobbs field, Lea Co., N. Mex. Named for discovery in Humble's Bowers No. 1 well.

Bowhan sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

M. I. Goldman and H. M. Robinson, 1920 (U. S. G. S. Bull. 686Y, pp. 361–362, pl. 51). *Bowhan ss.*—Thin slabby ls., which caps Bowhan Point, in sec. 16, T. 28 N., R. 11 E., and forms top of many ridges in SW. part of the area (T. 28 N., Rs. 11 and 12 E.). Is one of lower sss. in Lawrence sh. of Kans., and may be = Jonesburg ss. of T. 29 N., R. 11 E. Lies 95 ± ft. above Iatan ls. and Cheshewalla ss. and 40 ± ft. above Labadie ls.

N. W. Bass and L. E. Kennedy, 1935 (Subsurface geol. of Osage Co., Okla.), show this ss. lies 20 ± ft. below Cochahee ss.

Bowie shale member (of Mesaverde formation).

Upper Cretaceous: Central western Colorado (Delta County region).

W. T. Lee, 1909 (U. S. G. S. Bull. 341, pp. 20, 23). *Bowie sh. memb. of Mesaverde fm.*—Dark-colored sh. and gray sh. containing marine and brackish water invertebrates; coal-bearing. Thickness 0 to 425 ± ft. (absent in central part of Grand Mesa coal field). Conformably overlain by Paonia sh. memb. of Mesaverde fm. at E. end of field; absent in central part of field; uncon. below Paonia at W. end of field. Rests on Rollins ss. memb. of Mesaverde. Typically exposed at Bowie, Delta Co.

Bowler formation.

Triassic and Permian: Central southern Montana (Carbon County).

J. P. Rowe, 1906 (Univ. Mont. Bull. 37, geol. ser. No. 2, p. 81). *Bowler fm.*—Red shales and sss., thick gyp. beds. Thickness 400 to 500 ft. Triassic (?) and Perm. "Red Beds." Underlies Ellis fm. and overlies Quadrant fm. [Type loc. not stated, but judging from list of occurrences on p. 16 it is town of Bowler, Carbon Co.]

Bowling Green limestone member (of Edgewood limestone).

Silurian (early): Northeastern Missouri and southwestern Illinois.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 62). *Bowling Green ls.*—Fossiliferous buff mag. ls., 4 to 30 ft. thick, forming topmost fm. of Sil. in Pike Co., Mo., and Calhoun Co., Ill. Regarded as = part of so-called Niagara of upper Miss. Basin.

Later repts by T. E. Savage and other geologists classify this ls. as top memb. of Edgewood ls., of pre-Niagara Sil. age, and state that it is uncon. on Noix oolite and uncon. below Sexton Creek ls.

Named for exposures near Bowling Green, Pike Co., Mo.

Bowling Green stone.

Trade term for a building stone (white ls.) quarried from Gasper oolite (of Chester group) near Bowling Green, Warren Co., Ky.

Bowman limestone.

Middle Cambrian: Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Bowman ls.*—Mottled shaly lss., intraformational cgl., and oolitic ls., with shaly memb., about 35 ft. thick, at base. Thickness 280 ft. Grades into overlying Lynch dol., the bdy being arbitrarily drawn at base of lowest dol. bed. Conformably overlies Hartmann ls. Named for exposures in Bowman Gulch, NW. of Ophir.

Bow River group.

Lower Cambrian and pre-Cambrian: Alberta and British Columbia.

R. G. McConnell, 1887 (Canada Geol. Surv., n. s., vol. 2, pp. 15D, 29D–30D).

According to C. D. Walcott this term covers St. Piran, Lake Louise, and Fort Mtn fms. (all Lower Camb.), but consists chiefly of pre-Camb. rocks. It underlies Castle Mtn group. (See Smithsonian Misc. Coll., vol. 53, No. 1804, p. 4, 1908.)

Box Elder limestone.

Ordovician (Lower): Northeastern Utah (northern Wasatch Mountains).

E. Blackwelder, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 519), in strat. table in a paper on geol. of Wasatch Mtns, applied *Box Elder ls.* to ls. of Ord. age, but did not describe it, nor give its thickness or type loc., and no geographic feature bearing that name is shown on his maps or mentioned in his paper. In 1913 G. B. Richardson applied *Garden City ls.* to the ls. of Lower Ord. (Beekmantown) age in NE. Utah, and fully defined the fm. This is presumably the same fm. that Blackwelder intended to name *Box Elder.*

Boyd series.

Carboniferous: New Brunswick.

W. J. Wright, 1922 (Canada Geol. Surv. Mem. 129, pp. 7, 13). [Assigned to Carbf.]

G. W. H. Norman, 1932 (Canada Geol. Surv., Econ. Geol. ser., No. 9, p. 170), assigned *Boyd fm.* of N. B. to Miss.

Boyd's Creek sand.

A subsurface sand of Niagaran age in Barren Co., Ky.

Boyer "sand."

Drillers' name for a *ls.* in Weston sh. (Penn.) of Butler Co., Kans.

Boyer till.

Term introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 55, p. 284, 1931) to replace *Iowan*. Named for river "in headwaters basin of which the till reaches in Sac Co.," Iowa.

Boyle limestone.

Middle Devonian: Central Kentucky.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 92). *Boyle lss.*—Dev. lss., 0 to 47 ft. thick, underlying Ohio sh. and overlying Crab Orchard fm. (Sil.). Includes Duffin layer at top and Kiddville layer at base, separated by thick series of lss., in places richly fossiliferous and cherty. Equiv. of Sellersburg, Jeffersonville, and Geneva lss. of west-central Ky. and southern Ind.

T. E. Savage, 1930 (Ky. Geol. Surv., ser. 6, vol. 33, pp. 1–21), redefined Boyle ls. by excluding Duffin layer. See under *Duffin layer,* 1930 and 1931 entries.

Named for Boyle Co.

Boyles sandstone member (of Pottsville formation).

Pennsylvanian: Northern central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 8). *Boyles ss. memb.*—Coarse, thick-bedded, quartzose ss., in places conglomeratic at base. Forms basal memb. of Pottsville fm. in Warrior coal field. Thickness 100 to 600 ft. Probably = Shades and Pine ss. members of Cahaba coal field, or = Pine ss. alone.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221), correlated Boyles ss. with Pine ss. only.

Named for exposure at Boyles Gap, N. of Birmingham.

Boylston schist.

Carboniferous: Massachusetts (eastern part of Worcester County).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 61, 67–68, and map). *Boylston schist.*—In Boylston it is a ragged, coarsely micaceous rock, which commonly lacks fissility because the muscovite scales are crushed and crumpled together. In many places it is crowded full of square prisms of andalusite, about an inch long, changing to sericite, and imperfect garnets changing to chlorite. It is a coarse contact "hornfels". Grades into Worcester phyllite and is intermediate btw. the Worcester and the Brimfield schist.

Boyne beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 129).

Boynton sand.

A subsurface sand, 25±ft. thick, of early Penn. (Cherokee) age, in Muskogee Co., central eastern Okla., which in Boynton pool lies at depth of 1,500 ft., the Leidecker sand at 1,400 ft., and †Mississippi lime at 1,800 ft.

Bozeman "lake beds."

Tertiary (late): Central southern Montana (Three Forks quadrangle) and southwestern Montana.

A. C. Peale, 1893 (U. S. G. S. Bull. 110, pl. 1), mapped, but did not describe, *Bozeman lake beds* (*Neocene*), over a large area in vicinity of Threeforks, Mont.

J. P. Iddings and W. H. Weed, 1894 (U. S. G. S. Livingston folio, No. 1). *Bozeman lake beds.*—The cgls., sss., and clays deposited in waters of a lake that once occupied Gallatin Valley, receive their name from town of Bozeman. Loosely cemented. Consist of variety of materials from adjacent mtn slopes, with marls and layers of volcanic dust. Thickness exposed in this quad. 1,200±ft., but much greater in other parts of Gallatin Valley. Rest uncon. on Archean schists and all sed. strata up to and including Livingston fm. (of Cret. and Eocene age.).

A. C. Peale, 1896 (U. S. G. S. Three Forks folio, No. 24). *Bozeman lake beds.*—Sand, cgl., ls., clay, and volcanic dust, deposited in extinct Gallatin Lake. Named for good exposures in vicinity of Bozeman. Total thickness may be 2,000 to 2,500 ft.

W. P. Haynes, 1916 (Jour. Geol., vol. 24, pp. 270–290). The whole series of Tert. valley sediments [in region about Three Forks] has been grouped under heading *Bozeman fm.* for convenience in mapping. Dr. Peale's name "Bozeman lake beds" seems no longer applicable, since they have been shown to be due to subaerial and fluviatile deposition rather than to lakes. Bozeman fm. here is chiefly Mio., but in some parts of region strata of Olig. (White River) age have been identified.

Brad formation (restricted). (In Canyon group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24–31, 35). *Brad fm.*, 225 ft. thick to N., about 200 ft. thick to S. Underlies Hog Creek sh. memb. of Caddo Creek fm. and overlies Adams Branch ls. memb. of Graford fm. In Colorado River Valley divided into (descending): Ranger ls. memb., 10 to 50 ft.; Placid sh., 30 to 50 ft.; Clear Creek ls. 10 to 25 ft.; and Cedarton sh. and ss., 20 to 80 ft. In Brazos River Valley divided into (descending) Ranger ls. memb. and Seaman Ranch sh. memb. Named for Brad, Palo Pinto Co., Brazos River region.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 112), defined Brad fm. of Colorado River Valley as consisting of Ranger ls. memb. (above) and Placid sh. memb. (below), and transferred to underlying Graford fm. the Clear Creek ls. and older members originally included in Brad fm. He stated that in Wise Co. the Adams Branch ls. is absent and that the shales and sss. from Devils Den ls. up to Ranger ls. have been named *Ventioner beds.*

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+), divided *Brad fm.* of McCulloch Co., Colorado River region, into the following members (descending), Ranger ls., Placid sh., Clear Creek ls., and Cedarton sh., and stated (p. 205): Clear Creek ls. is also known as Merriman ls. They drew base of Brad fm. at top of Adams Branch ls. memb. of Graford fm.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 47–55). *Brad fm.* was named by Plummer and Moore and made to include the strata from top of ls. capping the escarpment W. of Graford (here called Merriman ls. memb. of Graford fm., but previously misidentified as the older Adams Branch ls.) up to top of Ranger ls. Type loc. is the outcrop N. of Brad, Palo Pinto Co. The Brad of Palo Pinto Co. is divided into 2 members, Ranger ls. (45 ft. thick) above and Seaman Ranch beds (135 ft. thick) below.

The definition of Brad fm. that has recently been adopted by U. S. Geol. Survey (based upon rept of Wallace Lee soon to be published by Tex. Geol. Surv.) draws line btw. Brad fm. and underlying Graford fm. in midst of Placid sh. memb. of Plummer and Moore, the upper or shaly part of their Placid sh. being included in Brad fm. and the lower or ls.-bearing part being included in Graford fm.

†Braddyville limestone. (In Shawnee formation.)

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

G. L. Smith, 1909 (Iowa Geol. Surv. vol. 19, pp. 617, 618, 623, 629, 632). *Braddyville lss.*—Lss. and shales, 50 ft. thick, forming basal part of Atchison shales. Underlies City Bluffs [Scranton] shales and overlies Forbes [Deer Creek] ls. Included in Missouri stage.

Includes Topeka ls. and Calhoun sh., according to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 191, 195).

Named for exposures at Braddyville, Page Co., Iowa.

†Bradford schist.

Ordovician: Northeastern Vermont (Orange County).

C. H. Richardson, 1898 (Am. Ass. Adv. Sci. Proc., vol. 47, pp. 295–296). *Bradford schist.*—The noncalc. memb. of Calciferous mica schist. Named for Bradford, Vt. [Mount Cube quad.], where it predominates. The calc. memb. is here named *Washington ls.*

C. H. Richardson, 1902 (3d Rept. Vt. State Geol., 1901–02, p. 81). *Bradford schist.*—Contains lower Trenton fossils. Was originally a ss., which is now represented by terranes of granular and micaceous qtzite and a foliated mica schist. Overlies black sl. of Ord. age. The Washington ls. is intimately interstratified with Bradford schist.

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., pp. 90, 115, footnote). *Bradford schist* includes all of the non-calc. members of old "Calciferous Mica Schist." It therefore embraces the qtzite, staurolitic, actinolitic, amphibolitic, ottrelitic, graphitic, and garnetiferous phases lying btw. 2 large narrow belts of sl. and sh., one on E. near Conn. River, the other on W. passing through Newport and Montpelier to Barnard. [U. S. Geol. Survey has adopted *Vershire schist* as substitute for *Bradford schist* (preoccupied). *Washington ls.* (preoccupied) is replaced by *Waits River ls.*]

C. H. Richardson, 1924 (14th Rept. Vt. State Geol.). *Bradford schists*, in Bradford Twp, overlie Waits River ls. and are therefore younger than the phyllites here named *Randolph phyllite*.

See also *Vershire schist*.

Bradford oil sand group.

Drillers' term, long in use, for a series of Upper Dev. sands, of probable Chemung age, in NW. Pa. Lies higher than Elk sand. The principal sands have been called (descending) Bradford First sand, Bradford Second sand, and Bradford Third sand. Intervening sands are Sugar Run sand, Chipmunk sand, and Harrisburg Run sand.

Bradford division.

See 1912 entry under †*Bradfordian*.

Bradford group.

A term applied by C. Schuchert and C. O. Dunbar (Textbook Geol., pt. 2, pp. 199, 203, 204, 1933) to the post-Chemung Dev. deposits in N. Y., which are stated to be "much like the Chemung, being separated only by certain differences in its faunas." The term is used by them as synonymous with *Bradfordian*, the name used on p. 197.

†Bradfordian.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

G. H. Girty, 1904 (Sci., n. s., vol. 19, p. 24). *Bradfordian*.—The series of rocks and faunas in SW. N. Y. which overlie true Chemung, inclusive of sub-Olean cgl., recently assigned by Prof. J. M. Clarke to Carbf., really lie below Carbf. system as at present recognized in this country, just as they lie above the Chemung beds, the recognized top of Dev. This series, having approx. thickness of 500 ft., represents an interval not provided for in geological time scale, and for it the term *Bradfordian* is proposed. This term, which will rank with Senecan, Chautauquan, etc., includes Cattaraugus, Oswayo, and Knapp beds of N. Y. section, which may provisionally be accepted as its subdivisions. The Bradfordian faunas are equally distinct from those of Chemung group and from those of Waverly group. Contain to some extent an intermingling of Carbf. and Dev. species, and are in fact transitional btw. those of the two eras. Whether Dev. or Carbf. is question reserved for further study.

In 1903 (N. Y. State Mus. Hdb. 19) J. M. Clarke assigned Knapp, Oswayo, and Cattaraugus fms. to Carbf. The same year L. C. Glenn (N. Y. State Mus. Bull. 69, pp. 967–989) assigned Knapp and Oswayo to Carbf. and assigned Cattaraugus to Dev. In 1910 C. Butts (U. S. G. S. Warren folio) assigned all to "Devono-Carboniferous." In 1911 E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22) assigned "Bradfordian," Bedford, Cleveland, and "late Catskill" to his Waverlyan system, and stated that "Bradfordian" is of Kinderhook age.

G. H. Girty, 1912 (U. S. G. S. P. P. 71, p. 421). In NW. Pa. I have discriminated a group of rocks btw. Berea ("Corry") ss. and top of typical Chemung under name "*Bradfordian*." In Ohio I am tentatively assigning to this group Bedford sh., Cleveland sh., and Chagrin ("Erie") sh., or at least upper portion of Chagrin sh., from which our fossil faunas are obtained. Because "Bradfordian" faunas were very different from Waverly faunas (inclusive of Berea ss. but exclusive of Bedford sh.) I originally assigned "Bradfordian" without hesitation to Dev. After comparing "Bradfordian" faunas with typical Chemung, however, I find there exists a difference, almost equally marked, and feel somewhat doubtful whether the "Bradfordian" would not better be placed in Carbf. In northern Ohio the most convenient horizon at which to draw base of Carbf. would doubtless be immediately below Berea ss. If Bedford sh. is included in Carbf., so must also be the Cleveland. A more or less conspicuous change of fauna occurs in passing from the Chagrin into the Bedford.

G. H. Girty, 1912 (N. Y. Acad. Sci. Annals, vol. 22, pp. 295–319), assigned Bedford fauna to Dev.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 87 and chart). *Bradford div.* assigned to Miss. Includes Knapp, Oswayo, and Cattaraugus fms.

G. H. Girty, 1915 (Wash. Acad. Sci. Proc., vol. 8, p. 7). *Bradfordian* correlates with Pocono and part of Catskill and in western Pa. with the Riceville and considerable thickness of underlying beds.

W. A. VerWiebe, 1917 (Am. Jour. Sci., 4th, vol. 44, pp. 35–47), correlated Knapp, Oswayo, and Cattaraugus fms. with Bedford sh. and assigned all to Dev. But G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), excluded Cleveland and Bedford from *Bradfordian* and assigned them to overlying "Waverlyan," while he assigned Bradfordian to Upper Dev.

C. Schuchert (1924 Textbook geol.) assigned *Bradfordian* to Dev., as did G. H. Chadwick in 1924 (N. Y. State Mus. Bull. 251, p. 157), and 1925 (Geol. Soc. Am. Bull., vol. 36, p. 463). In latter publication Chadwick restricted †Bradfordian to beds beneath Olmsted sh. memb. of Cleveland sh. of Ohio and base of his Le Boeuf ss. of Erie Co., Pa., and in his 1923, 1924, and 1925 repts he drew its base at base of Venango group and top of Chadakoin.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 190). Knapp, Oswayo, and Cattaraugus included in *Bradfordian series* and all assigned to Miss.

K. E. Caster, Feb. 28, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, pp. 202–203). *Bradfordian series* is divided into (descending) Knapp fm. (revised Cussewago group), Riceville fm. restricted (Oswayo sh. memb.), and Cattaraugus fm. Base of Miss. is drawn at top of Oswayo memb. Thus "Bradfordian series" is misleading term. Includes both Miss. and Dev.

G. H. Chadwick, Oct. 1933 (Pan-Am. Geol., vol. 60, p. 197). Considering *Bradfordian* as presumably a unit, I assigned it all to Dev., with prediction of an uncon. at top, but recently K. E. Caster's careful faunal analyses and collecting have led him to divide Riceville sh., putting Early Carbf. basal uncon. within it. Thus, by exclusion of Cussewago (Knapp), the "Bradfordian" becomes invalidated, a fortunate circumstance since it was so readily confused with Bradford oil sands of greater age, and name *Conewangan epoch* now naturally replaces it for closing division of Dev.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 54, etc.), *Bradfordian series* must go. For Dev. portion the name *Conewango series* is appropriate. The original "Conewango fm." of Butts precisely covers Dev. part of former Bradfordian system, and now, on demise of the latter, should be elevated to series rank.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 334). Girty's *Bradfordian* included all these disputed beds from base of the Conewango to top of the Knapp. [On p. 338 he stated:] Conewango group, which with probably the overlying Cussewago (including perhaps also the false "Berea" of Pa.), constitutes closing epoch (Bradfordian) of Upper Dev. [On p. 351 is following:] Standing out with marked faunal individuality are 3 Upper Dev. epochs: Senecan, Chautauquan, and *Bradfordian*. [On p. 352:] The *Bradfordian* embraces the Conewango, with its various component members awaiting more refined field tracing, and probably the Cussewago (Knapp and so forth).

This term was never adopted by U. S. Geol. Survey. The age of the fms. included under it is still unsettled. They are all, including Bedford, Cleveland, Conewango, and Knapp, now classified by U. S. G. S. as *Devonian or Carboniferous.*

Bradley sand.

A subsurface sand in Pennington sh. of eastern Ky., supposed to be same as Maxton sand.

Bradore formation.

Lower Cambrian: Labrador and Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, pp. 18, 21).

Bradshaw granite.

Pre-Cambrian: Central Arizona (Bradshaw Mountains).

T. A. Jaggar, Jr., and C. Palache, 1905 (U. S. G. S. Bradshaw Mtns folio, No. 126). A coarse plutonic rock, which in places has a gneissic structure and in places a coarse granular structure. Frequently shows zones where the rock becomes highly schistose and would more properly be called a mica gneiss. Normal type is coarse biotite granite with rare green hornblende. Intrudes Yavapai schist, Algonkian. In places merges into Crooks complex.

Named for mtns in which it is so well displayed.

Bradshaw limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 397). *Bradshaw ls.*—Shaly, siliceous, calc. bed, 0 to 3 ft. thick. Marine fossils. Underlies Bradshaw ss. and overlies Bradshaw sh., all members of Bluefield group [fm.]. Named for association with Bradshaw ss., although not noted at type loc. of the ss. Is well exposed in Talcott dist., Summers Co., in bluff S. of Greenbrier River, just W. of Stony Creek and 0.3 mi. SW. of Bargers Springs.

Bradshaw sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 394). *Bradshaw ss.*—Greenish gray, shaly or massive, medium-grained, 15 to 50 ft. thick. Underlies Lower Bertha sh. and overlies Bradshaw ls., all members of Bluefield group [fm.]. Type loc. in vicinity of Indian Mills and along Bradshaw Creek, there being a cliff on the road which ascends the mtn immediately N. of Indian Mills and the mouth of Bradshaw Creek, Summers Co. Also observed in Mercer and Monroe Counties, W. Va., and in Tazewell Co., Va.

Bradshaw shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 398). *Bradshaw sh.*—Usually red and variegated, but sometimes green and sandy, 30 to 55 ft. thick, marine and plant fossils. Underlies Bradshaw ls., where present, or Bradshaw ss., and overlies Indian Mills ss., all members of Bluefield group [fm.]. Type loc. on mtn road immediately N. of Indian Mills, Summers Co. Also observed in Mercer and Monroe Counties and in Tazewell Co., Va.

Braeburn limestone.

Carboniferous (?): Yukon Territory and British Columbia.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 28).

Bragdon formation.

Mississippian: Northwestern California (Klamath Mountains region).

O. H. Hershey, 1901 (Am. Geol., vol. 27, pp. 236, 238). *Upper slates or Bragdon fm.*—The latest of the fms. included in "Auriferous Slate series." Consists of 2,000 ft. of alternating thin-bedded slates and thick-bedded blue qtzites; no ls. Similar to Mariposa slates. Tentatively assigned to Jurassic.

According to J. S. Diller (U. S. G. S. Redding folio, No. 138, 1906) the Bragdon fm. is 2,000 to 6,000 ft. thick in Redding quad., it underlies Baird fm., uncon. overlies Kennett fm., and is of Miss. age.

Named for exposures in Bragdon Gulch and vicinity of Bragdon, Weaverville quad.

Brainard shale. (In Maquoketa group.)

Upper Ordovician: Northeastern Iowa, northwestern Illinois and western Wisconsin.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 97). *Brainard sh.*—Blue and bluish gray shales, with some intimately associated ls. beds at top and bottom. Thickness 120± ft. Forms top fm. of Maquoketa stage [group]. Overlies Fort Atkinson ls. of Maquoketa stage and is succeeded by Hopkinton ls. of Niagara age.

E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett., vol. 21, p. 71). *Brainard sh.* at Savannah, Ill., is uncon. overlain by Burroughs dol.

Named for exposures near Brainard, Fayette Co., Iowa.

Brainerd quartz monzonite.

Tertiary (Eocene): Central northern Colorado (Ward district, Boulder County).

P. G. Worcester, 1921 (Colo. Geol. Surv. Bull. 21, p. 32). *Brainerd quartz monzonite porphyry.*—There are 2 large dikes of this rock on N. side of valley near mouth of Brainerd tunnel, on Lefthand Creek about a mi. E. of Ward, and another dike occurs farther N. in Tuscarora Gulch.

T. S. Lovering, 1935 (U. S. G. S. P. P. 178, p. 26), referred to *Brainerd quartz monzonite* of Ward dist.

Braintree slate.

Middle Cambrian: Eastern Massachusetts (Boston Basin region).

N. S. Shaler, 1871 (Boston Soc. Nat. Hist. Proc., vol. 13, pp. 173–175). *Braintree series.*—Probably not far from 1,000 ft. thick. Whole is fossiliferous, but it is only in upper 100 ft. that well-preserved characteristic fossils are found. Is composed of beds which were evidently at time of their formation very uniform mud of a sea floor tolerably remote from land, and although much changed by metamorphic action it is easily perceived that the whole set of beds contain no trace of shore deposits. [Mentions *Braintree slates*, but does not say what rest of "series" consists of.]

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, No. 4, p. 100). *Braintree slates* contain Middle Camb. fossils.

L. LaForge, 1909 (Sci., n. s., vol. 29, pp. 945–946). *Braintree sl.* contains Middle Camb. fauna. Overlies Weymouth fm. and is older than Roxbury cgl.

B. K. Emerson, 1917 (U.S.G.S. Bull. 597, pp. 38–39 and map). *Braintree sl.*—Dark-gray to black carbonaceous slates and dark gray lydite with a few calc. and epidotic layers and nodules. Appears to overlie Weymouth fm. conformably. To N. is overlapped uncon. by Roxbury cgl. Thickness at least 1,000 ft. Named for occurrence in Braintree.

Braintree argillite.

A name applied in some early repts to Braintree sl.

Brallier shale. (In Portage group.)

Upper Devonian: Central Pennsylvania (Bedford, Blair, Huntingdon, and Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523, 531, 536). *Brallier sh.*—Fine-grained, siliceous sh., in thick, even layers, revealing fissility on weathering; largely wavy or dimpled laminæ; some even and slaty; a few thin fine-grained ss. layers. Thickness 1,350 to 1,800 ft. Is upper fm. of Portage group. Underlies Chemung fm. and overlies Harrell sh.

Named for railway station 6 mi. NE. of Everett, Bedford Co., which is spelled *Brallier* in official Ry Guide.

Branch Pond gneiss.

Pre-Cambrian: Central southern Maine (Waldo County).

E. H. Perkins and E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 9, pp. 204–228). *Branch Pond gneiss.*—Mixed gneisses, schists, and phyllites, the latter observed especially in more NW. portions of fm. Named for fine exposures near Branch Pond in West Palermo. In general the fm. is a dark bluish quartzitic gneiss. At lower end of China Lake an area of staurolite schist is interbedded in fm. The portion of Branch Pond fm. from Beaver Ridge E. becomes noticeably more biotitic, and hence has been mapped separately and called *Branch Pond biotite gneiss*. Probably pre-Camb. Relations to Vassalboro ss. hidden.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as pre-Camb. sediments.

Branchtown clay.

Pliocene (?): Southeastern Pennsylvania.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 258–272, 296–309). *Branchtown clay.*—Found at high elevations at a few places in gneissic region. Contains occasional boulders. Is probably nearly coeval with Bryn Mawr gravel, judging from its contained boulders. In village of Branchtown [a suburb of Philadelphia], on a plateau 250 ft. above river, there is a local deposit of this brick clay. Thickness 2 to 3 ft. It rests on decomposed gneiss.

Brandon lignite.

Brandon residual formation.

Tertiary (Eocene): Southwestern Vermont (northern part of Rutland County).

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1). The *Brandon deposit* is the type of a tertiary fm. hitherto unrecognized as such, extending from Canada to Ala. Probably belongs to pliocene.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 282–291, 297). *Brandon period* is possibly Olig. The lignite at Brandon, Vt., lies in beds of plastic clay, kaolin, and iron ore. Contains fossil plants.

W. B. Clark, 1891 (U.S.G.S. Bull 83, pp. 90–93). Under name *Brandon fm.* are included the lignitic beds of Vt., Pa., and Ga., deposits whose taxonomy has not yet been definitely determined, but which may provisionally be referred to Eocene.

G. H. Perkins, 1910 (7th Rept. Vt. State Geol., pp. 43–55). Tertiary is exposed in Brandon only, but without doubt is more widely distributed in Vt., but has been deeply covered by Pleist.

E. W. Berry, 1919 (Am. Jour. Sci., 4th, vol. 47, pp. 211–216). Evidence is sufficiently weighty to justify considering *Brandon lignite* and its contained flora as Eocene.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned *Brandon lignite* to Mio.

G. H. Perkins, 1931 (17th Rept. Vt. State Geol., pp. 7–27). Tertiary clays extend from Colchester to Bennington; include *Brandon lignite*.

F. A. Burt, 1931 (17th Rept. Vt. State Geol., pp. 115–135). *Brandon residual fm.*—Kaolin, ocher, sands, lignite, and iron ores, 0 to 175 ft. thick. Extends through W. tier of counties from Colchester on N. to Mass. line on S. Lies in Vermont Valley btw. Green Mtn Range on E. and Taconic Mtns on W. It is unfortunate that *Brandon* has been used to denote both this entire fm. and also its lignite memb. The rock materials included under Hitchcock's and Clark's term *Brandon fm.* are kaolin, ocher, quartz sand, nodular and concretionary iron ores, manganese ore, and lignite, all, with exception of the lignite and manganese ore, residual products of rock decomposition. In endeavor to find a handle to apply to the group which will not involve the error implied by calling them a *fm.*, writer proposes compound word *residual fm.*, and will hereafter refer to them as *Brandon residual fm.* The only place in State where all of members are known to be present is in old lignite mining area E. of Brandon. The fm. is Tert., and its age has been established as Mio. by Lesquereux, Knowlton, and Perkins.

The flora is Eo. according to E. W. Berry.

Brandy Run sandstone. (In Chester group.)

Mississippian: Southwestern Indiana and northern Kentucky.

C. A. Malott, 1919 (Ind. Univ. Studies, vol. 6, No. 40, pp. 7–20). *Brandy Run ss.*—Gray blue shales and sandy shales, overlain by a thin ls. This interval represents strat. position of a ss. which farther S. in Ind. becomes prominent and reaches thicknesses of 30 to 50 ft. This ss. is well developed in region of Marengo, on Brandy Run Creek, Ind. Thins S. of Ohio River and is absent beyond Breckinridge and Meade Counties, Ky.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 515). Later investigations, as yet unpublished, by Butts and Malott in southern Ind. and in Meade and Breckenridge Counties, Ky., have shown that Malott's Brandy Run ss. is= Sample ss.

Brandywine formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Georgia.

W. B. Clark, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 499, 506). The recognition by U. S. Geol. Surv. and the various State Surveys in Atlantic border area of the inappropriateness of the term *Lafayette* as employed in Atlantic border region has led to proposal by author of name *Brandywine* for the oldest of the terrace fms. of that dist. This name has already been submitted to Board of Geologic Names of U. S. Geol. Survey and adopted by it. The name Brandywine is proposed for this fm. because the deposits are extensively and typically developed in vicinity of Brandywine, Prince George's Co., Md. The terms *Appomattox* and *Lafayette* as originally employed in Middle Atlantic Coastal Plain embraced much more than it is proposed to include under the name *Brandywine fm.*, the diagnosis of which is based on different physiographic conceptions from those used by McGee and Darton. The Brandywine fm. covers extensive area in southern Md. peninsula, reaching from E. bdy of D. C. to N. line of St. Marys' Co., Md., with numerous outliers to N. and to S. of these lines. It attains max. width from NW. to SE. of nearly 40 mi. It extends northward into Del. and Pa., and has been traced southward through Va. into the Carolinas. Altitude of landward bdy reaches 400 ft. in outliers in W. part of D. C.; 486 ft. at Burtonville, Montgomery Co., Md.; 508 ft. at Catonsville, 480 ft. at Loch Raven, Baltimore Co.; and 470 ft. at Woodlawn, Cecil Co. Each of these outliers is extensively eroded and isolated from main body of the fm. farther seaward. The altitude of the fm. along the seaward bdy in northern St. Mary's Co. is not over 200 ft., while farther northward in Md. elevations of 240 ft. are found at Marriott Hill, Anne Arundel Co., and 300 ft. on Elk Neck, Cecil Co. The fm. is composed of gravel, sand, and loam. Over considerable areas the gravel occurs in great abundance at the base. Thickness of fm. .10 to 30 ft., the thickness for most part increasing from the landward toward the seaward margin of the fm. Exceptional thicknesses of over 50 ft. have been found. No determinable fossils have been found in type area. The fm. uncon. overlies all older Coastal Plain fms. of Tert. and Cret. age, and at a few places rests on crystalline rocks. Throughout much of region it is separated from next younger (Sunderland) fm. by a clearly marked escarpment and uncon. Brandywine, Prince George's Co., Md., is located on the slightly eroded surface of the old Brandywine terrace not far from center of largest tract still preserved intact. Max. thickness of fm. is in general area in which Brandywine is situated. The adjacent ravines to E. and W. of Brandywine cut through the fm. Most authors have referred these deposits to Plio., but author questions whether they may not with equal propriety be referred to early Pleist.

F. Bascom, 1920 (U. S. G. S. Elkton-Wilmington folio, No. 211, p. 12), and 1921 (Jour. Geol., vol. 29, pp. 540–559). The *Brandywine fm.* includes sand and marl of two levels and of different ages. The *early Brandywine* consists of about 50 ft. of sand and gravel lying at altitudes of 200 to 400 ft., and is believed to be of Pleist. or late Tert. age. The *late Brandywine* consists of about 1 foot of sand and gravel lying at altitudes of 390 to 500 ft., and is thought to be a terrestrial deposit of Pleist. streams.

F. Bascom, 1924 (U. S. G. S. P. P. 132H, pp. 117–119). The *early Brandywine gravels* are found in Elkton-Wilmington dist. at altitude of 380 ft., capping Egg Hill and other outstanding hills on W. border of Elkton quad. The *late Brandywine gravels* lie at altitudes of 220 ft. or more. The deposit at the type loc. in Md. is the low level (200 to 300 ft.) or late Brandywine, presumably of Pleist. age. The high-level gravels (390 to 480 ft.) are presumably of Plio. age. Such a time interval btw. the early and late gravels as is now recognized has made it infeasible to treat the deposits as a unit. It is therefore proposed to *restrict the term Brandywine fm.* to the late or lower-level deposits of the type loc., and to reinstate the old term *Bryn Mawr gravel* for the early or high-level deposits of Pa., Del., and Md. (Cecil Co.).

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, pp. 503-513), suggested that Brandywine fm. be restricted to the 270-foot level, but there is not unanimity of opinion in regard to this matter. The terrace fms. of Columbia group (including the Brandywine) now recognized by Cooke across the Atlantic Coastal Plain from Del. to southern Ga. and probably into Fla., are enumerated herein under *Columbia group*.

Brandywine granite.

Commercial term for a quartz diorite quarried in Elkton and Wilmington quads., Md.-Del.

Branford granite gneiss.

Pre-Cambrian: Central southern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 146, and map). *Branford granite gneiss.*—Medium grained granite, with banded structure, consisting very largely of white feldspar. In the feldspars are embedded small round quartz grains having a slightly brownish tint, and biotite is present in about equal amount. Small reddish garnets commonly present. Covers large part of Branford Twp. Probably igneous and pre-Camb.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 38). *Branford gneiss* is of igneous origin.

Branford granite.

A facies of Branford granite gneiss. See under ***Light House granite.***

Brannon cherty member (of Flanagan limestone).

Middle Ordovician: North-central Kentucky.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 324). *Brannon bed.*—Siliceous ls., 15 ft. thick, which weathers to chert. Is weathered phase of lower part of Flanagan chert of Campbell; upper part is bouldery. Extends S. of Kentucky River. Overlies Bigby fm. and underlies Woodburn bed of Flanagan memb. of Lexington.

Adopted by U. S. Geol. Survey as ***Brannon cherty memb. of Flanagan ls.*** Named for exposures at Brannon Station, Jessamine Co.

Brannon limestone member. (In Millsap Lake formation.)

Pennsylvanian: North-central Texas (Parker County).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept, by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See 1933 entry under *Millsap Lake fm.*) Type loc. not stated.

This name appears to have been replaced by ***Brannon Bridge ls.*** in 1936.

Brannon Bridge limestone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 16). *Brannon Bridge lss.*—Top beds of Lazy Bend memb. of Millsap Lake fm. as defined by G. Scott and J. M. Armstrong (unpublished ms., on Parker Co.). Consists of 3 prominent lss. separated by 10-ft. breaks of sh. and some sand. Outcrop in vicinity of Brannon Bridge on the Brazos, about 6 mi. S.-SW. of Millsap, Parker Co. The upper 2 lss. have been mapped across SE. corner of Palo Pinto Co. [This name appears to replace the preoccupied name ***Brannon ls.***, used by Scott and Armstrong in 1933, as listed by Sellards under ***Millsap Lake fm.***]

Brassfield limestone.

Silurian (early): Central Kentucky, southern Tennessee, southwestern Ohio, southern Indiana, southwestern Illinois, and central northern Arkansas.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 27). *Brassfield ls.*—Fossiliferous ls., 13 to 19 ft. thick, usually consisting in lower part of several rather thick and massive layers, and in upper part of more numerous thinner bedded layers; toward top thin layers of clay are often interbedded. Called *Clinton ls.* in earlier repts. Overlies Ord. and underlies Indian Fields fm., basal fm. of Sil. in Ky.

Has generally been considered to be of Albion age (pre-Clinton), altho W. Stout and R. E. Lamborn (Ohio Geol. Surv., 4th ser., Bull. 28, chart opp. p. 358, 1924) correlated it with Wolcott ls. memb. of Clinton fm., and W. Stout (personal communication Feb. 7, 1930) still adhered to this correlation. See also C. Schuchert, Geol. Soc. Am. Bull., vol. 25, p. 278, 1914. In SW. Ohio it underlies Dayton ls. In Ind. it discon. underlies Osgood fm. In central northern Ark. it underlies St. Clair ls. and overlies Cason sh.

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 184–185). In Ind. and Ohio the Brassfield overlies Centerville fm. (earliest Sil. and supposed equiv. of Edgewood fm. of SW. Ill. and adjacent Mo.). [See under *Centerville ls.*, 1931 entry.]

Foerste amplified his description in Denison Univ. Bull., Sci. Lab. Jour., vol. 30, 1935, pp. 123–127, and stated that type exposure is along Louisville & Atlantic R. R. btw. Brassfield and Panola, Madison Co., Ky., where it is 21 ft. thick; is 40 to 50 ft. thick in Adams and Highland Counties, Ohio; 22 ft. at Lewisburg, Ohio; 14 ft. at Elkhorn Falls, 4 mi. S. of Richmond, Ind.; in northern Tenn. 3 ft. thick E. of Bledsoe and 33 ft. btw. Franklin and Centerville. He gave further details on pp. 145–149.

See also under *Belfast bed, Beavertown marl*, and *Dayton ls.*

Brasstown schist.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U.S.G.S. Nantahala folio, No. 143, p. 4). *Brasstown schist.*—Greater part consists of banded ottrelite schist, at base of which is a variable thickness of banded sl. with little or no ottrelite. This lower memb. is most developed S. of Valley River, and relation of the two members to each other are well seen btw. Brasstown and Hayesville. A few mi. N. of Brasstown the ottrelite-bearing rocks are much less conspicuous and banded slates occupy a large area. The strata are there less folded and metamorphism is less. On N. side of Valley River Basin practically all of fm. contains ottrelite. Eastward toward Nantahala River the ottrelite diminishes, and disappears in neighborhood of Nantahala. All schists and slates of the fm. are dark colored and vary from dark blue or bluish black to dark gray. They are nearly always marked by fine banding of light-gray and dark colors. The light-gray layers are slightly siliceous and occasionally grade through sandy sl. into seams of light-gray ss. Thickness estimated at 1,200 to 1,500 ft. Underlies Valleytown fm. and overlies Tusquitee qtzite.

Named for exposures on Brasstown Creek, Clay Co., N. C.

Brattleboro phyllite.

Ordovician: Southeastern Vermont (Windham County).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., p. 232). *Brattleboro phyllite.*—Includes all phyllites that flank Cavendish schist and Reading gneiss on E. of Reading, Cavendish, Baltimore, and Chester. Its home is in Springfield, Rockingham, Putney, Brattleboro, Guilford, and Vernon, and southward into Mass. Is youngest fm. in SE. Vt. Assigned to Ord. Named because Brattleboro Twp is practically all covered with a fine-grained graphitic phyllite schist. Brattleboro phyllite and the older Randolph phyllite are interstratified with Waits River ls.

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., pp. 192–211). *Brattleboro phyllite* may be time equiv. of Randolph phyllite. Belongs to Memphremagog group.

Bratton shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 318). *Bratton sh.*—Sandy sh., red in places, greenish brown in other places; 25 to 35 ft. thick. Underlies Bratton ss. and overlies Upper Belcher ss. (all members of Bluestone group [fm.]). Type loc. same as Bratton ss.

Bratton sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 317). *Bratton ss.*—Green, flaggy, or massive, fine-grained ss., 5 to 20 ft. thick. Underlies Hunt sh. and overlies Bratton sh. (all members of Bluestone group [fm.]). Type loc. near extreme head of Bratton Branch of Brush Creek, in Mercer Co.

Brave Boat Harbor biotite granite.

Carboniferous (?): Southwestern Maine (York County).

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 148, 149, 154). Much more sheared than the other nearby intrusives. Doubtfully classified as Carbf. Highly cataclastic. Occurs on NE. side of Brave Boat Harbor, Kittery Twp, York Co.

Braxton formation.

Pennsylvanian: Northern West Virginia.

J. A. Taff and A. H. Brooks, 1896 (U.S.G.S. Buckhannon folio, No. 34). *Braxton fm.*—Chiefly red clay sh. with some green and yellow shales interbedded with friable brown ss.; some ss. beds are compact and 30 to 40 ft. thick. The shales locally become calc. and grade into impure ls. Max. thickness in this quad. 750 ft., but top has been eroded away. Is surface rock over greater part of Braxton Co. Overlies Upshur ss.

Corresponds to upper part of Conemaugh fm. and Monongahela fm.

Brayman shale.

Ordovician (?): Eastern New York (Schoharie and Albany Counties).

A. W. Grabau, 1906 (N. Y. State Mus. Bull. 92, p. 101). *Brayman shales.*—Pyritiferous sh., olive or grayish clay sh., often alternating with bluish beds and weathering to lighter color. Thickness 27 to probably 40 ft. Is of distinctive character and local development, and demands separate name as a local memb. of Salina series, whose exact equivalence in complete Salina series of central N. Y. is doubtful. Called Clinton shales, pyritiferous shales, Salina shales, etc., in the literature. No fossils. Probably approx. = Rosendale cement bed. Is uncon. overlain by Cobleskill ls. and rests on a ss. that may be Binnewater ss. Named for Braymanville, Cobleskill Co.

J. M. Clarke, 1911 (N. Y. State Mus. Bull. 149, p. 12). During investigation of Frankfort sh. in Cobleskill region, evidence was obtained showing that Brayman sh., which formerly was referred to the Clinton and later correlated with the Salina, is most probably of Lower Siluric [Ord.] age.

In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27) E. O. Ulrich assigned the Brayman to Ord. and correlated it with Frankfort sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 52-53). Age of Brayman sh. not definitely determined. Absence of lower members of the Salina in section where it occurs, and apparent hiatus btw. the Brayman and the Cobleskill, make it imperative, if the Brayman belongs to Salina series, to correlate it with the Camillus. On other hand, since basal Brayman is intimately connected with underlying shales without any apparent break, it is highly probable the Brayman constitutes uppermost memb. of Lower Siluric [Ord.] system.

R. Ruedemann, 1912 (N. Y. State Mus. Bull. 162) and 1930 (N. Y. State Mus. Bull. 285, p. 40), assigned Brayman sh. to Ord., but in 1929 (Geol. Soc. Am. Bull., vol. 40, p. 412) he assigned it to Sil.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 318, 342). *Brayman sh.* probably represents a residual soil of the Ord., according to Ruedemann (1912 and 1930) and Ulrich. [But she placed it opposite Salina, and in N. Y. State Mus. Bull. 303, 1935, she assigned it to Sil.]

Brazean formation.

Cretaceous (?): Alberta.

G. S. Malloch, 1911 (Canada Geol. Surv. Mem. 9, p. 37). [Assigned to Triassic.]

W. Malcolm, 1913 (Canada Geol. Surv. Mem. 29, p. 45), assigned this fm. to Cret., and J. A. Allan and R. L. Rutherford, 1934 (Alberta Research Council Rept. No. 30, p. 34) assigned it to Tert.

Brazer limestone.

Mississippian (upper and middle): Northeastern Utah, eastern and south-central Idaho, and southwestern Wyoming.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 407, 413). *Brazer ls.*—Massive to thin-bedded light-gray siliceous ls. and ss., 800 to 1,400 ft. thick, in northern Utah. Underlies Wells fm. and overlies Madison ls.

Named for exposures in Brazer Canyon, Rich Co., NE. Utah.

Brazil formation.

Pennsylvanian: Southwestern Indiana.

M. L. Frller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84). *Brazil fm.*—Alternating shales and thin sss., with an occasional thin ls. and several coal beds; 300 ft. thick; massive ss. near top and near base. Extends from top of Mansfield ss. to base of Petersburg coal (basal memb. of Petersburg fm.). [Includes strata of Pottsville and Allegheny age.]

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 525). Brazil fm. of Fuller and Ashley corresponds to nothing significant in Coal Measures stratigraphy, overlapping from the Pottsville into the Allegheny, and includes beds unknown in vicinity of Brazil. Either the name should be abandoned, or it should be restricted to limits consonant with strat. requirements, and in keeping with the rocks exhibited at Brazil. Writer prefers latter procedure, and has accordingly amended the name *Brazil fm.* to include only the Brazil block coal intervals and the Minshall coals up to the marked discon. above coal No. 2. The Mansfield and Brazil as emended constitute the Pottsville of Ind. Is discon. overlain by Staunton fm.

W. N. Logan, 1926 (Ind. Dept. Cons., Div. Geol. Pub. 55, pp. 477–478), divided the Penn. rocks of Putnam Co., Ind., into *Brazil (Allegheny)* and *Mansfield (Pottsville)*. On other pp. of this rept he classified the Penn. rocks as *post-Allegheny, Allegheny,* and *Pottsville.*

W. N. Logan, 1929 (Ind. Dept. Cons. 11th Ann. Rept., pp. 30–34). Pottsville div. of W. and SW. Ind. divided into (descending): (1) *Brazil group* (80 ft. thick, including coal No. 2 at top and Lower Block coal at base) and (2) *Mansfield group* (100 to 400 ft. thick, resting uncon. on Miss.). Brazil group underlies Staunton group, lowest group of Allegheny div. [This classification was followed by M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. No. 133).]

Named for Brazil, Clay Co.

Brazil limestone.

Pennsylvanian: Central western Indiana.

F. C. Greene, 1911 (Ind. Acad. Sci. Proc. for 1910, pp. 169–171). *Brazil ls.*—Dark-colored bituminous stone, having irregular fracture, exposed just below surface at Brazil; 7 to 17 ft. thick. Probably to be correlated with Fort Scott ls. of Kans., since it contains similar fauna.

Preoccupied. Included in Brazil fm.

Named for Brazil, Clay Co.

Brazil Branch breccia.

Cretaceous: Central northern Arkansas (Perry County).

C. Croneis and M. Billings, 1929 (Jour. Geol., vol. 37, pp. 543, 554) and 1930 (Ark. Geol. Surv. Bull. 3, pp. 158–160). The rock here described as *Brazil Branch breccia* crops out in W½ of SE¼ of sec. 29, T. 4 N., R. 17 W., about 3 mi. S. by W. of Perryville, in valley of Brazil Branch (a perennial tributary of Fourche la Fave River), on land owned by J. R. Myers. Consists chiefly of angular fragments of black sh. set in a gray to black groundmass containing crystals of biotite. Less common fragments are ouachitite, nephelite-aegirite syenite, and shonkinite. Probably middle Cret.

†Brazos series.

Late Permian and Triassic: Texas, Oklahoma, southern Kansas, and eastern New Mexico.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 100–103). *Brazos series.*—All rocks of Tex., Okla., Kans., and eastern N. Mex. btw. top of conformable Coleman div. [now known to be approx. same as Wichita] of Permo-Carbf. beds below and base of uncon. Cret. above. Consists of red clays, sss., occasional impure ls., some cgl., and great beds of gyp. [Also called "Red Beds" and "Permo-Triassic Red Beds."] Includes Wichita [then supposed to be older than Coleman div.], Clear Fork, Double Mtn, and Dockum fms.

Named for Brazos River, central northern Tex.

†Brazos sandstone.

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol 3, p. 138). Strawn div. overlies Millsap div., and is divided into (descending) Gordon, Mineral Wells sss., *Brazos ss.*, etc. [Subdivisions not described.]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, p. 76 and charts). [See 1922 entry under *Brazos River cgl. memb.*]

Same as *Brazos River cgl. memb. of Garner fm.*, of Strawn group.

Brazos River conglomerate member (of Garner formation).

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919. [See *Brazos ss.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, pp. 75, 76, and charts). *Brazos River ss. and cgl. memb. of Mineral Wells fm.*—The lowest of the thick sss. which are most prominent feature of Mineral Wells fm. Occurs about 300 ft. above base of that fm. Is a very prominent ledge of massive, coarse-grained ss. that produces a striking escarpment. In places contains lenticular masses of cgl. Thickness 25 to 50 ft. Underlies East Mtn sh. memb. and overlies Mingus sh. memb.; all included in Mineral Wells fm. Named for widely distributed exposures along Brazos River, especially the high cliff at Inspiration Point, 8 mi. due S. of Mineral Wells.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 108). G. Scott and J. M. Armstrong (unpublished rept on geol. of Parker Co.) restrict *Mineral Wells fm.* to beds above *Brazos ss. and cgl.* and introduce *Garner fm.* for lower part of original Mineral Wells fm., extending from top of Brazos ss. and cgl. down to base of Thurber coal.

The name *Brazos* being preoccupied, the U. S. Geol. Survey designates this memb., which is chiefly cgl., as *Brazos River cgl. memb. of Garner fm.* F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 23+), call this memb. *Brazos River ss.* They state that, as pointed out by H. X. Bay (Univ. Tex. Bull. 3201, 1933, pp. 165–166), it is in part at least of fluviatile origin and that it grades to W. into beach and marine deposits.

Breakwater quartzite.

Pre-Cambrian (upper Huronian): Northeastern Wisconsin (Florence district).

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184, p. 4). *Breakwater qtzite*, named for its location near Breakwater Falls on Pine River, Florence Co., is tentatively assigned to Goodrich epoch [being correlated with Goodrich qtzite of Marquette dist.].

Breathitt formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

M. R. Campbell, 1898 (U. S. G. S. London folio, No. 47). *Breathitt fm.*—Sandy sh. and coarse ferruginous ss. with occasional coal seams, the Pittsburg (Ky.) coal lying at base. Thickness 550 ft. Overlies Corbin cgl. lentil of Lee fm. and includes all post-Lee Penn. rocks. Named for Breathitt Co., where it is present in great force. [As defined included rocks of Pottsville age only, the Allegheny fm. not being present in this part of Ky.]

A. M. Miller, 1910 (Ky. Geol. Surv. Bull. 12). Crandall, like Mr. Campbell, made no attempt to define upper limits of any fm. which has as its base a contact with the Conglomerate Series. Crandall in his rept on Whitely Co. enumerated 9 coal seams in the Measures above the Cgl. Whether all of these will be finally included in the Breathitt is yet to be determined. [He included in the Breathitt, Lily coal or No. 4 (No. 1 of old writers), Lower Blue Gem coal (No. 5), Upper Blue Gem coal (No. 6), and Main Jellico coal (No. 7), also 200 ft. of beds above Jellico coal.]

A. M. Miller, 1919 (Dept. Geol. and Forestry Ky., ser. 5, Bull. 2, p. 10). *Breathitt fm.* overlies Corbin cgl. and includes Homewood ss. at top. Thickness 525 to 600 ft.

†Breckenridge formation. (In Cisco group.)

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Breckenridge fm.* consists of 3 persistent and lithologically similar ls. members, upper, middle, and lower, respectively, separated by thick sh. beds and lenticular sands. In places a 4th ls. memb. is present about 10 ft. below the lower ls. The 3 lss. form escarpments around E. end of Breckenridge oil-field. Underlies Waldrip fm. and overlies Gunsight ls.

F. B. Plummer and R. C. Moore in 1922 replaced this name with *Thrifty fm.* (in which, however, they included 0 to 140 ft. of sh. above Gunsight ls.), and adopted *Breckenridge ls.* for top memb. of Thrifty fm.

Breckenridge limestone member (of Thrifty formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 152, 154, 155, 160). *Breckenridge ls. memb.*—Gray, massive, and resistant ls., 3 to 5 ft. thick, forming top memb. of Thrifty fm. Makes prominent escarpment in and about town of Breckenridge, Stephens Co., and is typically exposed S. of Main Street. Lies 25 to 45 ft. above Blach Ranch ls. memb. of Thrifty, the two lss. being separated by sh.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+), used *Breckenridge ls.* for top memb. of Thrifty fm. in Colorado River region.

The U. S. Geol. Survey at present treats Chaffin ls. as top memb. of Thrifty fm. in Colorado River region. Some geologists regard Chaffin ls. as = Breckenridge ls.

Breckenridge lime.

See under *Caddo lime.*

†Brecksville shale member (of Orangeville shale).

Mississippian: Northeastern Ohio.

C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 69, 98, 127). *Brecksville sh. memb.*—Blackish or bluish black sh., with few thin sss., 105 ft. thick; forming major part of Orangeville fm. Underlain by Aurora ss. memb. of Orangeville [0 to 10 ft. thick] and overlain by Royalton fm.

Corresponds to all of Orangeville sh. except basal 10 to 20 ft. (See U. S. G. S. Bull. 818, 1931.)

Named for Brecksville, Cuyahoga Co.

Breedon sand.

A subsurface sand in Mingo Co., W. Va., that is believed to lie at base of Pottsville group (Penn.). Occurs near Breedon, Mingo Co.

Brelsford sand.

A subsurface sand, 0 to 45 ft. thick, in Smithwick sh. (Penn.) of central northern Tex., lying 75 to 160 ft. above Black lime.

Bremen sandstone member (of Pottsville formation).

Pennsylvanian: Northern central Alabama.

C. Butts, 1910 (U.S.G.S. Birmingham folio, No. 175). *Bremen ss. memb.*—Gray, coarse-grained, thick-bedded quartz ss., 80 ft. thick, occurring in lower part of Pottsville fm. in Warrior coal field. Overlies Black Creek coal.

Named for exposures in Bremen, Cullman Co., NW. corner of Birmingham quad.

Bremen moraine.

Pleistocene (Wisconsin stage): Northern Indiana. Shown on moraine map (pl. 32) of U.S.G.S. Mon. 53. Named for Bremen, Marshall Co.

Brentwood limestone member (of Bloyd shale).

Pennsylvanian: Northwestern Arkansas.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 28, 109). *Brentwood ls.*—Geographic name to replace non-geographic term *Pentremital ls.* Sometimes occurs in single ledge, but often separated into two ledges btw. which intervene shales and sss. Overlies Washington sh. and ss. of Ark. Geol. Survey [Hale fm.] and underlies Coal-bearing sh. of that Survey. Included in Morrow fm.

G. I. Adams and E. O. Ulrich, 1905 (U.S.G.S. Fayetteville folio, No. 119). *Brentwood ls. memb.*, 80 ft. thick, consists of thin beds of gray crystalline ls. and sh. underlain by sandy sh. [This sandy sh. appears not to be the same as the 6 to 10 ft. of calc. black sh. which in Winslow, Eureka Springs, and Harrison quads. and other areas underlies the Brentwood ls., being of same character as the black calc. shales which occur higher up in the Bloyd sh., but it appears to correspond to beds which in other areas are included in the underlying sandy Hale fm. When Morrow fm. was subdivided into Bloyd sh. above and Hale fm. below, the Brentwood was included in the Bloyd and was defined as separated from Hale fm. by the 6 to 10 ft. of calc. black sh. This is the present approved definition. (See U.S.G.S. Eureka Springs–Harrison folio, No. 202, 1916, by A. H. Purdue and H. D. Miser.)]

Named for Brentwood, Washington Co.

Brereton limestone. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Brereton ls.* to basal beds of McLeansboro fm. of Fulton Co., and called overlying beds *Copperas Creek sh. and ss.* Thickness and derivation of name not stated, but probably named for the town in Fulton Co.

Brereton cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to lower part of McLeansboro fm. (Penn.) and uppermost part of Carbondale fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 6. Derivation of name not stated.

Bretonian.

Upper Cambrian: New Brunswick.

C. D. Walcott, 1891 (U.S.G.S. Bull. 81, p. 247). *Bretonian.*—This name is applied by Mr. G. F. Matthew to upper series of Camb. rocks as found in the vicinity of St. John, New Brunswick, and on island of Cape Breton, where fauna of the div. is well developed. It will be arranged as an Upper Camb. fm. (Footnote: "Illustrations of the fauna of the St. John group, No. 5. Trans. Roy. Soc. of Canada, vol. 8, 1890, p. 129.")

In 1903 (Canada Geol. Surv. Rept. Camb. rocks of Cape Breton, p. 49) G. F. Matthew assigned *Bretonian div.* to Camb. In 1909 (Sci., n. s., vol. 29, pp. 351–356) A. W. Grabau proposed that *Bretonian* be redefined and adopted as name for Upper Camb., to replace Saratogan and Potsdamian. He stated that Bretonion of Matthew included at top basal Ord. beds corresponding to post-Tremadoc beds of Europe, which should be excluded from Bretonian, and that at base Bretonian should be extended so as to include the upper part of Johannian of Matthew. Named for Cape Breton, where its thickness approaches 1,000 ft. In 1911 (Geol. Soc. Am. Bull., vol. 22, p. 624) E. O. Ulrich stated that "All of the Bretonian seems to me younger than the Ozarkian" [and therefore all of Ord. age]; and (p. 679) that he "refers most—perhaps all—of Matthew's Bretonian to the Canadian" [Lower Ord.]. In 1913 (12th

Int. Geol. Cong. Guidebook 1, p. 270) Hyde referred Bretonian to Camb., as did Matthew in 1914 (Roy. Soc. Canada Trans., ser. 3, vol. 8, sec. 4, p. 77). In 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4) G. Van Ingen referred Bretonian to Lower Ord., as did Ulrich in 1919 (Md. Geol. Surv. Camb. and Ord. vol., chart opp. p. 90).

Brevard schist.

Lower Cambrian: Western North Carolina (Transylvania, Buncombe and McDowell Counties), northwestern South Carolina, and northwestern Georgia.

A. Keith, 1905 (U.S.G.S. Mount Mitchell folio, No. 124, p. 5 and columnar section). *Brevard schist.*—Mostly schist, of dark bluish black or black color and sed. origin. Between Swannanoa Gap and Old Fort the schistose character is less pronounced and the rock is a banded mica-slate. All strata are fine grained except a few siliceous layers, which represent original sandy strata. The rocks are composed mainly of very fine quartz and muscovite, with countless minute grains of iron oxides scattered throughout. Graphite in minute grains is a common constituent and here and there occurs in layers; has been mined. Lss. are not found in Mount Mitchell quad., but a few mi. SW. of Fairview they appear at frequent intervals for more than 50 mi. Principal variation in appearance of fm. is in presence or absence of garnets (of secondary origin). Thickness 1,000+ ft. Rests uncon. on Archean gneisses and granites.

Named for exposures near Brevard, Transylvania Co., N. C.

Brewer phyllite member (of Talladega slate).

Pre-Cambrian or Paleozoic: Northern central and eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 52). *Brewer phyllite memb. of Talladega sl.*—Sericitic phyllite of deep purplish or chocolate color, occurring in Talladega sl. a few hundred ft. above Sawyer ls. memb. Max. thickness 1,000± ft.

C. Butts (U.S.G.S. Montevallo-Columbiana folio, No. 226, in press), treated *Brewer phyllite* as a distinct fm., underlain by Waxahatchee sl. and overlain by Wash Creek sl.

Named for exposures at Brewer School, in Columbiana quad., in Chilton Co.

Brewer Creek latite.

Tertiary: Southern Colorado (Bonanza district, Saguache County).

W. S. Burbank, 1932 (U.S.G.S.P.P. 169). *Brewer Creek latite.*—Flows, 500± ft. thick. Overlies Porphyry Peak rhyolite and is overlain by andesite flows. Exposed N. of and westward along Brewer Creek.

Brewer Dock member.

Silurian (Niagaran): Western central New York (Rochester region).

H. E. Alling and J. E. Hoffmeister, 1932 (16th Int. Geol. Cong. Guidebook 4, chart opp. p. 6, pp. 106, 107, 108). In the Clinton of Rochester region, above Maplewood sh. occurs about 3 ft. of interbedded ls. and sh., typically exposed in Genesee Gorge near Brewer Dock, and locally known as *Brewer Dock lss. and shales.* Characteristic fossil (chiefly in ls. layers) is a minute gastropod of genus *Cyclora.* The brachiopod *Hyattidina congesta* is also found in the fm. Overlain by Furnaceville iron ore.

J. T. Sanford, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 194). The former *Bear Creek* of Genesee Gorge is designated as *Brewer Dock memb. of the Reynales,* as the fm. at Bear Creek is younger. [All are included in Clinton.]

Brewerton shale.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Brewerton sh.*—Fossiliferous shales, 36 ft. thick, lying just under Kirkland ls. in Lakeport section, and terminating downward with a black pebble seam. Exposed at Brewerton [Onondaga Co.]. Overlies true Williamson sh. [memb. of Clinton fm.].

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347, etc.). [See 1923 entry under *Phoenix or Schroeppel sh.*]

†Brewerville sandstone. (In Chester group.)

Mississippian: Southwestern Illinois and southeastern Missouri.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 121). *Brewerville ss.*—Massive brown, fine or medium-grained ss., in thick beds, often more or less conspicuously cross bedded. Thickness 70 to 80 ft. Uncon. underlies Renault fm. and uncon. overlies Ste. Genevieve ls., or, where that fm. is absent, St. Louis ls. Equiv. to more massive basal memb. of Cypress ss. of Engelmann and Ulrich.

Later (1920) abandoned by Weller, for older name *Aux Vases ss.* The true Cypress is now known to be a much younger ss. (See Ill. chart.)

Named for Brewerville Twp, Randolph Co., where it is well exposed in Mississippi River bluffs.

†Brewster formation.

Middle Ordovician: Southwestern Texas (Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex., Bur. Econ. Geol. and Tech. Bull. 44, pp. 35, 37). *Brewster fm.*—Interbedded dark-colored sss. and shales of Upper Camb. age, occupying small areas in the ancient eroded mtn folds in Brewster Co., 5 to 30 mi. S. of Marathon. Total thickness unknown. Underlies Marathon series (Lower and Middle Ord.)

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1063–1064). Fossils recently collected from typical Brewster fm. show that type section is part of Woods Hollow sh., of Middle Ord. (Trenton) age, and that "Brewster" should be abandoned and a new name be given to the indigenous Upper Camb. strata. They are here named *Dagger Flat ss.*

Named for exposures in Brewster Co.

Brezee phyllite.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 399). *Brezee phyllite.*—Almost wholly sl. or phyllite, dark or bluish gray, much of it banded with light gray. Weathers brownish or dull greenish gray. In upper part is a bed of calc. qtzite, 5 to 10 ft. thick, that can be followed for considerable distances. Locally this qtzite passes into sandy ls. A few ft. below the qtzite is a zone of small ls. lenses. Lowest part of fm. contains beds of cherty sl., mostly black but associated with purple sl. of kind so characteristic of the Lower Camb. in Taconic Range. Thickness doubtless exceeds 500 feet. Outcrops around N. and NW. margins of Taconic Range. Underlies Stiles phyllite. What normally lies beneath it is not known because of overthrust. Named for Brezee Mill Creek, which flows out of NE. end of Taconic Range [3 mi. S.–SW. of Brandon, according to Keith, personal communication; so must be in Brandon or Castleton quad., but name not shown on either map].

Briarfield dolomite.

See *Brierfield dol.*

Briceville shale. (In Pottsville group.)

Pennsylvanian: Eastern Tennessee.

A. Keith, 1896 (U. S. G. S. Loudon folio, No. 25, p. 4). *Briceville sh.*—Mainly bluish gray and black fine-grained sh., containing many small beds of hard ss. and workable coal seams. Thickness 300 ft. or more. Highest fm. in Loudon quad. Overlies Lee cgl. [In type area (to NE. of Loudon quad.) the fm. is overlain by Wartburg ss., according to U. S. G. S. folio No. 33; but the fm. overlying the Briceville was in 1925 named *Jellico fm.* by L. C. Glenn, and Wartburg ss. was restricted to a ss. near middle of Briceville sh., which, according to Glenn, is the ss. exposed at Wartburg. These changes of definitions have not been considered by U. S. Geol. Survey for its publications.]

L. C. Glenn, 1925 (Tenn. Dept. Ed., Div. Geol. Bull. 33B, p. 16), gave thickness of Briceville fm. as 550 to 825 ft., and stated it is now known that there are at least 200 and probably 300 or even more ft. of shales belonging to this fm. beneath drainage level in Briceville-Coal Creek region, and that 85 per cent of fm. is sh.

Named for occurrence at Briceville, Anderson Co.

Brick Yard limestone.

Pennsylvanian: Northern central Texas (Eastland County).

W. G. Wender, 1929 (Tex. Bur. Econ. Geol. geol. map of Eastland Co.). [*Brick Yard ls.* is shown in section as lying 75 ft. below Lake Pinto ss., in Mineral Wells fm. Is not defined, and is not listed by E. H. Sellards, Univ. Tex. Bull. 3232, 1933.]

Bridal Veil granite.

Probably Cretaceous: Northern California (Yosemite region).

H. W. Turner, 1899 (Jour. Geol., vol. 7, p. 154). *Bridal Veil granite.*—Fine-grained white granite, occurring in drainage of Bridal Veil Creek, on Horse Ridge, and at many other points in Yosemite Park.

Forms brink of Bridalveil Fall.

Bridgeburg horizon.

Silurian: Western New York.

G. H. Chadwick, 1917 (see 1917 entry under *Bertie ls. memb.*).

Derivation of name not stated.

Bridge Creek limestone member (of Greenhorn limestone).

Upper Cretaceous: Western Kansas.

N. W. Bass, 1926 (Kans. Geol. Surv. Bull. 11, p. 67). *Bridge Creek ls. memb.*—Alternating limy sh. and thin chalky ls. Four-fifths of memb. is limy sh., but the ls. beds are the conspicuous feature. Thickness 74 ft. Top memb. of Greenhorn ls. in Hamilton and Kearny Counties. Top 25 ft. is = Pfeifer sh. memb. of counties to E., and rest of memb. corresponds to Jetmore chalk memb. of areas to E. Rests on Hartland sh. memb. of Greenhorn ls. and is overlain by Fairport chalky sh. memb. of Carlile sh.

Named for exposures in Bridge Creek NW. of Medway, Hamilton Co.

Bridge Creek shales.

Miocene (lower) or Oligocene: Central northern Oregon (John Day Basin).

R. W. Chaney, 1927 (Carnegie Inst. Wash. Pub. 346). *Bridge Creek leaf shales*, heretofore included in upper part of Clarno fm., properly belong to John Day series (Olig.). [See 1927 entry under *Clarno fm.*]

R. W. Chaney, 1927 (Carnegie Inst. Wash. Pub. 349, pp. 1–22). *Bridge Creek shales.*—At least 40 ft. thick. On Bridge Creek consist of layers of leaf-bearing shales separated by beds of fine yellow clay up to 1 ft. thick. At Clarnos Ferry and at Grays Ranch on Crooked River the intervening clays are thicker and coarser than at Bridge Creek. Horizontally the leaf shales do not appear to extend great distances, probably not more than a few hundred ft., and are surrounded by the banded reddish and yellowish shales characteristic of lower John Day. On lithologic and strat. grounds it does not seem possible to draw line btw. the leaf shales and the lower John Day beds with which they are associated. Flora is more closely related to Mio. floras of West than to Eo. [On p. 47 he assigned Bridge Creek flora to Olig.] Bridge Creek sh. here included in John Day series, instead of Clarno fm.

See under *Clarno fm.*

R. W. Brown classifies the flora from Bridge Creek, Oreg., as lower Mio. (See recent U. S. G. S. publications.)

Bridgeport sandstone. (In Wills Creek shale.)

Silurian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 57, 58). *Bridgeport ss.*—Hard flinty ss. 5 ft. thick. Overlain by 200 ft. of red sh. and underlain by

500 ft. of red sh., all included in Onondaga red and variegated shales. Best two exposures are near [S. of] Bridgeport [Perry Co.], on bank of Sherman's Creek and near Mr. Egolf's mill in Kennedy's Valley.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 761–764). The *Bridgeport ss.,* in Salina Lower (Bloomsburg red) sh., is a very singular bed of hard flinty ss., about 8 ft. thick, very hard and solid in middle but more soft and shaly toward top and bottom.

Bridgeport limestone. (In Palo Pinto formation.)

Pennsylvanian: Central northern Texas (Wise County).

E. Böse, 1918 (Univ. Tex. Bull. 175, pp. 12–13). *Bridgeport ls.*—Thick-bedded gray and yellowish ls. full of crinoids. Excellent horizon marker. Is 3± ft. thick near Bridgeport [Wise Co.], 5 ft. thick near ranch house of Waggoner ranch; eroded to SW. Exposed in W. part of East Bridgeport. Lies 180± ft. below Rockhill ls. Is separated from underlying coal seam worked at Bridgeport by 30± ft. of gray marly sh. Appears to belong to Strawn fm.

Replaced by *Willow Point ls.* (see 1932 and 1933 entries under *Willow Point ls.*) and included in Palo Pinto fm. by E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105, 110).

Bridgeport sand.

Subsurface sand in Carbondale and Pottsville fms. (Penn.) of Crawford and Lawrence Counties, Ill. (See Ill. Geol. Surv. Bull. 54, index.) The name is also applied to a sand in Mansfield ss. memb. of Pottsville fm. of southern Ind.

Bridger formation.

Eocene (middle and upper?): Southwestern Wyoming, northwestern Colorado, northeastern Utah (Uinta Mountains region).

F. V. Hayden, 1869 (U. S. Geol. Surv. Terr. 3d Ann. Rept., p. 191 of 1873 ed.). The next group commences not far W. of Bryan and is doubtless a prolongation upward of Green River shales. The sediments are composed of more or less fine sands and sss., mostly indurated, sometimes forming compact beds, but usually weathering into those castellated and domelike forms which have given such celebrity to the "Bad Lands" of White River. Church Buttes, near Fort Bridger [Uinta Co., Wyo.], is an example of this group, and shows the style of weathering to which I refer. I have called this group the *Bridger group,* from fact it is best developed in this region. Assigned to upper tertiary.

F. V. Hayden, 1871 (U. S. Geol. Surv. Terr. 4th Ann. Rept., pp. 55–58). *Bridger group.*—Leaden-gray, sombre, indurated aren. clays intercalated with beds of rusty-brown and gray sss., all tending to concretionary structure and disintegrating by exfoliation in thin concentric layers. Aren. materials predominate. Covers large area E. of Fort Bridger and composes upper part of Bridger Butte. Grades into underlying Green River group, which is lighter colored.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1). *Bridger group,* upper Eocene fresh-water deposits, is 0 to 2,500 ft. thick. Upper part consists of 1,500 ft. of peculiar clay ss., olive and drab banded with olive green; lower part consists of 1,000 ft. of drab and gray ss. with some admixture of clay. Deposited in Washakie Lake. On N. side of the Uinta the beds overlap Green River group and come in contact with Vermilion Creek group (=Wahsatch group of Hayden).

According to J. D. Sears and W. H. Bradley (U. S. G. S. P. P. 132F, 1924, p. 99) the Bridger deposits are of fluviatile and fresh-water lake origin.

In Uinta Basin of NE. Utah the Bridger fm. is overlain by Uinta fm. (upper Eocene). (See under *Uinta fm.*) Farther NE. in Utah, however, and in SW. Wyo. and NW. Colo., the Uinta fm. is absent and the Bridger is uncon. overlain by the much younger Browns Park fm. or the Bishop cgl. The Bridger ranges in thickness up to 2,500 ft. For many years the Bridger fm. has been divided by vertebrate paleontologists of Am. Mus. Nat. Hist. into several named paleontologic zones, each characterized by certain vertebrate genera. These zones have also been called, for convenience, Bridger A, Bridger B, Bridger C, Bridger D, and Bridger E, in ascending order. In Uinta Basin of Utah the Bridger beds equiv. to Bridger A, Bridger B, Bridger C, and Bridger D are said not to be fossiliferous, and the beds corresponding to Bridger C and D have in the past been assigned to Uinta fm. and called *Uinta A*, while beds corresponding to Bridger E horizon of Bridger Basin have been called *Uinta B*, the overlying beds (*Diplacodon* zone) being called *Uinta C*. The latter zone (Uinta C) is present only in Uinta Basin, Utah, where it is 600± ft. thick. It is the "true Uinta" of H. F. Osborn, 1895, 1909, 1929, etc., and is Uinta fm. of U. S. Geol. Survey and other authors. Some (all?) members of Am. Mus. Nat. Hist. staff, however, continue to follow the old classification, and include in Uinta fm. the beds equiv. to Bridger C, D, and E, calling Bridger C and D the *Uinta A*, and calling Bridger E the *Uinta B*. This old classification is followed by H. E. Wood, 2d (Am. Mus. Nat. Hist. Bull., vol. 67, art. 5, May 26, 1934, pp. 241–242), who calls these zones *members* and applies to them new geographic names, as explained under *Blacks Fork memb. of Bridger fm.*

†Bridgerian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 279, 309). *Bridgerian series.*—Sss., 500 ft. thick, uncon. underlying Brownian series [Browns Park fm.] and uncon. overlying Greenian series [Green River fm.] in Utah. In Colo. consists of 600 ft. of shales, occupying same interval. In SW. Wyo. it is 1,500 ft. thick. Widely known as the *Bridger beds* or *Bridgerian series*.

Bridge River series.

Pennsylvanian or Permian (?): British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 79). [Assigned to "Devono-Carbf.," but later Canada Geol. Surv. repts assign it to "Penn.-Perm."]

Bridge River augite diorite.

Post-Lower Cretaceous: British Columbia.

V. Dolmage, 1934 (Canadian Min. and Met. Bull. 268, p. 422).

Bridgetimber gravel.

Tertiary? (Pliocene?): Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Bridgetimber gravel.*—Ancient gravel fans of coarse gravel, composed of bowlders and pebbles. Thickness 0 to 20 ft. Contemp. with Los Pinos and Bayfield gravels. Caps Bridge Timber Mtn, SW. of Durango.

Bridgeton formation. (In Columbia group.)

Pleistocene: New Jersey.

R. D. Salisbury, 1898 (N. J. Geol. Surv. Ann. Rept. State Geol. 1897, pp. 13–15). *Bridgeton fm.*—In general gravel, but contains both sand and loam and occasionally clay. Differs somewhat from overlying Pensauken fm. [restricted] and from underlying Beacon Hill fm., though difference is not always great. Is unlike Beacon Hill in containing bits of ironstone derived from Cret. or from Beacon Hill fm. Is like Beacon Hill in containing much decayed chert. In general it may be said to contain any sort of material which Beacon Hill contains and some which it does not. In some places seems not to be clearly separable from Beacon Hill fm., while in others it is not easily distinguishable from Pensauken. In other places it is distinctly separable from the Pensauken and in still others from the Beacon Hill.

R. D. Salisbury, 1901 (N. J. Geol. Surv. Ann. Rept. State Geol. 1900, p. xxxv). *Bridgeton fm.* is uncon. with overlying Pensauken fm. restricted and with underlying Beacon Hill fm. Was included in Pensauken fm. of 1895 and earlier repts.

R. D. Salisbury and G. N. Knapp, 1917 (N. J. Geol. Surv. vol. 8, pp. 11, 62). *Bridgeton fm.*—Chiefly coarse sand and gravel. Uncon. underlies Pensauken fm. and uncón. overlies Beacon Hill gravel. It has two contemp. phases so unlike that they are best described separately. They will be called *Glassboro phase* and *Woodmansie phase*. The *Glassboro* is better known and the more distinctive. It has its distinctive development in SW. part of State. Consists primarily of gravel and sand, arkose in many places. Contains occasional boulders and, exceptionally, seams and lenses of clay. Thickness 0 to 60 ft. Its material is primarily quartzose, and is believed to have been brought in largely from N. by rivers and deposited in wide valley btw. Amboy and Salem. It may be in part glacial outwash. The *Woodmansie phase* occurs E. and N. of Glassboro phase. It is not arkose and is without crystalline rock, sh., red ss., etc., of Glassboro phase. It is more largely sand and is thinner. Its materials were derived chiefly from the Miocene and Cohansey fms.

The Bridgeton fm. is now classified as basal fm. of Columbia group in N. J. Is of nonglacial origin.

Named for exposures at Bridgeton, Cumberland Co.

Bridgewater member (in Marcellus shale).

Middle Devonian: Central eastern New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 133, 219, etc.). *Bridgewater memb. of Marcellus fm.*—The sh. overlying Chittenango memb. of Marcellus fm. and underlying Solsville memb. of Marcellus in Chenango and Unadilla Valleys. Lower part is soft, fissile, slightly aren. sh. especially characterized by *Leiorhynchus limitare, Conularia,* and *Styliolina fissurella.* The succeeding zone is coarser nonlaminated sh. containing *Leiorhynchus laura* associated with many typical Hamilton fossils, showing the change in faunal facies to E. No continuous sequence of this memb. is exposed in Unadilla Valley, so that a number of ravines must be visited in order to construct a complete section. The lower part, including transition with Chittenango, is shown in Wordens Gulf 1¼ mi. W. of West Winfield; the middle of section is exposed in gully behind the buildings of Rose Farm ¾ mi. N. of West Winfield; and the upper part, and its contact with Solsville memb., are exposed in Seabridge Farm 2¼ mi. W. of Bridgewater. Markham and Fork Mtns at Unadilla Forks are almost completely composed of Bridgewater sh., the Solsville being also top of these elevations. Thickness 200 to 360 ± ft.

Brier slate member (of Vulcan iron-formation).

Pre-Cambrian (middle Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Brier sl. memb.*—Heavy, black, ferruginous quartzose sl., 100 to 360 ft. thick. Middle memb. of Vulcan fm. Underlies Curry ore-bearing memb. and overlies Traders ore-bearing memb. Named for Brier Hill.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), adopted *iron-fm.* as a lithologic term, and changed age of *Vulcan iron-fm.* from upper Huronian to middle Huronian.

†Brier Creek marl.

Oligocene and Miocene: Southeastern Georgia and western South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, name only, not defined); 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 435, 464, 465). *Brier Creek phase.*—A high grade marl of a pale yellow color typically exhibited along Brier Creek, near Jacksonboro, Ga In a silicified form it is probably represented on western scarp of Coosawhatchie River near Gifford Station. Overlies King's Creek phase S. of line of Cohen's Bluff near upper line of Hampton Co., S. C. Assigned to Olig.

According to studies of C. W. Cooke this bed in Ga. (type loc.) is Flint River fm. (Olig.), and at the one locality mentioned in S. C. it is Hawthorn fm. (lower Mio.).

Brierfield dolomite.

Upper Cambrian: Northern central Alabama.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 628, 633, 634, pl. 27). Name suggested by Charles Butts. *Briarfield dol.*—Chiefly medium thick-bedded blue and gray siliceous dol., 1,250 ft. thick. Well exposed in Cahaba Valley along Six-Mile

Creek, 10 mi. SW. of Montevallo. Not observed elsewhere. Upper 200 ft. blue dol.; the weathered rock above the middle for 400 to 500 ft. is streaked with convoluted plates of silica and weathers with drusy incrustations; except for basal part, the lower half is without chert; the basal part on weathering is marked by abundant dense residual chert. Underlies Ketona dol. and uncon. overlies Upper Camb. blue lss. [Conasauga ls.] and Conasauga sh. [=Conasauga ls.]. Basal fm. of Ozarkian system. Named for exposures on Mahan Creek in vicinity of Brierfield [correct spelling], Bibb Co.

Brigham quartzite.

Middle and Lower (?) Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 6, 7). *Brigham fm.*—Massive qtzitic sss. underlying Langston fm. Thickness at Brigham, Utah, 2,000+ft.; in Blacksmith Fork, Utah, 1,250 ft.; in section W. of Liberty, Bear Lake Co., Idaho, 1,000+ft. Characteristic Middle Camb. fossils in upper part. Type loc. is W. front of Wasatch Range NE. of Brigham, Box Elder Co., Utah.

C. D. Walcott, 1912 (U.S.G.S. Mon. 51, p. 153, footnote). Line of separation btw. Middle and Lower Camb. occurs somewhere in Brigham qtzite.

Bright Angel shale. (Of Tonto group.)

Middle Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Bright Angel sh.*—Soft, greenish, micaceous, fossiliferous, sandy sh. with two thin layers of brown crystalline ls. locally present in middle of fm. Thickness 25 to 375 ft. Consists of (descending): (1) Alternating layers of sh. and purplish brown ss. underlain by soft, greenish, micaceous sandy sh., 13 ft.; (2) snuff-colored ls., locally known as "Snuffy ls." 57 ft., including 25 ft. of soft sh.; (3) soft, green, micaceous sandy sh. and thin sss. 160 ft. Middle fm. of Tonto group. Conformably underlies Muav ls. and conformably overlies Tapeats ss. Named for Bright Angel Canyon, in walls of which the fm. is well exposed.

L. F. Noble, 1922 (U. S. G. S. P. P. 131B), transferred from Muav ls. to Bright Angel sh. 58 [68?] ft. of shaly beds containing near base a few beds of mottled ls. similar to the mottled lss. of Muav ls.

Bright Diamond limestone. (In Morrison formation.)

Upper Jurassic: Southwestern Colorado (Ouray district).

J. D. Irving, 1905 (U. S. G. S. Bull. 260, p. 56). [In geologic section of Gold Hill given on this page, upper part of *McElmo fm.* is shown as consisting of (descending): (1) Greenish altered shales and shaly sss.; (2) *Bright Diamond ls.;* (3) *Bright Diamond qtzite;* (4) reddish and greenish shales and sss. The names seem to be derived from Bright Diamond mine.]

Bright Diamond quartzite. (In Morrison formation.)

Upper Jurassic: Southwestern Colorado (Ouray district).

See under *Bright Diamond ls.*

Brighton melaphyr. (In Boston Bay group.)

Carboniferous or Devonian: Eastern Massachusetts.

W. W. Dodge, 1881 (Boston Soc. Nat. Hist. Proc., vol. 21, pp. 205–208), applied *Brighton amygdaloid* to fm. now known as Brighton melaphyr.

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Brighton melaphyr.*—Greenish, brownish, or purplish amygdaloidal melaphyr of basaltic character. Composed of dikes, flows, and probably sills intruded into and interbedded with Brookline cgl. memb. and Dorchester sl. memb. of Roxbury cgl. Few ft. to several hundred ft. thick. Included in Boston Bay group. [B. K. Emerson in U. S. G. S. Bull. 597, p. 56, 1917, included these rocks in Mattapan volcanic complex.]

Named for occurrence at Brighton.

Brigus formation.

Lower Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Brigus fm.*—Red shales with nodular ls. Fossils. Underlies Smith Point fm. and overlies Bonavista fm. Included in Etcheminian series. [Derivation of name not stated.]

Brill sand.

A subsurface sand in Pottsville fm. (Penn.) of SE. Ohio.

Brimfield schist.

Carboniferous: Central Massachusetts, southwestern and central southern New Hampshire, and northern Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 17, map, pl. 34). *Brimfield schist.*—Rusty graphitic fibrolite schist. Overlies Paxton whetstone schist.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 59, 60, 68–72, 86–87, 234–235, and map). *Brimfield schist.*—Coarse, rusty muscovite-biotite schist, full of pyrite, graphite, fibrolite, and pink garnet. Includes coccolite ls. Named for occurrence at Brimfield, Mass. Overlies Paxton quartz schist. To E. becomes Worcester phyllite.

E. Callaghan, 1931 (N. Y. Acad. Sci. Annals, vol. 33, pp. 29, 63–74). *Brimfield schist* restricted and redefined. Given significance as a fm. rather than a rock type. Retained for thin layer of biotite schist that overlies Paxton feldspathic schist; the biotite schist that underlies Paxton feldspathic schist and was formerly included in Brimfield schist being here named *Ware schist.* The schist at Brimfield, the type loc., is this upper biotite schist. Occurs btw. shaft 4 and the granite and in W. end of Wachusett-Coldbrook tunnel. Thickness 900 ft. to E., 1,100+ ft. to W. May be Carbf.

W. G. Foye and A. C. Lane, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 138), consider this fm. to be pre-Carbf.

Briones sandstone. (In San Pablo group.)

Miocene (upper): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Briones ss.*—Prevailingly light-colored to whitish, well-washed ss., in some places pebbly or conglomeratic, and in general of coarser texture than lower sss. of Monterey group, of which it is top fm. Thickness 2,300 ft. Very fossiliferous. [Fossils listed.] Includes the nonpersistent Hercules sh. memb. Overlies Rodeo sh. and uncon. underlies San Pablo fm. Named for exposures in Briones Hills, Contra Costa Co.

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 586–614), transferred these beds to San Pablo group.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). San Pablo group (upper Mio.) includes (descending) Neroly fm., Cierbo fm., and *Briones fm.* The latter fm. is locally known as *Astrodapsis brewerianus* zone. It was formerly included in Monterey group, but Parker Trask (1922) showed that stratigraphically and faunally it is more closely related to overlying San Pablo group. [This is present approved definition of U. S. Geol. Survey.]

Brisco formation.

Silurian: British Columbia.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, pp. 11, 26, 47).

Bristol granite gneiss.

Ordovician (?): Central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 104–105 and map). *Bristol granite gneiss.*—Consists of granite of varying texture and color, of gneisses and schists derived from the granite, and of hornblende gneiss and hornblende schist. The typical granite gneiss is light gray, with gneissoid structure more or less developed by presence of layers of biotite; the more schistose layers have muscovite. Quartz, orthoclase, some oligoclase, andesine, and biotite are chief components. Garnet nearly always present and in places is principal mineral. Noticeable feature is presence of rounded and lens-shaped eyes, made up of zone of white, granular quartz-feldspar aggregate, inside which is a dark spot composed largely of garnet and chlorite. Covers large part of Bristol Twp.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 34). *Bristol granite-gneiss* was originally a mass of granite and diorite intruded into Hartland [Hoosac] schist.

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 354–374). *Bristol quartz diorite* appears to be older than Brookfield diorite.

Bristol limestone. (In Washington formation.)

Permian: Northern West Virginia.

R. V. Hennen, 1912 (W. Va. Geol. Surv. Rept. Doddridge and Harrison Counties, p. 168). *Bristol ls.*—Buff-colored ls., very often nodular and brecciated. Thickness 0 to 4 ft. Underlies Washington fire clay and overlies Washington ss. Named for Bristol, Harrison Co.

E. L. Core, 1929 (W. Va. Acad. Sci. Proc., vol. 3, pp. 204–205). Near base of Little Washington coal near Core, Monongalia Co., occurs a massive, very hard, blue-gray ss., 10 to 15 ft. thick, here named *Dolls Run ss.* Beneath this ss. comes the siliceous *Bristol ls.,* quite persistent but here commercially unimportant. Its thickness is 2 to 8 ft. The 40 to 50 ft. beneath Bristol ls. is made up mostly of shales and thin shaly sss. except in N. part of area, where occurs the massive Mannington ss., 15 to 25 ft. thick. [According to Core and other writers the Washington ss. lies much higher in the section than Bristol ls., so whether the ls. called Bristol by Core is true Bristol ls. is a question.]

†Bristol formation.

Pliocene: Northern Florida.

E. H. Sellards, 1918 (Fla. Geol. Surv. 10th and 11th Ann. Rept., p. 51). If Altamaha is retained as a fm. name, restricted if necessary to the deposits consisting chiefly of red sands and clays lying above the Miocene, it is very possible that the similar materials of this area btw. Apalachicola and Ocklocknee Rivers may be included in that fm. If not referable to Altamaha fm., possibly these materials may be referred to Citronelle fm., although this should not be done until fossils can be obtained or continuity of deposition with Citronelle fm. can be determined. If these materials can be referred to neither of these fms., they may be known as *Bristol fm.,* from their typical exposure in vicinity of Bristol, where they are known to lie stratigraphically above the Choctawhatchee Miocene.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.), mapped these deposits as *Citronelle fm.,* and abandoned the preoccupied name "Bristol."

Bristol series.

Pre-Cambrian: Quebec.

M. E. Wilson, 1924 (Canada Geol. Surv. Mem. 136, p. 23).

Bristol Bay silts and gravels.

Pleistocene: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 177–178). *Bristol Bay silts and gravels,* Pleist., extend from Togiak Bay to Bristol Bay.

Bristol Pass limestone.

Mississippian (lower): Eastern Nevada (Pioche district).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171, pp. 7, 20, map, etc.). *Bristol Pass ls.*—Gray, finely crystalline ls., slightly cherty. Greatest measured thickness 305 ft., but full thickness is unknown. Seems to conformably overlie West Range ls. (Upper Dev.) and occupies strat. position below Peers Spring fm. Named for occurrence at Bristol Pass, in summit of hill immediately N. of benchmark 6149. Fossils (of Madison age) listed.

Bristow shale and sandstone. (In Chester group.)

Mississippian: Southwestern Indiana and western central Kentucky.

W. N. Logan, 1924 (Ind. Dept. Cons. Pub. 42, pp. 11, 125. Taken from unpublished rept. on Perry Co., Ind., by C. A. Malott). *Bristol sh. and ss.*—Underlies Mount Pleasant shales and sss. and overlies Buffalo Wallow shales. Belongs in upper part of Chester group. Thickness 25 ft. in well log in Knox Co., Ind.

C. A. Malott, 1925 (Ind. Acad. Sci. Proc., vol. 34, pp. 110–132). *Bristow ss.*—Thin to massive ss., fine-grained and hard, often qtzitic, well jointed. Occurs in upper Chester shales, about 210 ft. above Glen Dean ls. Thickness usually 3 to 7 ft., but in places it reaches a known max. of 25 ft. Lies 20 or more ft. above Siberia ls. and 15 to 35 ft. below Mount Pleasant ss. Named for exposures at and near village of Bristow, Perry Co., Ind. Also identified at Buffalo Wallow, 1½ mi. W. of Cloverport, Breckinridge Co., Ky., where it is 0 to 4 ft. thick.

M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. 133, p. 78), listed (but did not define) *Gennet Creek fm.*, 10 to 35 ft. thick, as underlying Mount Pleasant ss. and overlying Bristow ss.

Bristow formation.

Pennsylvanian: Central Oklahoma (Creek County).

A. E. Fath, 1925 (U. S. G. S. Bull. 759, pp. 13–15). *Bristow fm.*—Includes all strata btw. Elgin ss. above and base of Tiger Creek ss. memb. below. Consists of an interbedded series of ss. and sh. aggregating 600± ft. in thickness. The sss. are generally gray to yellowish brown and friable. In N. part of Bristow quad. some of shales are gray and have considerable thickness. Here and to N. beyond this quad. it would be possible to divide the fm. into strat. units, but to S. the shales become thinner, change from gray to red, and lose their identity as mappable units, making the fm. a monotonous series of interbedded ss. and sh. throughout. Named for Bristow, Creek Co.

Brito formation.

Tertiary: Nicaragua.

C. W. Hayes, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 285–308; and Nicaragua Canal Commission Rept., p. 114). Assigned to Olig.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 361) and 1924 (Revista económica, San Salvador, año 11, No. 4, p. 175), assigned *Brito beds* of Costa Rica to Eo.

Brittania formation.

Carboniferous (?): British Columbia.

O. E. Le Roy, 1908 (Canada Dept. Mines, Geol. Surv. Branch Pub. No. 996, p. 15). [Assigned to "Devono-Carbf." Subsequent repts of Canada Geol. Surv. assign it to Carbf., to Jurassic, and to Triassic (?).]

Britton clay.

Upper Cretaceous (Gulf series): Eastern Texas (Trinity and Brazos River regions).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 425). *Britton clay (from W. L. Moreman's unpublished description).*—Type loc., Britton, NW. part of Ellis Co. Typical thickness 250 ft.; near Dallas 300 or more ft. Mostly blue clay, with a few flaggy ls. seams and calc. concretions, the latter more abundant near top. Grades up into Arcadia Park fm. and overlies Tarrant fm., all of which are= Eagle Ford.

Broadback series.

Pre-Cambrian: Quebec.

H. C. Cooke, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 339).

Broad Branch series.

Pre-Cambrian: District of Columbia.

W J McGee, G. H. Williams, and N. H. Darton, 1893 (5th Int. Geol. Cong., p. 244). Granitic and schistose rocks assigned to Archean.

Broad Ford sandstone. (In Pocono sandstone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1925 (Econ. Geol., vol. 20, pp. 778–779). *Broad Ford ss.*—A very prominent red ss. with distinctive lithology and marine fossils. Occurs a few ft. below Langhorne coal in Poverty Gap and is traceable for several hundred mi. through Appalachian region. Thickness 230 ft. Named for its best exposure in Smyth Co., Va.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 505, 520). *Broad Ford ss.*—Usually reddish brown; occasionally greenish gray or rusty ledge; rarely gray; usually thick bedded; frequently hard but often shaly and weathering to concretionary or chunky blocks; marine fossils in several zones. Thickness 50 to 300 ft. Lies a few ft. below Langhorne coal and 25 to 100 ft. above Sunbury sh.; all included in Pocono series. Type loc. at line btw. Smyth and Tazewell Counties, Va., about ½ mi. N. of Broad Ford Village where Laurel Creek of Holston River cuts a gap through ridge known as Pine Mtn on W. and

Brushy Mtn on E. Also observed in Montgomery and Giles Counties, Va., and in Mercer, Monroe, Greenbrier, and Summers Counties, W. Va., and across latter State, through Pocahontas and Preston Counties, into Pa.

Broad Top series.

Carboniferous: Pennsylvania.

H. D. Rogers, 1836 (1st Ann. Rept. State Geol. Pa., pp. 16–18). Included in Coal Measures.

Broadway moraine.

Pleistocene (Wisconsin stage): Northern Ohio. Named for village in Union Co. See U. S. G. S. Mon. 41, 1902, pp. 531–537.

Brock shale.

Upper Triassic: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Brock sh.* conformably overlies Hosselkus ls. in Brock Mtn, whence the name, and has a thickness of about 400 ft. In lower 300 ft. or more adjoining the ls. the shales are dark, somewhat calc., and frequently contain *Halobia*. Above these come sandy shales, gray and reddish in color, and characterized locally by *Pseudomonotis subcircularis*. Is overlain, probably uncon., by Modin fm. [Brock sh. is approx.=Swearinger sl.]

Brock series.

Pre-Cambrian: Quebec.

H. C. Cooke, 1919 (Jour. Geol., vol. 27, p. 263).

Brockenback Hill formation.

Lower Cretaceous: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, pp. 487, 488). *Brockenback Hill fm.*—Aggls., 3,600 ft. thick, yielding *Aucella crassicollis*. Assigned to Lower Cret. Overlies Peninsula fm. (Lower Cret.).

Brockville granite.

Pre-Cambrian: Ontario.

J. F. Wright, 1923 (Canada Geol. Surv. Mem. 134, p. 25).

Broken Arrow formation.

Pennsylvanian: Northeastern Oklahoma (Tulsa County) and central Oklahoma (Creek County).

R. H. Wood, 1925 (Okla. Geol. Surv. Bull. 35, p. 71). *Broken Arrow fm.*—Mostly green sh., but includes a few thin beds of ls. and some ss., notably in lower part, S. of Arkansas River. Thickness 350 to 500 ft. or more; thickest toward S. Outcrops in a belt 10 to 15 mi. wide, extending from village of Broken Arrow [Tulsa Co.] southward to Arkansas River and beyond it for several miles. Embraces all strata btw. Fort Scott ls. below and Dawson coal above. The equivalent fms. to N. are (descending) Nowata sh., Altamont ls., Bandera sh., Pawnee ls., and Labette sh.

Brokeoff andesite.

See under *Divide Peak andesite*.

Bromide formation.

Middle Ordovician: Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), showed a new fm., called *Bromide*, of Black River and uppermost Chazy age, as overlying, in places uncon., Simpson fm. and uncon. underlying Viola ls., in Arbuckle Mtns, Okla., the typical region of the Simpson and the Viola. As originally defined and used up to this time the Viola rested on the Simpson.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, pp. 21–32). Simpson fm. of Taff comprises at least 3 faunas of exceedingly diverse origin and geographic distribution. None of these faunas, nor any beds that might contain them, are found in southern Mo. or Ark. The closing stage, provisionally added to top of *Bromide div.* of Simpson, contains a good representative of Decorah and Prosser faunas of Minn. (Black River and lower Trenton). *Typical Bromide* is of late Chazy age [and is shown as constituting topmost part of Simpson fm.].

F. C. Edson, 1927 (A. A. P. G. Bull., vol. 11, No. 9, pp. 967–975). Simpson fm. divided into *Bromide group* above and "Wilcox" sand below. The Bromide is a series of mag. limes and sands, in places interbedded with small amounts of green sh. Thickness 315 to 495 ft. in Arbuckle Mtns; 0 to 600 ft. in Mid-Continent field. The descriptive term "post-Wilcox" was applied by Luther White to these beds to indicate that part of Simpson fm. which is younger than "Wilcox" sand. Ulrich (1911) classified Bromide fm. as occurring btw. Simpson fm. and Viola ls. Taff mapped type loc. of Bromide fm., near Bromide, sec. 19, T. 1 S., R. 8 E., as *lower Viola ls.* This outcrop was visited recently by a party of geologists under direction of Okla. Geol. Surv., and all present agreed that this outcrop is made up of sediments that in every way resemble the "post-Wilcox" well cuttings. It is suggested by Luther White, the writer, and others that term "post-Wilcox" be dropped and that *Bromide* be retained to designate the group of sediments that occurs btw. "Wilcox" sand and Viola lime.

E. O. Ulrich, 1928. See under *West Spring Creek fm.*

E. O. Ulrich, 1929 (Letter dated Nov. 11, 1929, published by C. E. Decker in Okla. Geol. Surv. Bull. 55, p. 40, 1931). As used by me in past 2 yrs the Bromide includes all beds of Black River and Trenton ages that were deposited in Arbuckle region.

E. O. Ulrich, Feb. 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73). See under *West Spring Creek fm.*

F. C. Edson, July 1930 (A. A. P. G. Bull., vol. 14, No. 7, p. 947). *Bromide fm.* is overlain, with angular uncon., by Viola ls. and underlain, with angular uncon., by Tulip Creek fm.

C. E. Decker, Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498–1505). *Bromide fm.*—Chiefly lss., some sh., some ss., with a ss. of variable thickness at base. Thickness of fm. 171 to 600± ft. Of Trenton and Black River age. Overlies Tulip Creek fm. and underlies Viola ls. As *Bromide* has been used more extensively in connection with the Simpson it seems best to retain it for the upper fm. and drop Criner.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 11–12, 98). The *Simpson* is here raised to a *group*, divided into 5 fms. (ascending): Joins, Oil Creek, McLish, Tulip Creek, and Bromide. Heretofore *Bromide*, in various tables, has been used to represent a number of different horizons, but its last use was to limit it to upper part of section exposed in hill just W. of the hotel at Bromide, and it was thought that the fauna represented in this section was younger than that found in upper part of Simpson elsewhere. Further studies of a section above the 3 artesian wells at NE. edge of Bromide, and sections on Robertson ranch about 3 mi. S. of Bromide, have contributed evidence to show that certain parts of fauna and the physical characteristics of upper part of the Simpson at E. end of mtns are almost identical with those of upper part of Simpson in most of its outcrops. As Bromide has been used more extensively and longer in connection with the Simpson, it is thought better to retain it as the name for upper fm. of this group and drop *Criner*, which was at first the name of a memb., but later was raised to fm. name before it was realized the fauna at Rock Crossing in Criner Hills is largely a duplication of upper Simpson fauna to N., with addition of several apparently local forms. Named for town of Bromide, Johnston Co., where type section was made on a hill NW. of Galbraith Hotel.

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, p. 105). *Bromide fm.* included in Simpson group. Typical Bromide correlates with Lowville.

Bromley shale. (*In Cynthiana formation.*)

Middle Ordovician (Trenton): Southwestern Ohio and northern Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 9). *Bromley shales.*—Drab to dark-blue shales, 30 ft. thick, underlying Point Pleasant ls. and outcropping along Ohio River bank opposite Cincinnati. Well exposed along river just below Bromley, Kenton Co., Ky. Characterized by trilobite remains and a form of *Dalmanella.*

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2) and 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51), and A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, geol. ser. No. 121, chart opp. p. 58), divided Cynthiana fm. into (descending) Rogers Gap, Gratz, *Bromley*, and Greendale.

Broncho Mountain granite.

Pre-Cambrian: Colorado (Gold Brick district).

R. D. Crawford and P. G. Worcester, 1916 (Colo. Geol. Surv. Bull. 10). A comparatively small body of granite unlike the ordinary kind is exposed on Broncho Mtn [Gold Brick dist., Gunnison Co.], about ½ mi. SE. of top. Since this rock differs materially in composition, texture, and color from rest of granite of dist., it has been mapped separately and for purposes of reference is here called *Broncho Mtn granite*. Is commonly reddish, but facies very rich in biotite are almost black.

Bronson formation.

Bronson group.

Pennsylvanian: Eastern Kansas, Iowa, Oklahoma.

G. I. Adams, 1904 (U. S. G. S. Bull. 238, pp. 1, 17, 21). *Bronson fm.*—Heavy ls. fm., 60 to 80 ft. thick, including some ss. and sh. Overlies Dudley sh. and underlies Chanute sh. [Chanute as here used includes Cherryvale sh., Drum ls. and Chanute sh.] Includes (ascending) Hertha ls., Ladore sh., Mound Valley [Bethany Falls] ls., Galesburg sh., and Dennis [Winterset] ls.

In succeeding years this name had very limited usage in the literature, but when used it was applied to beds beneath Cherryvale sh. and above Dudley sh.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), defined *Bronson group* as extending from top of Winterset ls. (above) to base of sh. and channel ss. underlying Hertha ls. and resting uncon. on Pleasanton sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 90, 97). *Bronson group* [restricted].—*Bronson* was introduced by Adams in 1904 for prominent compact group of lss. in lower part of Missouri series which until recently has been designated *Hertha* (here renamed *Sniabar ls.*, as explained under *Hertha ls*), Bethany Falls, and Winterset. This group of lss. and associated shales, which are now referred to (ascending) the Swope, Galesburg, and Dennis fms., form a distinct and very persistent strat. unit traceable from Iowa to southern Kans. The distinction from associated strata is, however, mainly lithologic, and accordingly physiographic, rather than paleontologic. The div. is a convenient and natural one from strat. standpoint. [The Swope ls. of Moore rested on what he called Ladore sh. and treated as top fm. of his *Bourbon group* (new name). R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.) used *Bronson group* as redefined by Moore in Aug.-Sept., 1932, and this same definition was used by Moore in 1935.]

J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, p. 131). Type loc. of *Bronson group* is near Bronson, Bourbon Co., Kans. The group is recognized from SW. Iowa to northern Okla. Extends from top of Winterset ls. to base of Sniabar ls.

R. C. Moore, May 1, 1935 (Univ. Kans. Bull. 20, table opp. p. 14). Base of Bronson group is base of Hertha ls., which overlies *Bourbon group;* latter includes all rocks down to base of Warrensburg ss.

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21). *Bronson fm.* as first defined by Adams included from top of Dennis ls. to base of Hertha ls. [*Bourbon fm.* included in *Bronson group* on p. 19 and excluded on p. 21.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 41, 43, 76). *Bronson group* as here used is as defined by Adams. It conformably overlies Bourbon fm. and underlies Fontana sh., basal fm. of Kansas City group as here restricted. Is chiefly ls. Includes beds from base of Hertha ls. up to top of Dennis ls., and corresponds to lower part of Kansas City group as previously defined. Thickness in type region (vicinity of Bronson, Bourbon Co., Kans.), 100± ft.; in Kansas City area, 85± ft.; in southern Kans. 150 to 175 ft.

The U. S. Geol. Survey has not yet given consideration to the revival of *Bronson* and restriction of Kansas City fm., for use in its publications. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

†Brooke formation.

Lower Cretaceous: Northeastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 321). Because the beds are most typically developed in vicinity of Aquia Creek, I have decided to give name *Aquia Creek series* to memb. of Potomac fm. designated as "Brooke" by Professor Fontaine. [The compiler has been unable to find that Fontaine published the name *Brooke fm.* prior to 1905. He did, however, in U. S. G. S. Mon. 6, 1883, and Mon. 15, 1889, describe and figure a large fossil flora from vicinity of Brooke Station, 9 mi. N. of Fredericksburg, Va., but he seemed to studiously avoid using the name *Brooke beds.* In U. S. G. S. Mon. 48, p. 360, 1905, L. F. Ward published a letter from Prof. Fontaine dated Feb. 12, 1886, in which the term *Brooke beds* is casually used once. On p. 478 of Mon. 48 Fontaine calls the beds at Brooke locality the *Aquia Creek beds.* On p. 482 he calls them *Aquia Creek horizon or Brooke beds.* On p. 488 he mentions the *Aquia Creek or Brooke beds,* also the *Brooke beds,* and mentions *Brooke beds* on p. 575.]

L. F. Ward, 1905 (U. S. G. S. Mon. 48, pp. 402, 598). *Brooke fm.* replaces *Aquia Creek series.* Admitted on my part that "Aquia Creek" was published by Professor Clark a few months earlier than by me, and must apply to the Eocene beds if used at all, though it is only a portion of Mr. Darton's Pamunkey. For the Potomac beds called by me *Aquia Creek series* Professor Fontaine's term "Brooke" must be retained. *Brooke fm.,* 150 ft. thick, overlies Mount Vernon beds.

The use of the terms "Aquia Creek series" and "Brooke fm." was discontinued years ago. According to W. B. Clark and B. L. Miller (Va. Geol. Surv. Bull. 4, 1912) the beds described under those names are included in Patapsco and Patuxent fms. of present nomenclature.

Brookfield diorite.

Ordovician(?): Western Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, p. 107 and map). *Brookfield diorite* extends from near New Milford southward to Brookfield Center, with length of about 8 mi. and width of 1 mi. Is usually massive, but shows also gneissoid and even schistose phases. Both light and dark types are present in fm. Intrudes Poughquag qtzite [Lower Camb.] and the schists of the region [Berkshire and Hoosac, of Ord. age].

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 354–374). *Brookfield diorite* is older than Thomaston granite and appears to be younger than Bristol quartz diorite, Hartland schist, and Becket granite gneiss.

Brookline conglomerate member (of Roxbury conglomerate).

Devonian or Carboniferous: Eastern Massachusetts (Boston Basin).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 56–57). *Brookline cgl. memb. of Roxbury cgl.*—Massive cgl., 500 to perhaps 2,000 ft. thick, which contains some layers or pockets of ss. and a few thin lenses of sl. At some places along S. margin of basin its base is a slaty or sericitic qtzite, but at most places it is a coarse ill-sorted cgl. containing some pebbles or small bowlders more than a foot through. Extensively exposed at Brookline. Is basal memb. of Roxbury cgl.

See also L. LaForge, 1932 (U. S. G. S. Bull. 839), where thickness of 1,200± ft. is given.

Brooklyn formation.

Carboniferous: British Columbia.

O. E. Le Roy, 1912 (Canada Geol. Surv. Mem. 21, pp. 19, 26, 33).

Brooklyn moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U.S.G.S.P.P. 106, 1918. Named for Brooklyn Twp, Dane Co.

Brooklyn gneiss.

Pre-Cambrian: New York City.

C. P. Berkey, 1933 (16th Int. Geol. Cong. Guidebook 9, pl. 7).

Brooks bed.

Mississippian: Northwestern Kentucky.

A. F. Foerste, 1910 (Ky. Geol. Surv. Rept. Prog. 1908 and 1909, p. 83). *Brooks div.*—The upper, medium-grained part of Knobstone fm. at Stephensport, Breckenridge Co., may represent *Brooks bed,* and the lower fine-grained part includes New Providence clay sh.

Derivation of name not explained; may be from Brooks, Bullitt Co., Ky.

Brookville clay. (In Allegheny formation.)

A clay bed, 0 to 8 ft. thick, underlying Brookville coal, lying 0 to 25 ft. above base of Allegheny fm. in Pa. and adjacent States.

Brookville terrane.

Cretaceous: Kansas.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 255). *Brookville terrane,* sss., 150 ft. thick. Underlies Cawker terrane (shales) and overlies Pete terrane (shales). Included in Dakotan. [Derivation of name not stated, but probably Brookville, Saline Co., north central Kans.]

Brookwood coal group.

Pennsylvanian: Central Alabama.

A group of coal beds in upper part of Pottsville fm. Includes Brookwood, Milldale, and Carter coals.

Broomhill facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 77, 100, etc., 1931) to the lithologic facies of New Providence fm. at its type loc.

Brosseau formation.

Upper Cretaceous: Alberta.

J. A. Allan, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 12). Included in Belly River series.

Brougher dacite.

Tertiary (upper Miocene?): Central Nevada (Tonopah district).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 44, 50, map, etc.). *Brougher dacite.*—Composes Butler, Brougher, Siebert, and Golden Mtns, Tonopah dist. Intrudes earlier andesite, Fraction dacite breccia, Tonopah rhyolite dacite, Siebert tuffs, and overlying basalt. Is apparently of about same age as Oddie rhyolite and of same nature and origin.

J. A. Burgess, 1909 (Econ. Geol., vol. 4, pp. 681–712), assigned this fm. to Plio.; T. B. Nolan (personal communication Jan. 1933) considers it to be same as Oddie rhyolite.

Broughton series.

Pre-Cambrian: Quebec.

J. A. Dresser, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 190).

Brown sand.

A subsurface sand, of Penn.(?) age, in Stephens Co., southern Okla., lying at 2,100 ft. depth in Empire pool, the Smith sand lying at 2,000 ft. and the Blaydes at 2,200 ft.

Brown oil sand.

A subsurface sand in Tri-County oil field, SW. Ind., lying 20 to 60 ft. below Oakland City sand.

Brown zone.

A petroliferous zone, about 250 ft. thick, in Fernando group of Long Beach field, Los Angeles Basin, Calif. Lies lower than Alamitos zone and higher than Bixby zone. Named for fact Petroleum Midway Brown No. 1 well is thought to be the discovery well of this zone.

Brown Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 381). *Brown Creek bed.*—Friable white ss., 240 ft. thick, with 25 ft. of blue clay about 40 ft. from top. Memb. of Strawn div. Overlies Big Valley bed and underlies Spring Creek bed.

Named for Brown Creek, Mills Co.

Brownian series.

A term introduced by C. [R.] Keyes to include Browns Park fm. (late Mio. or early Plio.) and Uinta fm. (Eo.) of Utah.

Brown Mead formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Brown Mead fm.*—Gray shales carrying *Bryograptus*. Basal fm. of Clarenville series. Overlain by Apsey fm. and underlain by Elliott Cove fm. (Upper Camb.). [Derivation of name not stated.]

Browns Mountain group.

Ordovician: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 241).

Browns Park formation.

Tertiary (late Miocene or early Pliocene): Northwestern Colorado and northern eastern Utah (Uinta Mountains region).

J. W. Powell 1876 (Geology of eastern part of Uinta Mtns, pp. 40, 44, 168). *Brown's Park group.*—Sss., gravel, lss., concretionary and stratified flints, 0 to 1,800 ft. thick. In some places cgls. having a great development are found at base. Uncon. underlies Bishop Mtn. cgl. [according to geologic column on p. 40, but according to later pp. the two fms. do not appear to be in contact]. Uncon. overlies Bridger group and older rocks. Well represented at Brown's Park, NE. Utah and NW. Colo. and in a dist. stretching to SW. beyond Snake and Yampa rivers. [The early writers used *group* in sense that modern writers use *fm*. The Browns Park "group" of Powell is same as Browns Park *fm.* of present nomenclature, the true Uinta fm. (*Diplacodon* zone), which overlies Bridger fm. in Uinta Basin (S. of Uinta Mtns), being absent in NE. Utah and NW. Colo.]

For many years Browns Park fm. of E. end of Uinta Mtns, in NE. Utah and NW. Colo., was supposed to be same as Uinta fm. of Uinta Basin, which lies to S. of Uinta Mtns, and the two names were used interchangeably.

J. D. Irving, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 255). The lithological characteristics of *Brown's Park beds* of Utah are exceedingly peculiar and entirely different from those of any other tertiary in region. The most characteristic strata are a very soft, friable, siliceous silt, everywhere thinly bedded and throughout highly calc. They differ entirely from those of the Eocene Bridger group to N. of the mtns and the Uintah (Eocene) to the S., in containing comparatively little clay and being everywhere very soft. The Bridger is characterized by a grayish or greenish tinge and the Uintah by a prevailing brownish red color, whilst the Brown's Park is always white. But most important difference is in texture. Only fossil found in Brown's Park beds was a fragment of bone which Dr. Wortman, of Am. Mus. Nat. Hist., is of opinion could not have been deposited earlier than Plio. or at most Mio.

J. D. Sears, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 279–304) and 1926 (U.S.G.S. Bull. 781B, pp. 16, 22). Writer believes Bishop cgl. is=basal memb. of Browns Park fm. of Uinta Mtn region.

W. H. Bradley, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 11, p. 318) and 1936 (U.S.G.S.P.P. 185, I) demonstrated that Bishop cgl. is older than Browns Park fm., and J. D. Sears accepts Bradley's evidence.

The few fossils that Browns Park fm. has yielded are regarded as Mio. or possibly Plio. The U. S. Geol. Survey tentatively classifies the fm. as late Mio or early Plio.

Brownsport formation.

Silurian (Niagaran): West-central Tennessee and northeastern Mississippi.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 566–583, 681–708). *Brownsport bed (of Niagara age)*.—Richly fossiliferous white lss. and calc. clays, 120 ft. thick, overlying Dixon red clays and forming top of Sil. section in Tenn. River Valley. Uncon. underlies Linden fm. (Helderbergian), or, where that is absent, the younger Hardin ss. [As thus defined included at top the beds of Cayugan age later separated under name *Decatur ls.* Some geologists, however, still classify the Decatur as Niagaran and include it in the Brownsport. A. F. Foerste stated (Denison Univ. Bull., Jour. Sci. Lab. vol. 30, 1935, pp. 197–198) Decatur fauna is Niagaran.]

Now subdivided into (descending) Lobelville shaly ls. memb., Bob crystalline ls. memb., and Beech River shaly ls. memb. Underlies Decatur ls. and overlies Dixon earthy ls. memb. of Wayne fm.

Named for Brownsport Furnace, Decatur Co.

Brownstown marl (restricted).

Upper Cretaceous (Gulf series): Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 86–87, 188); 1894 (Geol. Soc. Am. Bull., vol. 5, p. 302, pl. 12); 1901 (U.S.G.S. 21st Ann. Rept., pt. 7, p. 340).

A. C. Veatch, 1906 (U.S.G.S.P.P. 46, p. 25). *Brownstown marl*.—This name was first applied by Hill [first reference above] to marl beds typically developed at Brownstown, Ark., which at that time he thought were above the Annona (White Cliffs) chalk. In his rept. on geology of part of Tex., Ind. Ter., and Ark. adjacent to Red River [second reference above] he used *Brownstown* to include all beds btw. Annona chalk and Washington (Nacatoch) beds. Later [1901 reference above], appreciating that the beds at Brownstown are below the Annona chalk, he gave them their right strat. position, but included with them the marls which overlie the Annona chalk. The term is now defined to include the blue clay marls btw. Bingen sand and Annona chalk.

In 1926 L. W. Stephenson and C. H. Dane (U.S.G.S. Press Bull. 8823, Sept. 10), 1927 (A.A.P.G. Bull., vol. 11, p. 8), and 1929 (Ark. Geol. Surv. Bull. 1, p. 46) divided †Bingen sand into Woodbine sand below and Tokio fm. above, and restricted *Brownstown marl* to lower part of Veatch's Brownstown marl, the new name *Ozan fm.* being applied to the upper uncon. part of the Brownstown of Veatch. The village of Brownstown, Sevier Co., Ark., is located on top of Brownstown marl as thus restricted by Stephenson and Dane.

According to L. W. Stephenson, 1928 (Am. Jour. Sci., 5th, vol. 16, p. 492), and 1929 (A.A.P.G. Bull., vol. 13, No. 10), the Brownstown marl overlies Bonham clay and uncon. underlies Annona chalk in NE. Tex.

Brownstown sandstone. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 586). *Brownstown ss.*—Massive ss., 25 to 35 ft. thick, lying a short distance below Campbells Creek coal and 35 ft. above Brownstown coal. Has been quarried at Brownstown and Montgomery.

Brownstown Hills sandstone member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76., 172, 174, 175, 237, 239, 240, 245). *Brownstown Hills ss. memb. of Edwardsville fm.*—The ss. bed or set of beds with a brachiopod fauna dominated by several species of Spirifer, which lies upon Floyds Knob ls. in NW. Washington Co. and in Jackson Co., in general E. of a line running from SW. corner of the Co. NE. of Houston. At Sparksville quarry, 1 mi. E. of Sparksville, it consists of 17 ft. of massive bedded ss. On SW. side of Brownstown Hills, slightly W. of Brownstown, it is 20 ft. thick; near old Goss Mill, 6½ mi. N. of Medora, it is 5 to 6 ft. thick; at Medora Knob it consists of 11 ft. of massive, gray to buff, bedded ss. with thin sh. partings; at Fort Ritner it is 25 ft. thick. Pinches out to S. and E. of McKinley, Washington Co. Named for fact it caps Brownstown Hills of south-central Jackson Co.

†Browntown sandstone. (In Monongahela formation.)

Pennsylvanian: Southwestern Pennsylvania, northern West Virginia, and eastern Ohio.

I. C. White, 1891 (U.S.G.S. Bull. 65, p. 58). *Browntown ss.*—Hard, massive, gray ss., 0 to 35 ft. thick. Lies 5 to 20 ft. below Waynesburg coal and overlies Little Waynesburg coal. Finely exposed along bed and bluffs of Ten Mile Creek, at and below Browntown, Harrison Co., W. Va. It is sometimes called *"Gilboy" ss.*, from a rocky cut of that name near Mannington, Marion Co., W. Va.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 150). *Gilboy ss.*—Was formerly termed *Browntown ss.*, from a locality in Harrison Co., but as there is a Brownstown ss. in Kanawha Co., W. Va., it was concluded best to change the name of this ss. to *Gilboy.*

Replaced by *Gilboy ss. memb.*

Brownville slate.

Name listed in U.S.G.S. Bull. 191 and credited to C. T. Jackson, Geol. rept. public lands of Maine, vol. 1, p. 37, 1837. The name was not defined, but only casually referred to, by Jackson on p. cited. He also casually used the name on pp. 76 and 91 of First Rept. on geol. of State of Maine, 1837, but evidently did not intend it as a geologic name.

Brownville limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, and eastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 17, 29). *Brownville ls.*—Basal part of Admire (?) fm. Overlies McKissick Grove shales and is separated from overlying Aspinwall ls. by 10 to 25 ft. of sh. Is light bluish green; upper part somewhat nodular; lower part massive. In section 3 mi. S. and 2 mi. W. of Falls City it consists of 2 lss. separated by 7 inches of bluish sh. and weathered ls. Thickness 2½ to 6 ft.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 73, 74, 81, 89). *Brownville ls.*—Two grayish lss. separated by a thin sh. Thickness 3 to 5 ft. Top ls. is usually thinner; lower one forms rounded blocks. Both beds weather yellowish or brownish. Is basal bed of Admire sh. memb. of Wabaunsee fm. Named for exposures low in Missouri bluffs S. of Brownville, Nemaha Co., Nebr.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), restricted Admire sh. to beds above Brownville ls., and treated latter as a distinct fm., and this definition was adopted by Moore and Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Brownville ls. fm.*—Top fm. of Wabaunsee group restricted. Overlies Pony Creek sh. fm. and underlies Admire group.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Brownwood division.

Pennsylvanian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). [*Brownwood-Ranger series* on p. lxvii and *Brownwood-Canyon* on pl. 3.] Lss. and sss. containing considerable salt and some oil and gas. Overlies Milburn-Strawn series and underlies Waldrip-Cisco series. Named for Brownwood, Brown Co.

R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 204–207). *Brownwood div.*—Chiefly ls., but alternating with ss.; no coal. Thickness 1,300 ft. Underlies Waldrip coal div. and overlies Milburn shales.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 98). *Brownwood div.* now includes Milburn div. of Tarr and overlies Richland div. [See 1901 entry under *Milburn shales.*]

C. H. Gordon, 1911 (Jour. Geol., vol. 19, p. 117). *Brownwood div.* now includes Brownwood and Milburn of Tarr, and is =Canyon div.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, p. 13). *Brownwood* and Milburn of Tarr practically =Canyon group.

Named for Brownwood, Brown Co.

Brownwood shale member (of Graford formation).

Pennsylvanian: Central Texas (Brown County, Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 389). *Brownwood bed.*—Chiefly bluish, slightly sandy clay, though dark blue to black carbonaceous shaly clay, or even sh., is common at southern end, and lenticular beds of ss. of considerable extent occur in places. Fossiliferous. Thickness 200 to 250 ft. Memb. of Canyon div., near base. Underlies Adams Branch ls. and believed to overlie Rochelle cgl., but may belong to same horizon as the Rochelle.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132). Graford fm. is composed of Adams Branch ls. memb. (at top) and *Brownwood sh. memb.*, which was named by Drake. The Brownwood memb. consists of dark-gray and blue clay sh. weathering to light gray and yellow. It contains some lenses of ss. and a number of thin beds of ls. Is 180± ft. thick at Brownwood and at least 400 ft. thick at Graford. As here defined it overlies Palo Pinto ls. and includes Rochelle cgl. at or near base. Near Brownwood it includes Capps ls. lentil in lower part, and in Palo Pinto Co. it includes a fairly continuous ss. lentil designated Oran ss.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105, 109), revised the definition of Brownwood by transferring Capps ls. to top of underlying Strawn fm.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, p. 201), followed Sellards' definition of Brownwood sh. and Capps ls.

Named for Brownwood, Brown Co.

The U. S. Geol. Survey at present treats Capps ls. as top memb. of Mineral Wells fm., the upper fm. of Strawn group, and does not use *Brownwood*.

Brownwood Canyon.

U. S. G. S. Bull. 191, p. 77, lists *Brownwood Canyon*, Dumble, 1890, Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii. On pl. 3 E. T. Dumble showed *Brownwood-Canyon div.* underlying Waldrip-Cisco div. and overlying Milburn-Strawn div. On p. lxvii he called the rocks occupying the same strat. position the *Brownwood-Ranger series*.

Bruce series.

Pre-Cambrian (early Huronian): Western Ontario.

W. H. Collins, 1914 (Canada Geol. Surv. Mus. Bull. No. 8, p. 26). Includes (descending): Serpent qtzite, Espanola ls., Espanola graywacke, Bruce ls., Bruce cgl., and Mississagi qtzite.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Bruce limestone.

Pre-Cambrian (early Huronian): Western Ontario.

W. H. Collins, 1916 (Canada Geol. Surv. Mus. Bull. No. 22, p. 4). One of fms. of Bruce series.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Bruce conglomerate.

Pre-Cambrian (early Huronian): Western Ontario.

W. H. Collins, 1916 (Canada Geol. Surv. Mus. Bull. No. 22, p. 4). One of fms. of Bruce series.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Brule formation (also **Brule clay**).

Oligocene (upper and middle): Western Nebraska and South Dakota, northeastern Colorado, eastern Wyoming.

N. H. Darton, 1898 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 736, 755–759). The White River beds in their extension from S. Dak. into Nebr. present some differences in strat. range and relations. They expand considerably and include, at top, beds which appear not to be represented in the typical regions. Accordingly, to afford distinct definitions for the members in Nebr. I have introduced the designation *Brule clay* and separated the underlying *Titanotherium* beds as *Chadron fm.* The Brule consists mainly of a hard, sandy clay, of pale-pink color. Thickness about 600 ft. in vicinity of Wyo. line, but diminishes greatly eastward; in vicinity of 103° mer. in NW. corner of Nebr. it is 320 ft. Has not been recognized E. of long. 101°30′, where it appears to sink beneath the surface in Platte Valley. Extends far to NE. in So. Dak.

Is upper fm. of White River group.

Mr. Darton stated (personal communication April 8, 1931) that he named this fm. for the Brule Indians, who once roamed over Pine Ridge Ind. Res. in southern S. Dak., where the fm. covers large areas, and that it is not present in Brule Ind. Res., which occurs farther N. in S. Dak.

Brule schists.

Brule volcanics.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Iron River district).

R. C. Allen, 1910 (Mich. Geol. and Biol. Surv. Pub. 3, geol. ser. 2, p. 34). *Brule volcanics.*—On fresh fracture, dense, fine-grained, and grayish green. Contain ellipsoidal greenstone and green schists equiv. to Quinnesec schists of Menominee dist. [In table on p. 33 this fm. in Iron River dist. is called *Brule schists.*]

Named for exposures N. and S. of Brule River.

According to C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52), the volcanic rocks along Brule River are probably Quinnesec schist.

Brunner sand.

A subsurface sand of Penn. age, 10 to 35 ft. thick, lying at 3,018 to 3,200 ft. depth and 300 to 370 ft. above Cromwell sand, in Cromwell oil field, Okla. Lies higher than Harjo sand, which lies 175 to 250 ft. above Cromwell sand.

Bruno limestone. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., pp. 38, 40). [See definition under *Blue Springs sh.*]

Brunswick shale. (In Newark group.)

Upper Triassic: New Jersey and southeastern Pennsylvania.

H. B. Kümmel, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, pp. 47–55, and Jour. Geol., vol. 5, pp. 547–549). *Brunswick shales.*—Soft shales with a few ss. layers. Chiefly red, but a few purple, green, yellow, and black layers occur in lower 1,000 ft. and at higher horizons. Massive qtzite cgl. beds occur along NW. border of fm., a part of which are correlatives of Brunswick shales. Thickness 12,000 ft. Grade into underlying Lockatong series [fm.]. Top fm. of Newark system [group]. Well exposed in valley of Raritan, particularly near New Brunswick, N. J.

Brunswick conglomerate. (In Newark group.)

Triassic (Upper): Eastern Pennsylvania (Lehigh County).

E. T. Wherry, 1914 (Anniversary history of Lehigh County, by B. L. Miller, vol. 1, chap. 1, p. 8). *Brunswick cgl.*—Pebble rocks, breccias, and cgls. underlying Brunswick sh. Included in Triassic. Deposited at mouths of rivers.

A. I. Jonas, 1917 (Am. Mus. Nat. Hist. Bull., vol. 37, p. 178). *Brunswick cgl.*—Coarse-grained, variegated, reddish purple cgl., with quartz and ls. pebbles, which weather out of matrix, producing a cellular rock; associated with the cgl. is a vitreous red qtzite. Underlies Brunswick sh. Outcrops in region adjoining Boyertown hills [Berks Co.?].

The Brunswick fm. (chiefly sh.), in SE. Pa., as in N. J., rests on Lockatong fm., or, where that fm. is absent, on Stockton fm.

Brush formation.

C. Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 301). *Brush fm.*—Shales and sss., 100 ft. thick, uncon. beneath Dakota ss. and overlying Junction lss. A middle fm. of Flaming Gorge series in Utah. Assigned to late Jurassic [but Keyes also stated that it may correspond to Fuson fm., which is Lower Cret. Derivation of name not stated.]

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 40), these shales are Morrison fm. and Summerville fm. (both Upper Jurassic).

Brush Creek limestone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 34). *Brush Creek ls.*—Frequently seen along Brush Creek, Cranberry Twp, Butler Co., Pa., for which it is named. In places it is a black calc. sh. 4 to 5 ft. thick; again it is a very compact ls. 1 to 2 ft. thick. Often has a peculiarly slaty and aren. aspect, and sometimes contains so much iron as to be used as an ore. Underlies Buffalo ss., from which it is in places separated by thin sh., and lies 10 to 15 ft. above Brush Creek coal.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 303–305). *Brush Creek ls.* is same as Philson ls. of Somerset Co. [which has priority].

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Brush Creek (Summit) ls.* underlies Brush Creek fire clay.

According to modern repts of U. S. Geol. Surv. and Pa. Geol. Surv. the Brush Creek ls. lies higher in Conemaugh fm. than Brush Creek coal. In Ohio this bed is a fossiliferous calc. marine sh. and is called *Brush Creek sh. memb.*

Brush Creek sandstone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Allegheny County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 305–308). *Brush Creek ss.*—Lies 12 ft. below Brush Creek ls. and above Brush Creek coal.

Brush Creek clay. (In Conemaugh formation.)

Brush Creek fire clay. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Brush Creek fire clay* underlies Brush Creek coal and overlies Brush Creek (Summit) ls.

According to U. S. G. S. folios of SW. Pa. and recent repts of Pa. Geol. Survey, the Brush Creek ls. lies higher in section than Brush Creek coal and the Brush Creek clay immediately underlies Brush Creek coal.

Brush Creek shale. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia and western Maryland.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 309). *Brush Creek sh.*—Dark or black sh., 3 to 10 ft. thick, containing marine fossils in upper half and fossil plants in basal part. Underlies Brush Creek ls. and overlies Brush Creek coal.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied *Brush Creek sh.* to a sh. lying a short distance below Brush Creek ls. and resting on Brush Creek coal in Upper Youghiogheny Valley, Md.

Brush Creek fire clay shale. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 315). *Brush Creek fire clay sh.*—Contains layers of ferriferous ls. Underlies Brush Creek coal and overlies Upper Mahoning ss. Thickness 4 ft.

Brush Creek red bed. (In Conemaugh formation.)

Pennsylvanian: Southern Pennsylvania.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 58, pl. 6, pl. 7). *Brush Creek red bed.*—A red bed which in part of Somerset, Pa., area replaces Brush Creek sh., which overlies Brush Creek ls. and underlies lower bench of Buffalo ss.

Brushy Basin shale member (of Morrison formation).

Upper Jurassic: Southeastern Utah (San Juan County).

H. E. Gregory (U. S. G. S. P. P. 188, in press). *Brushy Basin sh. memb.*—Brightly banded shales, thin lss., cgls., and sss. forming top memb. of Morrison fm. in San Juan country. Thickness 350 to 470 ft. Dinosaur remains. Overlies Westwater Canyon ss. memb. Well exposed in Brushy Basin, San Juan Co.

Brushy Creek sandstone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Saline County).

G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 256–258). *Brushy Creek ss.*—A cuesta-forming ss., about 25 or 30 ft. thick, lying 100 to 125 ft. above base of McLeansboro fm. Lies lower than Galatia ss. and higher than Anvil Rock ss. Exposed on N. flank of ridge along Brushy Creek at Town Hall near center of Brushy Twp, and at other places.

†Brushy Creek chert.

Middle Devonian (Onondaga): Southeastern Oklahoma (Ouachita Mountains).

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 30). [In Arbuckle uplift column of correlation chart on p. 30 the name *Brushy Cr. chert* appears opposite Middle Dev., 1,000 ft., and is shown as resting conformably on Bois d'Arc ls. and uncon. underlying Woodford chert. On p. 19 reference is made to "the cherty beds on Brushy Creek, center W. side sec. 5 T. 2 N., R. 15 E," referred by Taff to top of his "Hunton" fm. On p. 27 the Brushy Creek section is described, but neither *Brushy Creek chert* nor *Brushy Creek cherty ls.* is used. On p. 33 is statement: "The Arkansas novaculite includes three distinct zones: The lower as determined by scant yet fairly conclusive evidence correlates with *Brushy Creek cherty ls.* mentioned on page 27."]

Named for exposures on Brushy Creek, Pittsburg Co., SE. Okla.

This is only known use of this name, which is preoccupied. Replaced by *Pinetop chert.*

†Brushy Mountain Measures. (In Pottsville group.)

Pennsylvanian: Southeastern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 149–153, 167, 169). *Brushy Mtn Measures.*—Shales and sss. including not less than 14 coal horizons, forming top div. of Coal Measures. Thickness 2,000± ft. Overlies Tracy City Measures in Brushy Mtns, where Bon Air Measures are also present beneath Tracy City Measures.

Divided into several fms. in U. S. G. S. Wartburg folio (No. 40), named (descending) Anderson ss., Scott sh., Wartburg ss., and Briceville sh.

Named for Brushy Mtn, Morgan Co.

Bruzer limestone.

Mississippian: Utah.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 37, table of geologic fms. in Utah). [Misprint for *Brazer ls.*]

†Bryant limestone.

Middle Ordovician: Central eastern Missouri.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 61). *Bryant ls.*—Compact, light-blue or gray, rather thin-bedded ls., with numerous sh. partings; somewhat fossiliferous, and presents marked contrast to underlying and overlying dolomitic lss. Thickness 125 to 150 ft. Underlies McCune ls. and overlies Folley ls. in Pike and Lincoln Counties.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), showed *Bryant ls.* of eastern Mo. as of Lowville age, as uncon. below Decorah sh., and as = upper part of Plattin ls.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2), showed Bryant ls.= Kimmswick and Plattin lss.

C. L. Dake, 1922 (Pan-Am. Geol., vol. 37, No. 4, pp. 288–300), treated Plattin and Bryant as synonyms, as did C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 39, pp. 67–70).

See also under *Kimmswick ls.* and *McCune ls.*

Named for exposures along Bryant Creek, Lincoln Co.

Bryant Lake limestone.

Pre-Cambrian: New York (eastern Adirondacks).

H. L. Alling, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 798, 800). *Bryant Lake ls.* (here named for first time) is somewhat saccharoidal in hand specimen and contains considerable quartz, biotite, and feldspar. Thickness 20 to 40 ft. Underlies Catamount schist and overlies Swede Pond qtzite. [Derivation of name not stated and not indicated on map.]

Bryn Mawr gravel.

Pliocene (?): Southeastern Pennsylvania, northern Delaware, and northeastern Maryland.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 258–272, 277–278, 288, 296–309). *Bryn Mawr gravel.*—Oldest gravel of consequence in Phila. region. Readily distinguished from other gravels by peculiar materials composing it, and also by occurring at high elevations (325 to 450 ft.), in often isolated patches, capping the gneissic hills. Characterized by presence of sharp or partially rounded fragments of a hard, heavy iron ss. or cgl., often covered by a brownish black iron glaze. One tract of this gravel extends from Bryn Mawr to near Cooperstown. Is 10 ft. thick. Is same as Mount Holly cgl. of N. J. Rests on decomposed gneiss.

W. B. Clark, H. B. Kümmel, and B. L. Miller, 1909 (U. S. G. S. Philadelphia folio, No. 162, p. 12). *Lafayette fm.* (Plio. ?) displaces "Bryn Mawr gravels."

Later work proved that at Lafayette type loc., near Oxford, Miss., the beds designated *Lafayette* are of early Eocene (Wilcox) age, and that the name has been applied to beds of Cret. and other ages. *Lafayette fm.* was therefore abandoned by U. S. Geol. Survey in 1916.

F. Bascom, 1924 (U. S. G. S. P. P. 132H). The name *Brandywine fm.* is here restricted to the late or low-level Brandywine deposits, of probable Pleist. age, and name *Bryn Mawr gravel* is revived for the high-level or early terrace gravels previously included in Brandywine fm. The deposit at Brandywine lies at 200 to 300-foot level; the Bryn Mawr gravel of Lewis lies at 390 to 480-foot level, and is same fm. for which *Bryn Mawr gravel* is here revived. Both fms. were included in "Lafayette" and "Appomattox" of former repts on this region. [These are present commonly accepted definitions of *Bryn Mawr gravel* and *Brandywine fm.*]

Bryson formation. (In Pottsville group.)

Pennsylvanian: Northeastern Tennessee and southeastern Kentucky.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 33, 44, 208, and Pl. XLA). *Bryson fm.*—Shales, sss., and coals, 0 to 200 ft. thick, lying above Red Spring coal (top memb. of Hignite fm.) on higher tops of Log Mtns and possibly on highest points of Black Mtns and Reynolds Mtn. Probably included in time interval of upper part of Kanawha fm.

Named for Bryson Peak, Claiborne Co., Tenn.

Bryson sand.

A subsurface sand, of Penn. age, in North Bryson field, Jack Co., north-central Tex., lying at 3,100 ft. depth.

Bucatunna clay member (of Byram marl).

Oligocene (middle): Southeastern Mississippi (Clarke and Wayne Counties) and southwestern Alabama.

B. W. Blanpied et al, 1934 (11th Ann. Field Trip Shreveport Geol. Soc., charts, pp. 3, 4, 12–16, etc.). *Bucatunna memb. of Catahoula group.*—Cross-bedded sands, clays, bentonitic clays and bentonite, sparingly fossiliferous, forming basal 20 to 55 ft. of Catahoula group (Mio.) in Clarke and Wayne Counties. Rests uncon. on Byram marl and older fms. of Vicksburg group. Underlies Lower Chickasawhay memb. of Catahoula group. Type loc. along Bucatunna Creek N. of Denham P. O., which is located in sec. 19–8 N.–5 W., Wayne Co., Miss. The Bucatunna is provisionally assigned to Mio. Is evidently in part marine.

C. W. Cooke, 1935 (A. A. P. G. Bull., vol. 19, No. 8, pp. 1162–1172). *Chickasawhay marl* and *Bucatunna clay* of Blanpied are accepted as *members of Byram marl* (of Vicksburg group, Olig.), in which fm. the beds thus designated have heretofore always been included.

Buchanan gravel.

Pleistocene: Eastern and central Iowa.

S. Calvin, 1896 (Iowa Acad. Sci. Proc., vol. 3, pp. 58–60). *Buchanan gravels.*—Interglacial deposit in Buchanan Co., Iowa, consisting of cross-bedded sands and gravels, 15 to 20 ft. thick, the gravels made up of materials derived from Kansan drift. Overlain by Iowan drift.

Later studies by W. C. Alden and F. Leverett showed that the gravel was deposited in Kansan time and was weathered in Yarmouth, Illinoian, and Sangamon time.

G. F. Kay and E. T. Apfel, 1929 (Iowa Geol. Surv. vol. 34, pp. 258–259). *Buchanan interval* includes Yarmouth, Illinoian, and Sangamon time.

Named for Buchanan Co.

Buchanan sands.

Subsurface sands in Pottsville fm. (Penn.) and in Chester group (Miss.) of Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Buchanan Hill conglomerate.

Devonian or Carboniferous: Northwestern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 1489–1536). Sub-Olean cgl. is = *Buchanan Hill cgl.*, a flat-pebble cgl. that caps Buchanan Hill, in Pa., just S. of N. Y. line.

Buchans series.

Cambrian or Ordovician: Newfoundland.

W. H. Newhouse, 1931 (Econ. Geol., vol. 26, p. 401).

Buck tongue (of Mancos shale).

Upper Cretaceous: Central eastern Utah and western Colorado (Book Cliffs field).

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). A westward-pointing tongue of Mancos sh., 0 to 350 ft. thick, which in part of area [btw. Sunnyside and Colo. State line] wedges in btw. Sego and Castlegate ss. members of Price River fm., of Mesaverde group. Not recognized NW. of Beckwith Plateau. Carries marine invertebrates of Lewis age. Named for Buck Canyon, T. 19 S., R. 23 E., Utah.

This name first appeared in print in U. S. G. S. Bull. 851, 1934, by C. E. Erdmann, in a rept on E. part of Book Cliffs coal field, where he treated the Buck tongue of Mancos sh. as underlying Sego ss. and overlying Castlegate ss., and gave its thickness as 360 ft. (See also 1932 correlation chart of Utah, compiled by M. G. Wilmarth.)

Buckbee oil zone.

Subsurface beds, of Plio age, encountered in wells in Santa Fe Springs oil field, Los Angeles Co., Calif., that lie lower than Nordstrom oil zone and higher than O'Connell oil zone.

Buck Creek formation.

Pennsylvanian: Central northern and northeastern Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 78). *Buck Creek fm.* proposed by K. C. Heald in unpublished ms. Consists of lss., shales, and sss. extending from top of Pawhuska fm. to base of overlying Grayhorse ls. memb. of Sand Creek fm. Thickness 175 ft.

Named for exposures along Buck Creek in NE. part of Osage Co. The other Buck Creek in Osage Co. also cuts through the fm.

Buck Creek sandstone.

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 162). The lower water-bearing sand in Millsap Lake fm. lies 500± ft. below top of Brazos River ss., and in interval btw. Brannon Bridge and Barton Creek lss. The rock is coarse-grained, porous, highly permeable, about 25 ft. thick, and appears to be a fairly persistent layer that carries water of good quality. It outcrops on Buck Creek in SW. part of Parker Co., and is here named *Buck Creek ss.* It lies 200± ft. lower than Dobbs Valley ss.

Buckeye shale. (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12). [See under *Carlton ls.*]

†Buckhorn limestone.

Mississippian (lower): Central northern Utah (Ophir district).

F. M. Wichman, 1920 (Eng. and Min. Jour., vol. 110, No. 12, p. 563), mentioned "an important ls. bed below Gardner dol., in Ophir mining dist., which is apparently not represented in Tintic dist." "It is locally called the *Buckhorn*." Is a fine to medium-grained, nearly pure ls., which has been the source of considerable ore. Average thickness 30 ft.

S. G. Olmstead, 1921 (Econ. Geol., vol. 16, pp. 438, 442, 449, 453). Middle memb. of Ajax fm. (Lower Ord.) of Ophir mining dist. is locally known as *Buckhorn ls.* It is 30 ft. thick.

J. Gilluly, 1932 (U.S.G.S.P.P. 173, p. 143). Most of production within Madison ls. of Ophir Hill area has been derived from two beds, one at base, the other about 40 ft. higher. The lower part of Madison ls., including these beds, is locally called *"Buckhorn" ls.*

Buckingham gneiss.

Pre-Cambrian: Quebec.

M. E. Wilson, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 202).

Buck Lodge diabase.

Upper Triassic: Central northern Maryland.

C. R. Keyes, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 320). [*Buck Lodge diabase* is shown as a dike lying E. of Sugarloaf Mtn, Md.]

Buck Mountain moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County). On E. base of Buck Mtn. See N. Y. State Mus. Bull. 187, 1916.

Buck Point sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

F. R. Clark, 1918 (U.S.G.S. Bull. 686, I, p. 94). *Buck Point ss.*—Lies 95 to 115 ft. stratigraphically below top of Revard ss. Together with underlying sh. it is well developed at Buck Point and elsewhere around edges of main divide btw. Sand and Buck Creeks in T. 26 N., R. 11 E. On N. side of Buck Creek in secs. 2, 3, and 4, it is characterized by a thin productoid-bearing stratum at top, which is easily traceable and insures definite correlations. The ss. is 45± ft. thick and forms a prominent bench with a vertical cliff below. Is easily traced, but over greater part of area its only distinctive characteristic is presence of a calc. conglomeratic bed at or near base, which at many places is associated with

Fusulina-bearing sand. Except for a thin sh. immediately overlying the Buck Point, the interval btw. Revard and Buck Point sss. is occupied principally by ss.; in a few places the entire interval is sand. [See 2d entry under *Revard ss. memb.*] Below Buck Point ss. is a sh., which at Buck Point is 75± ft. thick and which occupies approx. same strat. position as the sh. below Bigheart ss., but the Buck Point and Bigheart sss. are not continuous and probably not at exactly same strat. horizon. They are therefore given different names.

Buckrange sand lentil (of Ozan formation).

Upper Cretaceous (Gulf series): Southwestern Arkansas.

C. H. Dane, 1926 (U. S. G. S. Press Bull. 8823, Sept. 10). *Buckrange sand lentil.*—Sandy marl or marly sand, 3 to 15 ft. thick, containing as much as 50 percent of coarse glauconite grains. Is basal part of Ozan fm. in Sevier, Howard, and Hempstead Counties. Grades into overlying marl of Ozan fm. Outcrops short distance N. of village of Buckrange, Howard Co., also 1 mi. NE. of village, on road to Nashville. Thins to E. [See also Dane, Ark. Geol. Surv. Bull. 1, 1929, p. 59.]

†Buck Ridge gneiss.

Pre-Cambrian: Southeastern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 80–91, 118). *Buck Ridge gneiss* (also called syenite in Hall's repts C_5 and C_6).—Syenite gneiss forming Buck Ridge.

According to G. W. Stose (personal communication Dec. 23, 1936) the gneiss that forms Buck Ridge is Baltimore gneiss.

Bucks Bridge mixed beds.

Lower Ordovician (Beekmantown): Northern New York (Saint Lawrence Valley).

G. H. Chadwick, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 289–291). *Bucksbridge mixed beds or fm.*—Approx.=Tribes Hill. Thickness 50 to 70 ft. Uncon. underlies Upper Beekmantown (Ogdensburg) dol. and uncon. overlies Heuvelton ss. Characterized by *Palæophycus beverlyensis* and a lower Beekmantown or Tribes Hill fauna, but as beds differ lithologically from that fm. in Mohawk Valley, exact equivalency is not yet proved and temporary designation *Bucks Bridge* is used.

In 1916 (N. Y. State Mus. Bull. 191) H. P. Cushing applied *Tribes Hill fm.* to beds beneath Ogdensburg fm. in St. Lawrence Valley; but in 1920 (N. Y. State Mus. Bull. 217, 218) Chadwick still called the beds *Bucks Bridge mixed beds.* He described them as consisting of 50 to 75 ft. of dol. and ss.—a white sandy mass, considerably more calc. than underlying Heuvelton ss., passing gradually upward into heavy, dark siliceous dolomites with only rare ss. layers, and these in turn becoming more quartzose as summit is approached. He also stated: "The Bucks Bridge beds are approx. what has been called *Tribes Hill* in Jefferson Co. Fauna is essentially same throughout and distinct lithologically and faunally from fms. above and below and from Tribes Hill fauna of Mohawk Valley. Hewittville calcilutites are tentatively included in fm., at top." Appears to be named for Bucks Bridge, on Nettle Creek.

J. C. Reed, 1934 (N. Y. State Mus. Bull. 297), used *Buck's Bridge mixed beds* for the rocks underlying Ogdensburg dol. and overlying Heuvelton ss. in Potsdam quad. He assigned latter fm. to "probably Camb.," and the *Ogdensburg* and *Buck's Bridge* to Ord., and listed fossils of latter.

†Buckskin limestones.

Descriptive term applied locally to lss. of Dev. age in central Colo. (Gunnison-Chaffee County region), because they weather to a peculiar yellow color resembling buckskin.

Buda limestone. (In Washita group.)

Lower Cretaceous (Comanche series): Southeastern Texas.

T. W. Vaughan, 1900 (U. S. G. S. Bull. 164, p. 18). *Buda ls.*—Hard, whitish or yellowish ls., weathering yellowish or pinkish. Thickness 100 ft. Top fm. of Lower Cret. (Comanche series). Overlies Del Rio clays. Replaces *Shoal Creek ls.*, preoccupied.

Top fm. of Washita group in southern central and eastern Texas. Overlies Del Rio clay and underlies Eagle Ford sh.

Named for Buda, Hays Co.

Buell Run sand.

A subsurface sand in Conemaugh fm. of SE. Ohio that is said to probably be same as Buffalo ss. memb. Encountered in wells along Buell Run, SW. of Elba, Aurelius Twp, Washington Co.

Buena Suerte formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 335).

Buena Vista sandstone member (of Cuyahoga formation).

Mississippian: Southern Ohio and north-central Kentucky.

E. Orton, 1874 (Ohio Geol. Surv. vol. 2, pt. 1, pp. 615, 618, 626). *Buena Vista quarries* (also *Buena Vista stone*).—Series of quarry sss. 10 ft. thick, separated from underlying Waverly black sl. by 35 to 50 ft. of blue shales in Ross and Pike Counties, Ohio. Have been called *Waverly brownstone*.

C. S. Prosser, 1904 (Am. Geol., vol. 34, pp. 336–343). *Buena Vista memb. of Cuyahoga fm.* as here redefined consists, at Lithopolis, Fairfield Co., Ohio, of 49⅛ ft. of alternating sss. and shales, including, 5 ft. above the base, the "City Ledge," 2 ft. 10 in. thick, and 45±ft. of beds above the "City Ledge." Overlies Sunbury sh. By some *Buena Vista* has been restricted to "City Ledge." I erroneously so used it in 1902.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, p. 761). *Buena Vista memb. of Cuyahoga fm.* is restricted [?] to "City Ledge." It consists of 1 to 30 ft. of sss. underlying Rarden sh. memb. and overlying Henley sh. memb. (5½ to 226 ft. thick). [This is present approved definition.]

W. Stout and R. E. Lamborn, 1924 (Ohio Geol. Surv., 4th ser., Bull. 28, p. 358), divided Cuyahoga into (descending) Black Hand cgl., Raccoon sh., and *Buena Vista sss.*, the latter overlying Sunbury sh.

Named for Buena Vista, Scioto Co., Ohio.

†Buena Vista shale.

Lower and Middle Cambrian: Central western Virginia.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). *Buena Vista sh.*—Bright variegated sh. Red bands predominate, but green, yellow, and brown colors are common. In lower part mottled blue ls. beds alternate with the sh., and it passes by succession of sh. and ls. beds into underlying Sherwood ls. Thickness 600 to 900 ft. Underlies Natural Bridge ls. Named for Buena Vista, Rockbridge Co.

Name is preoccupied and fm. is now considered same as Watauga sh., and is called by that name.

Bufa sandstone.

Cretaceous or Tertiary: Mexico.

C. W. Botsford, 1909 (Eng. and Min. Jour., vol. 87, p. 692).

Buffalo sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 33). *Buffalo (Upper Mahoning) ss.*—Thickness 60 to 80 ft. Underlies Pine Creek ls. and is separated from underlying Brush Creek ls. by 0 to thin layer of sh. Attains max. development along Buffalo Creek, in Buffalo Twp, Butler Co., Pa. Was included in Mahoning ss. of

First Survey, but as there is a massive ss. coming below this, to which term *Mahoning* has always been applied, it is clear that one or other should have a distinct name, for the two rocks are always distinct, and never merge into one mass. Both sss. occur on Mahoning Creek. The name Mahoning is here restricted to the lower ss.

Buffalo shale.

Upper Ordovician and basal Silurian: Northeastern Missouri and southwestern Illinois.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 61). *Buffalo sh.*—Fossiliferous shales, 60 ft. thick, forming top memb. of Ord. in Pike Co., Mo. Generally considered as representing Maquoketa shales of NE. Iowa and Cincinnati shales of Ohio, but doubtful whether they occupy same strat. position. Underlies Noix oolite and overlies McCune ls.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 356; Ill. Geol. Surv. Extract from Bull. 23). Blue sh. at top of Ord. in Jersey, Calhoun, and Pike Counties, Ill., and Pike, Lincoln, and Ralls Counties, Mo. In Ill. has been correlated with Maquoketa sh. In Mo. has been called *Hudson River sh.* and *Buffalo Creek sh.* Upper part corresponds to Orchard Creek sh. of southern Ill. Uncon. underlies Sil.

In later papers (1914, 1915, 1917) C. [R.] Keyes defined *Buffalo sh.* as underlying Girardeau ls. and overlying Thebes ss. The Maquoketa sh. is of Richmond age and is included in Ord. by most geologists. The Orchard Creek sh. is now classified by Savage as post-Richmond and assigned to basal Sil.

Named for Buffalo Creek, Pike Co., Mo.

Buffalo shales. (In Conemaugh formation.)

Pennsylvanian: Near Pittsburgh, Pa.

T. K. Adams, 1903 (Mines and Min., vol. 23, p. 350). *Buffalo shales,* 60 ft. thick, lie btw. Pine Creek ls. and Brush Creek coal.

Buffalo glacial stage.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 328–336). *Buffalo stage,* represented by oldest glacial deposits (called *Buffalo drift*) in central western Wyo., which occur as remnants on flat-topped divides or isolated hills, or on spurs along valley slopes. Named for occurrence of the drift along Buffalo Fork of Snake River.

E. Blackwelder, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865–922) correlated this drift with Kansan glacial stage.

Buffalo granite.

Pre-Cambrian: Central southern Virginia (Mecklenburg County).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, p. 36, map). *Buffalo granite.*—Small masses or areas of a coarse porphyritic intrusive granite, with very large feldspar phenocrysts, which occurs in Redoak granite in vicinity of Buffalo Lithia Springs, Mecklenburg Co., Va. Is light gray, coarse-grained, and differs from main granite masses of Virgilina dist. very little except in texture.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. geol. map of Va.). *Buffalo granite porphyritic facies* of Red Oak granite. Is of pre-Camb. age and intrusive into Glenarm series (Algonkian?).

†Buffalo cement bed.

Silurian: Western New York.

G. H. Chadwick, 1917 (see 19[illegible] entry under *Bertie ls. memb.*). [In 1919 (Canada Geol. Surv. Mem. 111, pp. 93–94) Chadwick replaced this preoccupied name with *Williamsville waterlime and sh.* It is top bed of Bertie ls. memb. of Salina fm. at Buffalo, N. Y.]

Buffalo moraine.

Pleistocene (Wisconsin stage): Western New York and southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), 1913, p. 17. Named for Buffalo, N. Y.

Buffalo group.

Ordovician: Arkansas.

See under *Big Buffalo series.*

Buffalo formation. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Punxsutawney quadrangle).

G. H. Ashley, 1926 (Topog. and Geol. Atlas Pa. No. 65, Punxsutawney quad., pl. 4, pp. 24–25). *Buffalo fm.* includes beds btw. top of Brush Creek coal and base of Bakerstown coal.

M. E. Johnson, 1929 (Topog. and Geol. Atlas Pa. No. 27). *Buffalo memb.* (of Conemaugh fm.) includes all beds btw. top of Pine Creek [Cambridge] ls. and base of Brush Creek coal and red beds, including Buffalo ss. and Brush Creek ls.

Buffalo Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 384). *Buffalo Creek bed.*—Clay, 125 ft. thick; lower part in places slightly shaly, sandy, and of blue color; middle and upper parts of blue, purple, and yellowish color. Memb. of Strawn div. Underlies Wilbarger Creek bed and overlies Rough Creek bed.

Named for Buffalo Creek, Mills Co.

†Buffalo Creek sandstone member (of Conemaugh formation).

Name applied by G. H. Ashley, 1908 (Pa. Topog. and Geol. Surv. Comm. Rept. 1906–8, p. 161), to Buffalo ss memb. of Conemaugh fm.

Buffalo Creek shale.

See 1913 entry under *Buffalo sh.* (Upper Ord. and Sil.).

Buffalo Creek limestone. (In Kanawha formation.)

Pennsylvanian: Southwestern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 143). *Buffalo Creek ls.*—Hard, brittle, bluish gray, marine, fossiliferous ls., 0 to 15 inches thick. Separated from overlying Buffalo Creek coal by 35 to 80 ft. of fire clay and sh. Underlain by Upper Winifrede ss. Named for association with Buffalo Creek coal.

Buffalo Hart moraine.

Pleistocene (Wisconsin stage): Central western Illinois (Sangamon and Logan Counties). See U. S. G. S. Mon. 38, pp. 74–76. Named for Buffalo Hart, Sangamon Co., by F. Leverett. In 16th Int. Geol. Cong. Guidebook 26, 1932, M. M. Leighton and G. E. Ekblaw stated, regarding the term *Buffalo Hart moraine* as used by them: "Leverett applied the name *Buffalo Hart* to a prominent portion of the moraine, and that name has been adopted for the whole moraine."

Buffalo Hill sandstone. (In Clear Fork group.)

Permian: Central and central northern Texas (Taylor and Runnels Counties).

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, opp. p. 96). *Buffalo Hill sss.* consist of two thick sss. separated by sh., and lie 80± ft. above base of Tye fm. (basal memb. of Clear Fork beds in Taylor and Runnels Counties). [Derivation of name not stated.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). *Buffalo Hill ss.* is here included in Vale fm. It lies near base of Clear Fork group. Named for Buffalo Hills, Taylor Co.

Buffalo Peaks andesite.

Tertiary: Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 900, 990, 999, 1000). *Buffalo Peaks andesite*, extrusive, lies on truncated surface of Paleozoic strata (Perm.) affected by the syncline extending northerly from valley of Trout Creek in sec. 3, T. 14 S., R. 77 W., past Pony Spring, to NE. spur of Buffalo Peaks in Salt Creek area, Park and Chaffee Counties.

Buffalo River series.

Ordovician: Arkansas.

See under *Big Buffalo series.*

†Buffalo Run limestone.

Upper Cambrian: Central Pennsylvania (Center County).

C. D. Walcott, 1916 (Smithsonian Misc. Coll., vol. 64, No. 3, Pub. 2370, p. 165). *Buffalo Run ls.*, a provisional name suggested by E. F. Moore, from which a new species of Upper Camb. fossil was collected 2 mi. N. of Benore P. O., Center Co.

The bed mentioned probably refers to Warrior ls., 1,250 ft. thick, defined by C. Butts in 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523–537).

Buffalo Wallow formation. (In Chester group.)

Mississippian: Western central Kentucky (Breckinridge County) and southern Indiana.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., p. 112). *Buffalo Wallow fm.*—Chiefly soft bluish sh., but includes beds of red sh., ls., and ss., which altogether compose a subordinate part of mass. Thickness 150 to 200 ft. in Breckinridge Co. Greater part seems=Clore fm., but Menard ls. seems certainly represented and Palestine ss. may be represented. Overlies Tar Springs ss. Named for Buffalo Wallow, a cirquelike excavation in the characteristic shales of the fm. on highway 2 mi. W. of Cloverport.

Buff Bay beds.

Pleistocene or Pliocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 84).

Buffkin formation.

Pennsylvanian: Indiana.

See 1935 entry under *St. Wendell ss.*

†Buhrstone.

†Buhrstone formation.

Eocene (middle and, in S. C., upper): Mississippi, southern Alabama, Georgia, South Carolina.

John Finch, 1824 (Am. Jour. Sci., 1st, vol. 7, p. 38). The siliceous ls. or Buhrstone of Ga. is a fm. decidedly contemp. with above mentioned stratum [Calcaire Silicieuse of Paris basin], although the principal part of the celebrated mill-stones are from a rock higher in the series, the Meuliere sans coquilles, yet some are obtained from the Calcaire Grossier; and to this stratum and the C. Silicieuse I consider the Ga. Buhr stone allied, both by similarity of mineralogical character and nature of fossil remains.

M. Tuomey, 1848 and 1850 (Rept. on geol. of S. C., pp. 140–154, 211, 1848, and accompanying map, dated 1845; Ala. Geol. Surv. 1st Bien. Rept., p. 147, 1850). *Buhrstone fm.*—Thick beds of sand, gravel, grit, clay, and buhrstone, amounting to at least 400 ft., and underlying the calc. beds. Its upper portions are characterized by beds abounding in silicified shells, for most part identical with Claiborne fossils, which has given the name to the fm. [According to C. W. Cooke (personal communication, 1933) the †Buhrstone fm. of Tuomey, 1848, included practically all siliceous Eocene deposits in S. C.]

Nongeographic name. Replaced by *Tallahatta fm.* in Ala. and Miss. and by *McBean fm.* and *Barnwell sand* in eastern Ga. and S. C. See further explanation under †*Choctaw buhrstone* and *Tallahatta fm.*

Bulger limestone bed. (In Monongahela formation.)

Pennsylvanian: Southwestern Pennsylvania (Washington County) and eastern Ohio.

W. T. Griswold and M. J. Munn, 1907 (U. S. G. S. Bull. 318, pp. 38–39, 70+). *Bulger ls.*—At Bulger, Washington Co., it consists of solid brown ls., 1 to 2 ft. thick, breaking with uneven fracture and showing a number of small calcite crystals. West of type loc., in Steubenville quad., it is a foot or more thick, of muddy brown color, and breaks with smooth fracture. Underlain by 20 ft. of green sh. and overlain by 15 to 20 ft. of coarse calc. sh. Lies about 55 ft. above Sewickley coal.

The Bulger ls. bed is uppermost part of Benwood ls. memb. of Monongahela fm. and lies 15 to 20 ft. below Uniontown ls. memb. in Claysville region.

Bulkley eruptives.

Tertiary or Cretaceous: British Columbia.

W. W. Leach, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 63).

†Bull ledge.

Pennsylvanian: Northwestern Missouri (Kansas City).

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). The lower (nonoolitic) bed of Drum ls. at Kansas City is known as "Bull ledge," and the upper bed as "oolite ledge."

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 40). So-called Drum ls. of Hinds and Greene at Kansas City is Westerville ls., the upper part of which is "Kansas City oolite," and lower (nonoolitic) part the "Bull ledge."

Bull slate.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 401). *Bull sl.*—Sl., usually purplish more or less mixed with green. Comparatively thin fm., of fine, even grain, smooth texture, and banding so faint that as a rule it does not affect the smoothness of the cleavage. Only a few ss. layers; occasionally a small bed of ls. in upper part. No fossils, but age is fixed by fossils in underlying ls. Underlies Beebe ls. and overlies Barker qtzite. Named for the quarry on Bull Hill, 2 mi. N. of Castleton [in Castleton quad.]. It is principal horizon that is worked for the purple and unfading green slates of sl. industry, the principal development of which is in region of Fairhaven, Vt., and Granville, N. Y., a few mi. SW. of Castleton.

Bulla conglomerate.

Miocene (lower): Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Bullard limestone.

A name applied by O. P. Peterson (Am. Inst. Min. and Met. Engrs. Trans., vol. 70, p. 915, 1924) to a ls., 5 to 20 ft. thick, in Bingham qtzite (Penn.) of Bingham dist., Utah. Lies 220 ft. below Parnell ls. and 400 ft. above Yampa ls.

†Bulla striata marls.

Pleistocene: Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 147, footnote, 157, 322, 336). To distinguish the Pleist. beds containing *Venus cancellata* and *Bulla striata* from the Plio. beds containing same species, the Pleist. beds might be called, from their most abundant fossil, the *Bulla striata marls.*

According to C. W. Cooke these beds are a part of Fort Thompson fm.

Bull Creek sandstone. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 3, pp. 374, 379). *Bull Creek ss.*—Sss., largely in flaggy layers 6 in. to 4 ft. thick; white on fresh surfaces, weathering grayish. Thickness 50 to 75 ft. Memb. of Strawn div. Overlies Horse Creek clays and shales and underlies Big Valley bed.

Named for Bull Creek, Mills Co.

Bull Creek limestone.

Pennsylvanian: Central northern Oklahoma (Osage County)

F. C. Greene, 1918 (A. A. P. G. Bull., vol. 2, p. 121). *Bull Creek ls.*—Well exposed on Bull Creek, in NW. part of T. 23 N., R. 11 E. It is 5 to 15 ft. thick and lies about 100 ft. above Peoples sand and 150 ft. above Stanton ls. Its characteristics N. of Bigheart are not known to writer. To SW. it can be identified in most logs of wells in vicinity of Hominy. Above it lies an interval of irregular shales and sss., 80 to 125 ft. thick, overlain by Wild Horse ls.

†Bull Face slate.

A metamorphic sl. in NW. Ga., called by the people *Bull Face sl.* (G. Little, Ga. Min., Geol., and Phys. Surv. Rept. Prog. Sept. 1 to Dec. 31, 1874, 1875). Is believed to be the sl. underlying Weisner qtzite.

†Bullhead waterlime.

†Bullhead limestone.

Descriptive terms that have been applied to Cobleskill dol. in western N. Y.

Bull Head Mountain sandstone.

Lower Cretaceous: Alberta and British Columbia.

F. H. McLearn, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 16).

Bull Hill gneiss.

Age (?): Southeastern Vermont (Windham County).

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., p. 221). *Bull Hill gneiss*, new name, is necessary because of rather wide distribution of the gneiss and its characteristic structure. Type loc. is on Bull Hill, E. to NE. of village of Grafton and N. of village of Cambridgeport. [In Saxtons River quad.] The hill reaches altitude of 1,580 ft. and is practically all gneiss. Also well exposed in NE. part of Grafton Twp. The gneiss is profoundly porphyritic; is cut by pegmatite veins. Also occurs near SE. corner of Chester. Structure and texture are markedly different from that of Reading gneiss. It appears to be an orthogneiss.

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., pp. 316–347). *Bull Hill gneiss*, acid intrusive, embraces only those gneisses that are pronouncedly porphyritic.

Bullion dolomite member (of Monte Cristo limestone).

Mississippian (lower): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 18, etc.). *Bullion dol. memb.*—Massive light-gray ls. now largely altered to cream-colored and white dol.; chert uncommon. Thickness 185 to 300 ft. Underlies Arrowhead ls. and overlies Anchor ls., all members of Monte Cristo ls. Named for Bullion mine, sec. 23, T. 25 S., R. 58 E. Few fossils (lower Miss.).

Bull Lake glacial stage.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 325–340). *Bull Lake stage.*—The next older moraines, which I have compared with early Wisconsin drift of Illinois, will be called *Bull Lake drift*, from locality of that name on N. slope of Wind River Range. Is later than Buffalo drift and earlier than Pinedale drift. Succeeded the Circle interglacial cycle and preceded the Lenore interglacial cycle. Correlated with early Wisconsin drift of Illinois.

E. Blackwelder, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865–922), correlated Bull Lake stage with Iowan stage.

Bull Lake Creek shales.

Cambrian: Western Wyoming (Wind River Mountains).

E. B. Branson, 1917 (Geol. Soc. Am. Bull., vol. 28, pp. 347–350), in several places referred to a shaly fm., 300 to 400 ft. thick, overlying Deadwood ss. and underlying *Shoshoni ls.* in Wind River Mtns, as *Bull Lake Creek shales* (apparently from Bull Lake Creek), and stated that *Bull Lake Creek* and *Shoshoni* were names used by writer in paper in preparation. This is only record of these names.

See also under *Death Canyon memb.*

†Bull Mountain series.

Eocene: Central southern Montana (Yellowstone County).

W. Lindgren, 1886 (U. S. Tenth Census, vol. 15, p. 745, pl. 60). *Bull Mtn series (Upper Laramie)*.—A succession of light-colored clays, soft, white, argill. sss., and heavy benches (10 to 30 ft. thick) of massive yellow ss. with rounded corners and faces and generally carrying round nodules of brown iron ore. Contains the more valuable lignite beds. Thickness 1,550 to 1,660 ft. in Bull Mtns and adjacent territory. Contains abundant fossil leaves and plants.

Approx. same as Fort Union fm., according to T. W. Stanton (personal communication).

Bull Pond limestone.

W. W. Mather, 1843 (Geol. N. Y., vol. 1, pl. 45). [*Bull Pond ls.* is shown on this geol. cross section from Monticello, Sullivan Co., to Croton River near Bulls Bridge, Westchester Co., N. Y.]

Bull Run shales. (In Newark group.)

Upper Triassic: Northeastern Virginia.

J. K. Roberts, 1923 (Pan-Am. Geol., vol. 39, pp. 185–200). *Bull Run shales*.—Shales forming youngest Triassic sediments of northern Va. Occupy middle of Triassic basin. Are younger than Manassas ss.

J. K. Roberts, 1928 (Va. Geol. Surv. Bull. 29, pp. 24–25, 38–43). Manassas ss. is for most part intercalated with *Bull Run shales*. Where not disturbed by faulting and not covered by Recent material or soil the Bull Run shales overlie Manassas ss. Almost the only rocks outcropping over Bull Run Battlefield are Bull Run shales, which vary from an extra fine to a relatively coarse and gritty nature, and include red, gray, blue, black, and decolorized shales.

A part of Newark fm.

Bullwagon dolomite. (In Clear Fork group.)

Permian: Central northern and central Texas.

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pl., pp. 96–97). *Bullwagon dol.*—Two distinct strata separated by a sh. or clay parting. Thickness 2 to 5 ft. Thins to N. until it cannot be identified with certainty 35 mi. N. of Tex. and Pacific Ry. Lies 360 to 370 ft. below Merkel dol. Named for Bullwagon Creek, Taylor Co.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816). *Bullwagon dol.* is 36 ft. thick on Colorado River, where it is represented by a number of thin dolomites and blue shales. Underlies Choza fm. and overlies Vale fm. [Other repts give thicknesses as great as 65 ft.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 176, 181). *Bullwagon dol.* here treated as top *memb. of Vale fm.*, the definition of Vale fm. being modified to that extent.

†Bully Hill volcanics.

Age (?): Northern California (Redding quadrangle).

J. S. Diller, 1905 (Am. Jour. Sci., 4th, vol. 19, pp. 380–385). *Bully Hill volcanics*.—Lavas interstratified with tuffs and shales. Of late Carbf. and early Triassic age.

†Bully Hill rhyolite.

Jurassic(?): Northern California (Redding quadrangle).

J. S. Diller, 1906 (U.S.G.S. Redding folio, No. 138). In Bully Hill region [Shasta Co.] the rhyolite is arranged in flows alternating with tuffs dipping SE. beneath the Pit shales, but in places it cuts lower part of Pit shales and envelops its fragments. For convenience all the rhyolites erupted in Redding quad. during deposition of Pit shales are included under term *Bully Hill rhyolite*, though they represent a considerable range of time. Bedded tuffs, composed largely of crystal fragments of quartz and feldspar, with a smaller proportion of glass and pumice particles replaced by quartz, are common among the Pit shales and are locally associated with sheets of rhyolite. Thickness about 500 ft.

Later work by L. C. Graton (U. S. G. S. Bull. 430, pp. 81–85, 1910) proved this fm. to be intrusive alaskite porphyry, and same as so-called "Balaklala rhyolite." Both geographic names have therefore been discarded as unnecessary. The rock cuts fms. as young as Pit sh. (Middle and Upper Triassic).

Bulwark sandstone.

Cretaceous: Alberta.

S. E. Slipper, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 8).

†Buncombe group.

Cambrian(?) and pre-Cambrian: Western North Carolina (Blue Ridge Province).

W. C. Kerr, 1869 (N. C. Geol. Surv. Rept. 2, pp. 13–35). *Buncombe group.*—Occupies larger part of great transmontane plateau btw. Blue Ridge and Smoky Mtns. Average breadth of fm. is about 25 mi., and since it is conspicuously developed across whole breadth of Buncombe Co. and may be seen in complete section along the French Broad in its course through that county, it will be in accordance with usage to call it *Buncombe group*. The rocks of this belt manifest an extreme degree of alteration and disturbance. They belong to general description of granitoid or gneissic rocks, and consist of various and recurrent successions of gneissoid slates, quartzose, feldspathic, micaceous, and hornblendic, with frequent beds of gneiss proper, and occasional interpolations of true granite. A large body of reddish porphoroidal feldspathic gneiss is found along NW. edge of the belt, as may be seen a little below Marshall on the French Broad and again in Yancey, some 4 mi. N. of Burnsville. Mica schist also occurs in large development toward E. margin of belt, as may be seen in Asheville and along Swannanoa valley to a point near the gap. The fm. is also characterized throughout its whole extent by frequent occurrence of isolated masses of mag. rocks, ophiolites, serpentines, soapstones, talcose and chloritic slates, with tremolite, asbestos, and actinolite rocks, generally associated with hornblende, sl., and syenite, and usually containing veins of chromic iron. The Buncombe group is limited southeastward by Linville slates.

The following fms. are exposed on French Broad River, in Buncombe Co., N. C. (descending order): (1) Soapstone, dunite, and serpentine; (2) metagabbro; (3) Roan gneiss; and (4) Carolina gneiss. But several other pre-Camb. fms. and many Camb. fms. are exposed in the plateau btw. the Blue Ridge and Smoky Mtns in N. C., as shown on N. C. correlation chart.

Bunger limestone member (of Graham formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). Top memb. of Bunger fm. [For description see 1919 entry under †*Bunger fm.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 129, 130, and charts). *Bunger ls. lentil.*—A ls. memb. of Graham fm. in Brazos River Valley. Underlies South Bend sh. and ss. memb. and overlies Gonzales Creek sh. memb.; all members of Graham fm. Thickness 2 to 8 ft. In places is dark yellowish brown, quite dense and heavy; in other places is light gray, impure, and massively bedded. Lies 60 [50 to 110] ft. below Gunsight ls. memb. Best exposed around N. and W. sides of big curve of Brazos River 5 mi. S. of Graham.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 221–223), used *Bunger ls.* in McCulloch Co., Colorado River Valley, and stated: The ls. called *Bunger* in Colorado River Valley occupies same strat. position as typical Bunger of Brazos River Valley, and agrees in lithology and fossils. But fact that it is a lentil in northern area would make it unlikely that the Bunger of Colorado River area is continuous with the Bunger of Brazos River area. It seems less confusing, however, to use same name for these beds (20 to 25 ft. thick in McCulloch Co.), which lie 50 to 70 ft. below top of Bluff Creek sh. memb. of Graham fm. and 52 to 68± ft. above base of the Bluff Creek memb.

Named for Bunger, Young Co.

†Bunger formation. (In Cisco group.)

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Bunger fm.*—Poorly bedded, lenticular, dark-brown sss. and sandy shales with a few thin lss. Locally, in section W of Finis, a dark carbonaceous sh. occurs near bottom of fm. Thickness 230± ft. Top memb. is named *Bunger ls.* It is a persistent ls., 2 to 4 [8] ft. thick; in places dark yellowish brown, dense, and heavy; in other places light-gray and coarsely crystalline. Bunger fm. underlies Gunsight fm. and overlies Jacksboro fm.

Is a part of Graham fm., adopted name.

Named for Bunger, Young Co.

Bunger sand.

A lenticular subsurface sand in upper part of Strawn group of Bunger dist., Young Co., central northern Tex. It lies about 750 ft. below Palo Pinto ls.

Bunker andesite.

Tertiary (Eocene): Central southern Colorado (Silver Cliff-Rosita region).

W. Cross, 1890 (Colo. Sci. Soc. Proc., vol. 3, pt. 3, p. 272) and 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 289). *Bunker andesite.*—Holocrystalline, fine-grained, massive andesite, carrying hornblende, augite, and biotite. Forms greater part of Rosita Hills. Occurs in Bunker Hill, Sugar Loaf, etc.

Bunker slate.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

Burbank member (of Cuyahoga formation).

Mississippian: North-central Ohio (Wayne County).

G. W. Conrey, 1921 (Ohio Geol. Surv., 4th ser., Bull. 24, p. 50). *Burbank memb.*—Basal memb. of Cuyahoga fm. in Wayne Co. Grayish blue shales and grayish buff sss. alternating; 150 ft. exposed. Underlies Armstrong memb. and overlies Sunbury sh. Named for Burbank, in N. part of Wayne Co.

Burbank sand.

A subsurface sand, in lower part of Cherokee sh. (early Penn.), 40 to 80 ft. thick in Burbank field, Osage and Kay Counties, Okla., where it lies at depth of 2,700 to 2,900 ft. Also occurs in Woodson, Cowley, Butler, Sumner and Greenwood Counties, Kans. Lies lower than Oswego lime (Fort Scott ls.). Has been called *Bartlesville sand*, but *Bartlesville* is now restricted to a sand lying 50 to 100 ft. lower, and *Burbank* (*Red Fork*) *sand* is now applied to this higher sand. The lower sand is now regarded as true Bartlesville.

†Burches Ferry marl.

Upper Cretaceous: Northeastern South Carolina and eastern North Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 14). *Burches Ferry marl.*—Buff-colored high grade marl; greensand marl. Is exposed in Florence Co., S. of Jeffries Creek, and thence along the Great Pee Dee to Topsaw Landing. Is interruptedly exposed along Lynches River from Old Effingham to its confluence with the Great Pee Dee; along Black Mingo from Indianfield Church to Black River; along Black River from Perkins Bluff to confluence of Black Mingo; along the Waccamaw from N. C. to a point near Conway. The uppermost Cret. fm. in S. C. Overlies Black Creek sh. and underlies Black Mingo sh.

Replaced by Peedee fm., the older name.

Named for exposures at Burches Ferry, on W. side of Peedee River, in Florence Co.

Burden conglomerate.

Ordovician: Eastern New York (Columbia County).

A. W. Grabau, 1903 (N. Y. State Mus. Bull. 69, p. 1034). *Burden cgl.*—Calc. cgl. in which the pebbles are chiefly ls. embedded in a siliceous sand, which in turn is held together by a more or less calc. cement. Age unknown. That it belongs to Hudson River series is undoubted, but whether older or younger than Normanskill shales has not been ascertained. No fossils found. May correspond to Trenton cgl. of Rysedorph Hill [Rysedorph cgl.] or it may be still earlier. Areal relations seem to indicate it is older than Normanskill beds of Mount Moreno.

A. W. Grabau, 1906 (N. Y. State Mus. Bull. 92, p. 302). Fragments of Burden cgl. are found scattered over Mount Becraft, and it also occurs at Burden iron mines, 5 mi. S. of Hudson. Its age is probably lower Champlainic [Lower Ord.].

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 36). Age of the Burden has not been definitely determined, but it is thought it may correspond to Rysedorph cgl.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 281). *Burden cgl.* is found near Becraft Mtn and other places in vicinity of Hudson within the Normanskill shales. No fossils have been found. It is thought it may be identical with Rysedorph cgl.

Burditt marl.

Upper Cretaceous (Gulf series): Central Texas (Travis County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 407, 441, 442, 449). *Burditt fm.* (p. 239), *Burditt chalk marl* (p. 407), *Burditt marl* (heading on p. 449).—Hill included this chalk marl with Austin chalk, and stated that top is transitional to the Taylor. Taff segregated the upper marly lime zone of Austin chalk, and considered it lithologically transitional to Taylor marl. This chalk marl is here called *Burditt*, from Burditt School, Travis Co., and type loc. is along Little Walnut Creek downstream from Austin-Cameron road, where the marl is 40± ft. thick. It is a light gray, somewhat shelly, calc. clay overlying the hard chalk (Austin chalk proper). Stephenson states the Taylor in McLennan Co. uncon. overlies the Austin, and that its base contains a phosphatic pebble zone. There appears to be no marked break in Travis Co., although a prominent layer of phosphatic nodules and fossils occurs in the Burditt near type loc.

According to L. W. Stephenson, 1937 (U. S. G. S. P. P. 186G), the beds called *Burditt marl* by Adkins are no more marly than other lower parts of Austin chalk elsewhere in Tex. If recognized as a separate lithologic unit it should be treated as an upper marly memb. of Austin chalk.

Burge sands member. (In Ogallala formation.)

Tertiary (upper Miocene or lower Pliocene): Northern Nebraska (Cherry County).

F. W. Johnson, 1936 (Am. Jour. Sci., 5th, vol. 31, pp. 467–473). It is proposed to call the extensive channel deposits that contain the "Burge fauna" (described by R. A. Stirton and P. O. McGrew, Am. Jour. Sci., 5th, vol. 29, pp. 125–132, 1935) the *Burge sands memb. of Ogallala fm.* Type loc. is Burge Quarry, on Snake River, SW. of Valentine, Cherry Co. The beds consist of unconsolidated, fine to coarse-grained, gray, cross-bedded, channel sands, often containing nodules and lenses of greenish clay; coarse sand and some gravel noted in nearly all exposures. Thickness 25 to 28 ft. at Burge Quarry; varies up to 30 ft. in other places. Overlain by "cap rock bed" (highly calc. grit), and in many places rest uncon. on greenish gray massive sands of upper part of Valentine beds. Burge sands and "cap rock bed" assigned to lower Plio., and Valentine beds to transitional Mio.-Plio. The beds and their fauna have been traced from Cherry Co. into Brown Co., by M. F. Skinner.

Burgen sandstone.

Middle or Lower Ordovician: Eastern Oklahoma.

J. A. Taff, 1905 (U.S.G.S. Tahlequah folio, No. 122). *Burgen ss.*—Massive, moderately fine-grained, light-brown ss., 5 to 100 ft. thick. Underlies Tyner fm.

J. A. Taff, 1906 (U.S.G.S. Muscogee folio, No. 132). No fossils have been found in *Burgen ss.* Its age is inferred from its strat. position. A study of St. Peter or "Saccharoidal" ss. in northern Ark. and Mo., with which the Burgen is correlated by Dr. E. O. Ulrich, caused him to class it as early Ord.

The U. S. Geol. Survey from 1915 to 1930 used *St. Peter ss.* instead of Burgen ss., Key ss., Saccharoidal ss., Crystal City ss., Pacific ss., Cap au Gres ss., etc. The Okla. Geol. Survey, however, has rather consistently adhered to the Okla. name *Burgen ss.* On 1926 Okla. geol. map, by H. D. Miser, this ss. was called *St. Peter.* C. N. Gould, in the text to accompany that map (Okla. Geol. Surv. Bull. 35, p. 55, 1925), used *St. Peter* ("*Burgen*") *ss.*, but stated that his preference was for the Okla. name *Burgen ss.*

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, pp. 30–31), showed *St. Peter or Burgen ss.* of NE. Okla. as = upper part of St. Peter ss. of Minn.

E. O. Ulrich, 1930 (Okla. Geol. Surv. Bull. 40QQ, pp. 11–12). I have long insisted Burgen ss. does not fall into the place to which it is usually assigned by Okla. geologists—that is about middle of the Simpson. It is either older than base of Simpson and of age of some part of Buffalo River series, or it is much younger—probably Black River. Fossil evidence is lamentably indecisive and goes little further than to prove Ord. age of the Burgen. I am, somewhat reluctantly, I confess, forced to conviction that the Burgen is a much younger deposit than St. Peter ss. and probably that it is represented in Arbuckle region by the ss. that is locally developed, especially on NE. flank of that uplift, at base of the Bromide and above the Criner. The sand probably was blown in from eroding surfaces of Buffalo River sss. on W. side of Ozark uplift, which we have every reason to believe was emerged at that time.

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ, p. 12). In view of indefiniteness of correlation of Burgen ss. the name *Burgen* should be applied to eastern Okla. beds rather than *St. Peter.* Ulrich's suggestion that the Burgen is basal ss. of Bromide fm. of Simpson group is not entirely out of line with subsurface evidence, but if writer's suggestion that lower Tyner is lower Simpson in age proves to be correct, the Burgen must be older than Ulrich suggests it to be. Possibly it is basal ss. of Oil Creek fm. of Simpson group.

In view of doubt that exists as to Burgen ss. being the same as St. Peter ss., the U. S. Geol. Survey now employs the local name *Burgen ss.* for the ss. underlying Tyner fm. in eastern Okla.

Named for Burgen Hollow, NE. of Tahlequah, Cherokee Co.

Burgen limestone.

Lower Ordovician: Central Oklahoma (Okfuskee County).

J. P. Boyle, 1929 (Okla. Geol. Surv. Bull. 40KK). *Burgen ls.*—A single ls. memb., 30 to 70 ft. thick, underlying Tyner sh. and overlying Burgen ss. throughout NE. Okla. Present over entire area of Okfuskee Co. [The original definitions of Tyner fm. and Burgen ss. (U.S.G.S. Tahlequah and Muscogee folios, Nos. 122 and 132, 1905 and 1906, respectively) do not mention any ls. in lower part of Tyner nor in Burgen ss.]

Burgess shale.

Middle Cambrian: British Columbia.

C. D. Walcott, 1911 (Smithsonian Misc. Coll., vol. 57, No. 3, p. 51).

Burgess oolite. (In Bangor limestone.)

Mississippian: Northwestern Alabama (Franklin and Lawrence Counties).

W. B. Jones, 1928 (Ala. Geol. Surv. Circ. 8, pp. 13–15). *Burgess oolite*, variable in thickness (0 to 40 ft.) and physical properties. Lies 200 ft. below top of Bangor ls. in Russellville dist. (Franklin Co. and W. part of Lawrence Co.). Overlain and underlain by blue fossiliferous lss. of Bangor ls. Type loc. at Burgess quarry, on a comparatively high hill 3 mi. E. of Russellville, Franklin Co., where it has its greatest thickness—at least 40 ft.

Burgess sand.

A subsurface sand of early (?) Penn. age in Okla. and southern Kans. Lies lower than Bartlesville sand. Thicknesses reported, 7 to 60± ft. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 180, this sand is of Miss. age.

Burgoon sandstone member (of Pocono formation).

Mississippian: Western Pennsylvania, northern West Virginia, and southeastern Ohio.

C. Butts, 1904 (U.S.G.S. Kittanning folio, No. 115, pp. 5, 6, sections). So far as exposed in this quad. the Pocono fm. is composed mainly of a heavy gray to greenish coarse, thick-bedded ss., the Mountain or Big Injun sand of the driller, which is here named *Burgoon ss.*, because it is cut through by valley of Burgoon Run, above Kittanning Point [Blair Co.]. No considerable exposures of the ss. were seen on valley walls, but on S. side abundant boulders of coarse siliceous ss. and a soil that is almost pure sand, indicates its presence close beneath the surface. Thickness 300 ft. Overlies red sh. (Patton sh. memb. of Pocono) and uncon. underlies Pottsville fm. in Kittanning quad., but in Burgoon type region (Blair Co.) and elsewhere the Burgoon is immediately overlain by Loyalhanna ls.

Burgoon group.

Mississippian: Pennsylvania.

J. D. Sisler, G. H. Ashley, and others. 1933 (Pa. Geol. Surv., 4th, Bull. M19, p. 8). Included in Pocono series, and includes Burgoon ss. and Shenango ss.

Burkburnet sands.

Subsurface oil-bearing sands in Cisco fm. of central northern Tex.

Burke formation. (Of Ravalli group.)

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and northwestern Montana.

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277–285). *Burke fm.*—Gray, flaggy, fine-grained sss. and shales, with interbedded purple qtzitic sss. and white qtzite. Shallow-water features throughout. Thickness 1,700 ± ft. Underlies Revett qtzite and overlies Prichard sl. Typically developed along Canyon Creek from Burke to Gem, Idaho, also in vicinity of Wardner and elsewhere in Coeur d'Alene dist.

Description of general geology of region is based almost wholly on work of F. C. Calkins.

Burket black shale member (of Harrell shale).

Upper Devonian: Central Pennsylvania (Huntingdon to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523, 536) *Burket black sh. memb.* at base of Harrell sh. (of Portage group).

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227). *Burket black sh. memb.*—Black fissile sh., 80 ft. thick, forming basal memb. of Harrell sh. Overlies Hamilton fm. Named for exposures at Burket, a suburb of Altoona, Blair Co.

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1209–1213), transferred this memb. to his Rush fm. and restricted Harrell sh. to overlying beds.

Burkett sand.

A subsurface sand, of Penn. age, in Burkett field, Coleman Co., north-central Tex., where it lies at 360 ft. depth.

Burkeville beds.

Miocene (upper) and Pliocene(?): Western Louisiana and eastern Texas.

A. C. Veatch, 1902 (La. Geol. Surv. pt. 6, Rept. for 1902, p. 136, pl. 37). Fossils collected near Burkville [Burkeville] are regarded by Harris as representing a brackish water phase of Chattahoochee Olig. It is impossible from our present observation to say how far from base of the green clays these fossils occur (it is probably over 100 ft.) and how much, if any, of upper portions of Grand Gulf proper belong to this stage. On map, and in our consideration of Sabine River section, we have made the last hard ss. layer in the Grand Gulf the dividing line. This is of course purely arbitrary. These beds seem to be very nearly = Kennedy's Frio clays. His description, however, seems to partially indicate that he regards these clays as occupying a position beneath the upper sss. If this be the correct interpretation of his meaning we would suggest the name *Burkville beds* for this stage.

See also under *Cold Spring horizon.*

C. L. Baker, 1920 (Univ. Tex. Bull. 1869, pp. 223–225). In vicinity of Burkeville the base of the Fleming is not earlier than late Mio. nor younger than early Plio.

Named for Burkeville [correct spelling], Newton Co., Tex.

Burley lake beds.

Pleistocene: Southern Idaho (Cassia County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Burley lake beds.*—Deposited in ancient Lake Burley. Not exposed. Log of city well at Burley, Cassia Co., gives thickness of 150 ft. The beds are essentially horizontal and capped in S. and E. by gravel deposited by Snake River and Goose Creek. Not disturbed by diastrophism since deposition. As the beds reach nearly to old shore line the lake must have practically silted up before it was drained. Older than Minidoka basalt and younger than Sand Spring basalt.

†Burlingame shale.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth, 1895 (Kans. Univ. Quart., vol. 3, p. 278 and pl. 20; Am. Jour. Sci., 3rd, vol. 50, p. 461 and pl. opp. p. 466). *Burlingame sh.*—Shales, with considerable ss., 150 ft. thick, separated from underlying Osage coal by a thin but persistent ls.

Replaced by Scranton sh.

Named for Burlingame, Osage Co., Kans.

Burlingame limestone member (of Wabaunsee formation).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

J. G. Hall, 1896 (Univ. Geol. Surv. Kans., vol. 1, p. 105). *Burlingame ls.*—Just W. of Burlingame [Osage Co.], Kans., system No. 5 makes its first appearance. It is 8 ft. thick, brown, shelly, and covers the third and last heavy bed of shales in this section, which is 150 or 200 ft. thick.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 72, 73, 94, 105). Burlingame ls. proposed by J. G. Hall for ls. system No. 5, consisting of brown shelly ls. 8 ft. thick, overlying Osage sh. ["Osage" as here used included †Burlingame (Scranton) sh.]

Basal memb. of Wabaunsee fm. in Mo. In Kans. the Wabaunsee is treated as a group and the Burlingame as a fm. The present Kans. and Nebr. Surveys use Soldier Creek sh. for the beds overlying Burlingame ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 215–216). Soldier Creek sh. and overlying Wakarusa ls. have been included by various writers in Burlingame ls. at several places in central and southern Kans. The name *Burlingame* should be restricted to lower ls., which seems to accord with Hall's original description. Thickness 4 to 16 ft. Has been mapped from southern Nebr. across Kans., and identified 40± mi. S. of Kans.-Okla. line. The ls. makes a fairly prominent escarpment that crosses W. part of Burlingame, Kans.

Burlington limestone. (Of Osage group.)

Mississippian: Iowa, Illinois, eastern Missouri, and western Kentucky.

D. D. Owen, 1852 (Rept. Geol. Surv. Wis., Iowa, and Minn., btw. pp. 90 and 140). *Encrinital group of Burlington* (also called *Burlington beds*).—In descending order: White crystalline and semi-oolitic lss.; brown and flesh-colored encrinital lss., brown earthy crinoidal lss. with crystalline specks; band of cellular buff mag. ls.; oolitic ls.; dark-gray argill. lss. Overlies argillo-calc. group. Separated from overlying Keokuck cherty lss. by brown Encrinital lss. alternating with bands of chert, as near Hannibal [Mo.]. [According to later repts the cherty beds of passage are Keokuck cherty lss. of Owen.]

J. Hall, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pp. 53–57). Encrinital ls. of Burlington, or, as we shall hereafter term it, the *Burlington ls.* Very fossiliferous ls. overlying oolitic ls. and argill. ss. belonging to Chemung group of N. Y. and underlying cherty beds of passage (Keokuk cherty lss. of Owen, 60 to 100 ft.

thick) to the higher Keokuk or lower Archimedes ls. Includes Owen's Encrinital group of Hannibal, Mo., which is identical with Encrinital ls. of Burlington. Characterized by great numbers of crinoids.

A. H. Worthen, 1882 (Econ. Geol. Ill., vol. 1, pp. 79, 86). *Burlington ls.* at Burlington, Iowa [type loc.], consists of (1) an upper member of light-gray or nearly white ls. with some brown layers and abundant chert; and (2) a lower memb. of brown mag. ls. locally aren., with abundant chert.

C. R. Keyes, 1895 (Iowa Geol. Surv. vol. 3). *Upper Burlington ls.* is distinguished from *Lower Burlington ls.* by being more thin bedded and containing greater abundance of chert. The upper 30 ft. (the flinty beds of Upper Burlington) are here named *Montrose chert.*

See also under *Keokuk ls.*

S. Weller, 1926 (Jour. Geol., vol. 34, pp. 320–335), considered the Fern Glen "a manifestation of the very lowest Burlington." The Fern Glen is at present treated by U. S. Geol. Survey as basal fm. of Osage group of Mo. and Ill.

Named for exposures at Burlington, Des Moines Co., Iowa.

†Burlington limestone. (In Chemung formation.)

Upper Devonian: Central northern Pennsylvania (Bradford County).

A. Sherwood, 1878 (2d Pa. Geol. Surv. Rept. G, p. 37). *Burlington ls.*, the thickest stratum of ls. I have ever seen in the Chemung group; 40 ft. is exposed, and this does not seem to be all of it. It is nearly a solid mass of sea shells. Occurs about 1 mi. E. of Burlington [Bradford Co.] on farms of W. B. Kline, J. Morley, and C. E. Campbell, and at other places.

Name preoccupied and replaced by Franklindale ls. lentil of Chemung fm. by H. S. Williams and E. M. Kindle in 1905 (U. S. G. S. Bull. 244).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571–592). Franklindale ls. of Williams and Kindle is older than "Burlington ls." of Sherwood, and is lithologically different. Writer therefore replaces "Burlington ls." of Sherwood with *Luthers Mills coquinite.*

†Burlington limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 110, 120–121, 125). Hard, compact lss. separated into two parts by 8 to 10 ft. of sh. Here called *Burlington or Garnett ls.*, ultimate choice of name being left to future. Overlies Le Roy shales. Separated from overlying Strawn ls. by 75 to 100 ft. of sh.

Same as Oread ls., according to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).

Named for Burlington, Coffey Co.

Burls Creek shale member.

Oligocene: Southeastern Alaska (Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 772–775, 779). *Burls Creek sh. memb.*—Upper memb. of Katalla fm. as here restricted. Conformably overlies Split Creek sh. and ss. memb. Best exposed on Burls Creek. Consists of 3 conformable divisions (descending): (1) 1,700 ft. of dark bluish-gray to almost black platy sh. containing numerous round concretions and lenses of dense blue-gray ls.; (2) 300 to 500 ft. of glauconitic ss. (the organic sh. horizon, which is made up of highly organic shales, often containing numerous grains of glauconite and several thick glauconitic sss.; (3) 700 ft. of dark platy sh., sometimes organic, with occasional thin layers of hard, tightly cemented, fine-grained sss., the sh. containing some ls. concretions. Correlated with fossiliferous beds in Yakataga dist. that are assigned to upper Olig. by B. L. Clark. This memb. is also exposed in Nichawak dist.

The U. S. Geol. Survey classifies typical Katalla fm. as Mio.(?).

Burnet marble.

Cambrian and Ordovician: Central Texas.

B. F. Shumard, 1861 (Am. Jour. Sci., 2d, vol. 32, p. 214). *Burnet marble.*—Upper 90 ft. alternating, nearly pure, brittle ls. and dol.; lower 55 ft. thick beds of very hard brittle ls. May represent Birdseye ls. of N. Y. Underlies Carbf. ls. and overlies Calciferous sand group.

See later description under *Hoover div.*

Named for exposures at Burnet and neighboring parts of Burnet Co.

†Burnetan system.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lv, 255–267). *Burnetan system.*—Largely gneisses. At base gneisses, granites, and allied rocks (Lone Grove series), overlain by basic hornblende and pyroxene rocks (Long Mtn series), and at top acidic mica and chloritic schists (Bodeville series). Underlies Fernandan system.

Includes parts of Packsaddle schist and Valley Spring gneiss of present nomenclature.

Named for Burnet Co.

Burnett formation. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54). *Burnett fm.*—Top fm. of Puget group. Consists of sss. and shales, generally barren of workable coal seams, but containing 5 beds of inferior coal near top of section at Pittsburg. Thickness 8,270 ft.; 4,770 ft. exposed on South Prairie Creek above Burnett, Tacoma quad. Overlies Wilkeson fm. [In text *South Prairie fm.* is used interchangeably with *Burnett fm.* This is *Pittsburg fm.* of Willis's 1898 rept.; latter name is preoccupied, which probably is reason *Burnett fm.* was introduced.]

Burning Springs sand.

A subsurface sand in Allegheny fm. (Penn.) of W. Va. that is believed to correspond to Butler ss. memb. Named for Burning Springs, Wirt Co., W. Va.

Burns latite (also **Burns latite tuff**).

Tertiary (Miocene): Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Burns latite complex.*—Succession of flows, tuffs, breccias, and dikes of dark hornblendic quartz-bearing latite of andesitic habit. Thickness 1,200 ft. Is uncon. overlain by great thickness of pyroxene andesite, and uncon. overlies Eureka rhyolite. *Included in Silverton volcanic series.* The most widely distributed variety of the hornblendic latites is named *Niagara Gulch latite;* another variety is named Canby latite.

Named for exposures in Burns Gulch, Silverton quad.

Burnside sand.

A subsurface sand, of Upper Dev. (Chemung) age, in W. Va. that has been correlated with Warren Second sand. Named for Burnside well, near Good Hope, Harrison Co., W. Va.

Burnt **Bluff** formation.

Silurian: Michigan (Upper Peninsula).

G. M. Ehlers, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 129). *Burnt Bluff fm.*—Includes Fiborn ls. and upper part of Hendricks series of R. A. Smith's tentative classification, and is thought by writer to be of Niagaran age. Discon. underlies Manistique fm. and overlies Mayville fm. Is without doubt a NE. extension of Byron and Lower Coral beds of Wis.

W. A. VerWiebe, 1928 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 8, pp. 330–331), assigned thickness of 111 ft. to Burnt Bluff fm. on Drummond Island, Chippewa Co. Best exposed in Seaman quarry at W. edge of village of Drummond, Chippewa Co.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 23, 35–36). Recently G. M. Ehlers (unpublished ms.) has included the *Hendricks* and *Byron* as individual members of *Burnt Bluff fm.* Type section of the Burnt Bluff is at Burnt Bluff on Big Bay de Noc, and top is clearly marked by a massive, coarsely crystalline light-brown dol. of Manistique fm. containing molds of *Pentamerus*. This section is 248 ft. thick, and includes *Byron memb.* (below) with 117 ft. of thin-bedded and laminated light-gray dolomitic lss., and *Hendricks memb.* (above), with 121 ft. of strata containing a greater number of dol. beds. Thick beds of brown dol. are prominent in upper part, but in lower part there is more lithologic similarity to Byron memb. Btw. SE. Schoolcraft Co. and southern Chippewa Co. most of Hendricks strata are comparatively pure lss. R. A. Smith named these pure ls. beds in upper part of the Hendricks the *Fiborn ls.* These beds are buff to grayish buff, dense grained to lithographic ls. containing small disseminated crystals of calcite. Smith observed possible lenticular nature of the Fiborn and stated "further field work and faunistic studies may show that Fiborn ls. should be included in Hendricks series." Savage and Crooks (Am. Jour. Sci., 4th, vol. 45, p. 62, 1918) also favored this explanation, and detailed work of Ehlers has added further supporting evidence.

Named for exposures in high cliff called Burnt Bluff, on E. shore of Big Bay de Noc, Delta Co.

See also under *Byron beds*.

Burnt Branch bed. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 375). *Burnt Branch bed.*—Flaggy sss., 125 ft. thick, including 25 or more ft. of clay at base. Memb. of Strawn div., near base. Overlies Lynch Creek bed, where present, and underlies Elliott Creek bed.

Named for Burnt Branch, in Lampasas Co. or vicinity.

Burnt Fork white layer.

Name applied by W. D. Matthew and W. Granger (Am. Mus. Nat. Hist. Mem., vol. 9, 1909, p. 295) to a bed of flinty lime lying at about middle of their horizon C of Bridger fm. in Bridger Basin. (See under *Lone Tree white layer* for their subdivisions of Bridger fm.)

Burnt Meadow syenite.

Post-Carboniferous: Maine.

F. W. Toppan, 1932 (Geol. of Maine, Dept. Geol. Union Coll., Schenectady, p. 26).

Burnt River schist.

Pre-Carboniferous (?): Northeastern Oregon (Baker quadrangle).

J. Gilluly, 1937 (U. S. G. S. Bull. 879). *Burnt River schist.*—Various greenstone schists, quartz schist, conglomeratic schist, and some interbedded ls., sl., and qtzite. Thickness, 5,000+ ft. Tentatively assigned to pre-Carbf. (?). May possibly be Triassic or younger, but believed to be older than Clover Creek greenstone (Perm.) and older than Elkhorn Ridge argillite (Penn.?). Named for exposures in canyon of Burnt River, Twps 11 and 12 S., R. 41 E.

Burntside granite gneiss.

Pre-Cambrian (Huronian): Northeastern Minnesota (Vermilion district).

F. F. Grout, 1926 (Minn. Geol. Surv. Bull. 21, p. 29). *Burntside granite gneiss.*—The older and more gneissic intrusive of Burntside Lake. Is intruded by Vermilion granite. Both assigned to Algonkian.

Burpee formation.

Eocene: Northwestern Oregon (Lincoln County).

H. G. Schenck, 1927 (Calif. Univ. Pub. Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 455, 456). *Burpee fm.*—Massive blue feldspathic ss. and interbedded micaceous clay sh. [Thickness not mentioned.] Underlies Moody sh. memb. of Toledo fm., of lower Olig. age. May later prove to be = whole or part of Tyee. Only fossils found are leaves of indeterminate genera. Assigned to Eocene because of field relations. Type loc. is the rock quarry on Southern Pacific Railroad at Burpee

Station, on E. bank of Yaquina River, Lincoln Co., midway btw. Toledo and Elk City. Is oldest Tert. fm. in Yaquina dist.

H. G. Schenck, 1928 (Calif. Univ. Pub. Dept. Geol. Sci. Bull., vol. 18, pp. 22–31). *Burpee fm.* is upper Eocene and 3,000± ft. thick. Uncon. underlies Toledo fm.

Burr limestone member.

Pennsylvanian: Southeastern Nebraska, Kansas, and northern Oklahoma.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1). *Burr ls. memb. of Grenola fm.*—The newly established Grenola fm. is divided into following members (descending): Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls. The salient lithologic feature of Burr memb. is its lamination. It is calc. throughout and has a carbonaceous sh. in the middle to N. Is of nearshore marine origin. Averages about 11 ft. in thickness from Roca, Nebr., to Burbank, Okla., disregarding the abnormal Pawnee Co., Nebr., section. The upper Burr in Nebr. is light gray, with an extremely dense, carbonaceous lime cap that covers an ostracodal zone. The middle Burr in Nebr. and northern Kans. is black or brownish sh. containing abundant plant remains. The lower Burr in Nebr. consists of 1, 2, or 3 lss. separated by sh., and farther S. it is irregular, shaly, and nodular with dark-gray mottling, and weathers platy or shattered. Type loc., the bluffs and ravines W. of South Fork of Little Nemaha River, in sec. 20, at point ¼ mi. W. of N.–S. road, 2½ mi. NW. of Burr, Otoe Co., Nebr.

G. E. Condra, 1935. (See under *Roca sh.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Burrard formation.

Eocene: British Columbia.

W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 13).

Burro gravel and tuff.

Tertiary (?): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 67). *Burro gravels and tuffs.*—Regularly bedded gravels, breccias, sss., and yellow and red tuffs, with a well-worn cgl. at one locality. Directly underlie lava flows that cap Burro Mesa, and some of deposits apparently are interbedded with the lava. Uncon. overlie Crown cgl. Tentatively assigned to Tert.

Named for Burro Mesa, Brewster Co.

Burro quartzite.

Cambrian (?): Southwestern New Mexico (Silver City region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 5). *Burro qtzites.*—Main body of Mid Cambric qtzites which immediately *overlie* Chloridian series of lss. near Silver City. Thickness 500 ft. [On p. 4 it is shown as *underlying* his Chloridian series. Derivation of name not given. The Middle Camb. is absent in N. Mex., according to E. Kirk and others.]

Burroak shale.

Pennsylvanian: Southwestern Iowa, eastern Kansas, southeastern Nebraska, and northwestern Missouri.

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser. pp. 8, 14, 53–54, figs. 1, 2). *Burroak sh.* is a new name herein suggested to replace "Mission Creek sh." of previous publications. Type loc. is in the road cuts and ravines near Burr Oak School, E. ½ sec. 21, T. 71 N., R. 43 W., Fremont Co., Iowa, about 6 mi. S. of Pacific Junction, Iowa, and about 3½ mi. N. of Bartlett, Mills Co., Iowa. "Mission Creek" should be abandoned because the exposures on Mission Creek in NE. Doniphan Co., Kans., correlate with Larsh sh. of northern outcrops. In naming *"Mission Cr. sh."* in 1927, Condra miscorrelated the Rock Bluff and Ozawkie of Iowa Point section with the Haynes and Rock Bluff, respectively, of Weeping Water Valley and Jones Point sections of Nebr. The Burroak sh. is very thin or absent near Big Springs, Kans., SE. of Iowa Point, Nebr., and at Forbes, Mo. It is

1 to 2 ft. thick N. of Thurman, Iowa, and at Jones Point and near Weeping Water, Nebr. It is thin or absent at Macedonia and NE. of Greenfield, Iowa. It consists of bluish gray, argill., fossiliferous sh., often containing a persistent carbonaceous streak near its top.

Burroughs dolomite.

Silurian (early): Western Wisconsin and northwestern Illinois.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, No. 7, p. 533). In NW. Ill. Ulrich has found a pre-Clinton dol. (*Burroughs dol.*) beneath the Niagaran. Its extent and character are but slightly known.

E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett., vol. 21, pp. 71–82). Near top of Burrough's Bluff, at N. end of Savannah, Ill. [Carroll Co., NW. Ill.], and also in and above Charles Miles' quarry near SE. edge of same city, the easily recognized Brainard sh., at top of Maquoketa facies of Richmond group is succeeded uncon. by a variable succession of bluish to grayish yellow irregularly bedded mag. mudstones and brownish dol. aggregating some 50 to 60 ft. in thickness. On weathering, upper half or more of these beds shows more or less of earthy chert in nodules and uneven plates. The bluish gray lower third contains few fossils. The cherty upper beds contain a more varied though not abundant fauna [listed], which is decidedly post-Richmond, is clearly older than Clinton, and evidently falls into some part of intermediate Upper Medina stage in which Edgewood fm. of Mo. is probably a nearer contemporary than the Cataract of Ontario. Lithologically very different from the Edgewood and some doubt as to their strict equivalence, hence *Burroughs* is proposed. The same beds are indicated, though mainly by debris, in the mounds in SW. Wis., where they have been classed with Niagaran dol.

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 48), differentiated 35 ft. of Kankakee dol. and 10 to 15 ft. of Edgewood dol. at Savanna, Ill. (type loc. of Burroughs dol.), and stated that because Burroughs dol. of Ulrich "is equiv. to the Edgewood and Kankakee this name should be abandoned."

Burton sandstone. (In Greene formation.)

Permian: Northern West Virginia.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties, p. 182). *Burton ss.*—Light gray, generally massive, but changes into sandy beds in Marshall Co. and not recognized in Tyler Co. Thickness 20 to 40 ft. Lies 25 to 35 ft. below Nineveh ls. and above Hostetter coal. Named for Burton, Wetzel Co.

Burton formation.

Middle Cambrian: British Columbia.

S. J. Schofield, 1914 (Canada Geol. Surv. Mus. Bull. No. 2, p. 82).

Busby quartzite.

Middle Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Busby qtzite.*—Basal 50 to 75 ft. is coarse-grained qtzite, containing in places tiny rock fragments in addition to quartz. Thin beds of dark qtzite and green sandy sh. in varying proportions compose remainder of fms., the shales becoming increasingly abundant upward. Mud cracks and fucoid markings present in many of beds. Thickness 450± ft. Top arbitrarily placed at base of lowest ls. bed, although qtzites and shales similar to those in the Busby are present above this line. No fossils, but gradational contact with overlying Abercrombie fm., which contains Middle Camb. fossils, indicates Middle Camb. age of Busby. Grades into underlying Cabin sh. Named for exposures in Busby Canyon, on NE. slope of Dutch Mtn, Gold Hill dist.

See also U. S. G. S. P. P. 177, 1934.

Bushberg sandstone member (of Sulphur Springs formation).

Mississippian: Central eastern Missouri.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Bushberg ss.*, 10 ft. thick, forms top memb. of Sulphur Springs fm. Overlies Glen Park ls. memb. of the Sulphur Springs.

See also under *Sulphur Springs fm.* R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., opp. p. 282), showed *Bushberg ss.* as=lower part of Hannibal sh., and as uncon. overlain by Fern Glen fm.

Named for exposures at Bushberg, Jefferson Co.

Bushveld complex.

See under *Stillwater complex.*

Busseron sandstone member.

Pennsylvanian: Southern Indiana.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, chart and pp. 524, 529). *Busseron ss.*—Ss. and sandy sh., forming basal memb. of Shelburn fm. Rests discon. on coal No. 7 (topmost bed of Petersburg fm. as redefined by Cumings). Is probably=Anvil Rock ss. of Ky., and is of post-Allegheny age.

Probably named for village of Busseron, Knox Co.

Butano sandstone.

Oligocene? (may be Eocene): Southern California (Santa Cruz Mountains).

J. C. Branner, J. F. Newsom, and R. Arnold, 1909 (U. S. G. S. Santa Cruz folio, No. 163). *Butano ss.*—Massive brown and buff sss. with cgl. at base. Thickness about 2,100 ft. No fossils found. Conformably underlies San Lorenzo fm., and believed to uncon. overlie Eocene ls., but sequence is concealed.

Named for exposures on Butano Ridge, San Mateo Co.

Butler sandstone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 40–71, 130). *Butler (Upper Freeport) ss.*—Massive ss. Lies 35 ft. below Upper Freeport ls. and overlies Lower Freeport coal. Thickness 30 ft. Type loc. is in town of Butler, Butler Co., Pa., just below Mr. Muntz's, opposite the mills of Woldo & Bros., where it has been quarried.

†Butler limestone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania.

See under *Lower Freeport ls. memb.*, the established name.

Butler sands.

Drillers' terms; western Pa.; strat. order as follows (descending): Butler first sand, Butler gas sand (=Murrysville and =Butler Thirty-foot sand), Butler Second sand, Butler Third Stray sand, Butler Third sand (=Gordon sand), Butler Fourth Stray sand, Butler Fourth sand, Butler Fifth sand. Probably named for Butler Co.

Butler amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

Name locally in use many years. Used by B. S. Butler (in U. S. G. S. P. P. 144, 1929), who states (personal communication) that the rock was probably named for a Captain Butler, the probable discoverer of the lode. Belongs in lower part of Central Mine group. The mineralized part is the Butler lode.

Butler flow.

Includes Butler amygdaloid and the underlying trap.

Butler clay member (of Rockdale formation).

Eocene (lower): Central and southern Texas between Brazos and Frio Rivers.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 587, etc.). *Butler clay.*—Basal memb. of Rockdale fm. in central and southern Tex. Consists of (a) gray and buff, lenticular, fine-grained, thin-bedded sand containing indurated and laminated rough-surfaced concretions; (b) micaceous clays, in most places rather free of sand, tough and massive, in other places silty and laminated and characterized by limonitic partings; (c) seams and lentils of lignite. Thickness 400 ft. Underlies Simsboro sand memb. of Rockdale fm. and overlies Seguin fm. Typically exposed at town of Butler, Freestone Co.

Butlerville quartzites.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38). Qtzites, 1,000 ft. thick, composing lower fm. of Panamintan series (Early Cambric) in Utah. [Derivation of name not stated.]

Buttahatchie gravel.

Quaternary (?): Alabama.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. for 1888, vol. 2, p. 189). [Mentions deeply ferruginous sands, clays and gravel, of early Quat. age, in SW. Ark., which are "allied by position to older Llano Estacado fm. and *Buttahatchie gravel* of Ala., but no lithologic resemblance to either." All the description there is, and only known use of the name.]

Butte quartz monzonite.

Tertiary? (Eocene?): Central western Montana (Butte region).

W. H. Weed, 1899 (Jour. Geol., vol. 7, pp. 740–750). *Butte granite or quartz monzonite* covers area of several sq. mi. and is prevailing rock of Butte dist., and the one that contains the world-famous copper and silver veins of that place. It is a rather dark colored, coarsely granular rock.

Butte gravels.

Eocene (middle): Northern California (Sutter County).

Howel Williams, 1929 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 112–129). *Butte gravels.*—Coarse gravels, composed of rounded, chiefly very siliceous pebbles, with sandy intercalations and thin beds of massive ss. and siliceous ls. Thickness 450 to 1,200 ft. Overlie White Ione sands, usually with minor discon., but occasionally with erosion uncon. Are overlain by Sutter fm., in some places with sharp contact, in other places almost insensible gradation. Fossils 700 ft. above Ione sands are assigned by B. L. Clark to Meganos (middle Eocene) age. Present at Marysville Buttes.

Butterfield limestone member (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 37, map, sections). *Butterfield ls. memb. of Bingham qtzite.*—Chiefly blue and dark-blue lss., usually pure carbonate of lime, but many siliceous layers are present, and occasionally beds of sandy ls. occur, also small chert nodules and round balls; the chert is black, alternating, in the larger nodules, with concentric, dark-gray bands. Thickness 300 ft. Lies much lower than Jordan ls. memb. [Map shows it exposed in Butterfield Canyon, SE. corner of sheet.]

Butting Ram sandstone member (of Talladega slate).

Pre-Devonian, probably Paleozoic: Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 54, 58). *Butting Ram ss. memb. of Talladega slate.*—Coarse cgl. at bottom, overlain, to W., by thick-bedded qtzite or quartzose ss., and to E. by beds of ss. intercalated with cleaved sl. or phyllite of the usual Talladega character. Thickness probably 1,000 ft. Lies about 7,500 ft. higher stratigraphically than Jumbo dol. memb., and either directly or at no great distance below Jemison chert. Believed to be same as Cheaha ss. memb. Is pre-Dev. and probably Paleozoic.

Named for fact it is believed to form Butting Ram shoals on Coosa River, on border btw. Chilton and Coosa Counties, about 10 mi. NE. of Clanton. Is well exposed on headwaters of Mahan Creek, 4 mi. W.-SW. of Jemison, and has been closely traced from 2± mi. E.-NE. of Jemison, to Coosa River in vicinity of Butting Ram shoals.

Buttle Lake group.

Permian: British Columbia.

H. C. Gunning, 1931 (Canada Geol. Surv. Summ. Rept. 1930, pt. A, p. 59).

button beds.

Miocene: Southern California (Kern County).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, p. 170). *Button beds.*—The first sandy beds below Monterey sh. at Temblor. Included in Temblor beds. Thickness 100 ft. Named for great numbers of small discoidal sea urchins (*Astrodapsis*) that characterize them. [See also under *Temblor fm.*]

Buttram sand.

A subsurface sand in Strawn fm. (Penn.) of Buttram and Bryson oil fields, Jack Co., Tex.

Buttsgin formation.

Eocene: Southern Texas (Medina County).

R. A. Liddle, 1921 (Univ. Tex. Bull. 1860, p. 82, map, and columnar section). *Buttsgin fm.*—Yellow, brown, and brown-red aren. shales and clays interbedded with large calc. ss. lenses and hard aren. ls. lenses. Basal part contains more calc. matter, is harder, and forms a range of hills. Upper part weathers to a more sandy soil. Thickness 500± ft. Lower fm. of Wilcox group in Medina Co. Underlies Seco fm. and overlaps Squirrel Creek fm. Typically exposed at Butts Gin, approx. 6 mi. NW. from Yancey, Medina Co., in bed and tributaries of branches of Seco Creek.

Bu-Vi-Bar bed.

Permian: Central northern Oklahoma.

See under *Evansville ss. bed.*

†Buxton formation.

Pennsylvanian: Southeastern Kansas.

F. C. Schrader and E. Haworth, 1905 (U. S. G. S. Bull. 260, p. 447). *Buxton fm.*—Shales, with beds of ss. and coal and lenses of ls.; 320 ft. thick. Underlies Painterhood [Oread] ls. and overlies Piqua [Stanton] ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 139). †Buxton fm. includes beds from top of †Piqua (Stanton) ls. to base of †Painterhood (Oread) ls.

Named for Buxton, Wilson Co.

Byer member.

Mississippian: Central and southern Ohio.

J. E. Hyde, 1912 (History of Fairfield County, p. 211) and 1915 (Jour. Geol., vol. 23, pp. 656, 657, 659, 678, 764–765, 771–775). *Byer memb.*—Fine-grained, rather soft, yellow ss., 40 to 150+ ft. thick, forming basal memb. of Logan fm. [as here used includes upper part of Black Hand fm.]. Underlain by Berne memb. of Cuyahoga fm. [expanded Cuyahoga] and overlain by Allensville memb. of Logan fm. [expanded Logan]. Extends from Fairfield Co. to Ohio River.

Named for Byer, Jackson Co.

Byham limestone member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 134). At base of Harvest Home sh. memb (lower Meadville sh. of early repts) in several ravines S. of Meadville, especially in Buchanan's Ravine, N. of Shaws School (Buchanan Station) and about 1½ mi. W.-NW. of Byham School, there is a ls. similar to West Mead ls. (lower Meadville ls. of early repts). It is proposed that this "middle Meadville ls." be called *Byham ls.* Resembles West Mead ls. lithologically and faunally, both being characterized by iron-ball concretions, fish bones, and a Syringothyrid fauna interspersed with inarticulate brachiopods. In area around Byham School it is 3 to 12 ft. thick and much used in past for lime.

Byram marl. (In Vicksburg group.)

Oligocene (middle): Mississippi, Louisiana, southwestern Alabama, and northwestern Florida.

T. L. Casey, 1902 (Phila. Acad. Nat. Sci. Proc., vol. 53, pp. 517–518). Mr. D. W. Langdon enumerates (Am. Jour. Sci., XXXI, p. 205) the fossils collected by him at Byram Station, on Pearl River. They are all Vicksburgian with exception of *Capulus americanus*, which is Jacksonian. As this species has never been found at Vicksburg, the presumption is that the *Byram beds* are older than true Vicksburgian, and this is further borne out by the fact, which I have noted from personal observation, that the Byram deposit contains, besides the species quoted by Mr. Langdon, a considerable number peculiar to it and apparently occurring nowhere else. The evidence adduced by Mr. Langdon would seem to show that there is a notable thickness of marine, though scarcely fossiliferous, deposits btw. the true Jackson and Byram, and it is probable that during this interval the Red Bluff beds were formed. The order of emergence of the various deposits—which were all more or less local—may therefore be stated to be: (1) Jackson stage, (2) Red Bluff substage, (3) *Byram substage*, and (4) Vicksburg stage. [The strat. position of Byram as here given is now known to be incorrect. See below.]

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, No. 7, pp. 186–198). *Byram calc. marl.*—Largely sandy marl, but contains thin beds of impure ls., clay, and sand. Thickness 13 to 70 ft. Top fm. of Vicksburg group. Conformably overlies Marianna ls. (of Vicksburg group), and underlies Catahoula ss. Is same as upper Vicksburgian of Casey [at Vicksburg].

The present approved definition is that of C. W. Cooke, but the fm. is now called *Byram marl.* Beds formerly included in upper part of Marianna ls. have since been separated as a distinct fm. (Glendon ls.), so that the fm. upon which Byram marl rests is Glendon ls., instead of Marianna ls. The Red Bluff clay has now been determined to correspond in time to lower part of Marianna ls. The Byram as defined by Cooke included in upper part the beds in Miss. that were later named (by Blanpied) Chickasawhay marl [memb.], and Bucatunna clay [memb.], and they are still included in the Byram by U. S. Geol. Survey.

Named for exposures in bank of Pearl River at Byram, Hinds Co., Miss.

Byram granite gneiss.

Pre-Cambrian: Northern New Jersey and eastern Pennsylvania.

A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). The rocks here grouped as *Byram gneiss* include several varieties of granitoid gneiss which are lithologically related by presence of potash-bearing feldspars among their principal mineral components. Composed essentially of quartz, and microcline or microperthite (potash feldspars), with variable proportions of hornblende, pyroxene, and mica. Oligoclase (soda-lime feldspar) usually very subordinate in amount, but here and there it equals the potash feldspar. Accessory minerals are magnetite, zircon, apatite, and titanite. There are several facies of the rock which vary greatly in appearance in the field, but almost without exception show greater resemblance to each other than to varieties of other gneisses with which they are associated. In a broad way the Byram gneiss can be separated into light and dark facies. General tone of dark facies is ordinarily gray in outcrop, but on fresh surfaces brownish accompanied by bronzy effect. A common dark variety contains considerable hornblende in crystals grouped in form of pencils arranged parallel to a common axis. The light varieties are yellowish in outcrop, and pink, light gray, or whitish on fresh surfaces. Usually they are somewhat finer grained and less foliated than the dark facies and carry mica rather than hornblende or pyroxene. The Byram gneiss includes "Hamburg" [Mountain] gneiss, "Sand Pond," and "Edison" gneisses of Wolff, the "Oxford type" of Nason, and gneissoid granite of Breakneck Mtn., on the Hudson. Appears to cut Pochuck gneiss and Franklin ls. Relations to Losee gneiss not known.

The Byram gneiss (predominantly granite gneiss) is now considered as probably younger than Losee gneiss (predominantly diorite). It is classified by E. B. Knopf and A. I. Jonas (U. S. G. S. Bull. 799, correlation chart, 1929) as post-Glenarm. Intrudes Franklin ls. and Pickering gneiss.

Named for Byram Twp, Sussex Co., where good exposures occur in hills NE. of Roseville.

Byron beds.

Silurian: Southeastern Wisconsin.

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, pp. 345–348). *Byron beds.*—Fine-textured white ls., 110 to 140 ft. thick. Rests on Mayville ls. and underlies Lower Coral beds. Fossils rare. Named for Byron Twp, where it is extensively used for lime, building stone, and flagging. Is =lower part of Waukesha beds. [The equivalency of Byron to basal part of Waukesha was published in many subsequent Wis. repts, by different authors.]

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). Waukesha dol. of eastern Wis. (250 to 300 ft. thick) is younger than Byron dol. (100 ft. thick). [This was a restriction of Waukesha dol.]

R. B. Newcombe (1933) carried this name into Upper Peninsula of Mich. See 1933 entry under *Burnt Bluff fm.*

A. H. Sutton 1935 (Rept. 9th Ann. Field Conf. K.ns. Geol. Soc., p. 278). *Byron* is pre-Niagaran and correlates with Kankakee of Ill.

Caballos novaculite.

Devonian ? (Oriskany?): Southwestern Texas (Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 39). *Caballos novaculite.*—Upper part massive bedded, ripple-marked, and much fractured white novaculite, 50 ft. thick; lower part 40 ft. of rather thin-bedded light-brown chert with some layers of white novaculite. Occurs in Marathon region. Named by Baker. E. O. Ulrich regards it as of Oriskany age. Uncon. underlies Santiago chert and uncon. overlies Maravillas chert.

C. L. Baker and W. F. Bowman, 1917 (Univ. Tex. Bull. 1753, p. 93). *Caballos novaculite* redefined to include what were originally called Caballos novaculite and Santiago chert. Later work by senior author appears to indicate that they are really one fm., two members of both the original Caballos and Santiago being included in the section in some localities. It is now thought that in the localities first examined erosion has removed the upper novaculite and upper predominantly green chert. But there is possibility of duplication of beds by shearing or thrusting. Should this finally prove to be the case in the region where the section exhibits two members, both of the white novaculite and the banded, vari-colored chert in the same succession, the name Santiago may be reapplied to the latter. Type loc. of Caballos novaculite is Caballos Mtn, the entire N. face of which is made up of white Caballos novaculite.

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, p. 1078). The type Caballos of 1916 publication comprised lower chert memb., lower novaculite memb., middle chert memb., and upper novaculite memb. The type "Santiago" of 1916 publication consisted of middle and upper chert members combined, with upper novaculite memb. nearly absent btw. them. Because of overlapping of typical section, and strat. unity of whole series, writer supports Baker and Bowman's decision to abandon "Santiago."

Named for exposures on Horse (Caballos) Mtn, Brewster Co.

Cabano conglomerate.

Ordovician (?): Quebec.

H. W. McGerrigle, 1934 (Quebec Bur. Mines Ann. Rept. 1933, pt. D, p. 115).

Cabano River limestone.

Silurian (Niagaran): Quebec.

H. W. McGerrigle, 1934 (Quebec Bur. Mines Ann. Rept. 1933, pt. D, p. 116). Included in Temiscouata group.

Cabezon fanglomerate.

Quaternary: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 387–392, and map). *Cabezon fangl.*—A fangl. deposited in Bear and Holcomb

Valleys. Differs from older Coachella fangl. in being more uniform and massive, of yellowish color, and in lying nearly horizontal. The largest area in Bear Valley is broad flat btw. Rathbone Creek and Erwin Lake, where material is almost wholly unsorted angular and subangular qtzite brought down from Sugarloaf Mtn to SE. Holcomb Valley is nearly surrounded by flat ridges of fangl. Those on S. and E. sides are particularly conspicuous and consist of ls., granite, and qtzite from surrounding hills. The fangl. in Bear and Holcomb Valleys is only local representative of a widespread deposition during third cycle of erosion. The Cabezon fangl. is older than Heights fangl. and younger than Coachella fangl.

Named for Cabezon Station, Riverside Co.

Cabin shale.

Lower Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Cabin sh.*—Dominantly dark green or khaki-colored sh., locally calc. Sandy laminae abundant near top. Thickness 510 ft. Grades rather abruptly into overlying Busby qtzite. Is Lower Camb. Overlies Prospect Mtn qtzite. Named for exposures in Cabin Gulch, S. of North Pass Canyon, Gold Hill quad.

See also U. S. G. S. P. P. 177, 1934.

Cabin Creek sandstone.

Name applied by C. Croneis (Ark. Geol. Surv. Bull. 3, pp. 242–244, 1930) to beds lying btw. 55 and 120 ft. depth in Watkins well No. 1 of Peney Oil and Gas Co. (subsidiary of Columbia Carbon Co.) in sec. 4, T. 8 N., R. 22 W. [Clark Co.] in Knoxville anticline, Ark., said to belong to Hartshorne ss.

Cable formation (or lake beds).

Quaternary (?): Southern California (Kern County).

A. C. Lawson, 1906 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 431–462). *Cable fm.* (also *Cable lake beds*).—Fresh-water lake beds, of well-stratified lss., cherts, gravels, clays, and fine light-colored volcanic tuff. Named for town of Cable, Kern Co. Older than Tehachapi fm. and younger than Tank volcanics.

Cabo Rojo stage.

Quaternary: Puerto Rico.

B. Hubbard, 1923 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 96).

Cabot Head shale member (of Cataract formation).

Silurian (early): Ontario.

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 438, 460). *Cabots Head beds.*—Green, calcareo-argill. shales and thin-bedded ls. underlain by 100 to 150 ft. of red shales and some sss. Believed to be westward extension of true Medina sedimentation, which at Niagara is about 125 ft. thick. Rest on Keppel dol. Named for exposures at Cabots Head, on Manitoulin Islands.

C. Schuchert, 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 277–320), recognized his Cataract fm. as divisible in Ontario into (descending) *Cabots Head sh. memb.*, *Manitoulin ls. memb.*, and *Whirlpool ss. memb.*, and restricted *Medina ss.* to beds above Cabots Head sh. and below Wolcott ls. memb. of Clinton fm. [See fuller explanation of Schuchert's subdivisions under *Cataract fm.*] He recognized Cabot Head sh. in Stony Creek, Hamilton, Dundas, Limehouse, Cataract, Collingwood, Owen Sound, Cabots Head, and Manitoulin sections, all in Ont.

M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. for 1913, pp. 179–188), introduced *Grimsby memb.* for 0 to 50 ft. of red and gray ss. with some gray sh. overlying Cabot Head sh. [replaces Williams' preoccupied name *Kagawong*] and underlying Thorold ss. memb. of the Medina.

E. M. Kindle, 1914 (Sci., n. s., vol. 39, pp. 915–918), advocated following names for subdivisions of Grabau's restricted *Medina fm.* (descending): Thorold ss., Grimsby ss., Cabot Head sh., Manitoulin beds, and Whirlpool ss.

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser.), stated that Schuchert's 1914 classification restricted Medina to Grimsby and Thorold sss., but that Grimsby ss., as well as the overlying Thorold ss., are "only facies of top of Cabot Head sh., although they represent another faunal invasion." He also introduced two new names for dol. beds in *Cabot Head sh. memb. of Medina-Cataract fm.* of Bruce Peninsula and Manitoulin Island (the type loc.), using *St. Edmund dol. lentille* for a bed near top of Cabot Head sh., and *Dyer Bay dol. lentille* for a bed in lower part of upper half of Cabot Head memb.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 334–336), stated that fauna of Dyer Bay dol. is of Niagaran age (middle Clinton), and he restricted *Cataract* to pre-Dyer beds of upper Medinan age, included Grimsby ss. in Medinan, and transferred Thorold ss. to Clinton.

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138), used Grabau's restricted *Medina* "to include the beds above the Queenston and below the Clinton," and stated that upper part of Cataract fm. in southern Ont. is formed by Thorold ss. memb. and Grimsby ss. memb. and that Whirlpool ss. memb. is base of Cataract fm. from Niagara River to vicinity of Duntroon, about 8 mi. S. of Collingwood, Ont.

Cabotian.

A term applied by N. H. Winchell to lower part of Keweenawan rocks of eastern Minn., extending up to base of a cgl. interpreted by him as corresponding to Puckwunge cgl., and including the †Beaver Bay diabase. (See Minn. Geol. Nat. Hist. Surv. Final Rept, vol. 4, pp. xiv–xx, 215, 295–298, 1899.) Includes lavas, red rock, and gabbro. Named for mtn range that appears at Duluth and eastward and is formed by the gabbro, which Buchette named *Cabotian Range.*

Cabullona group.

Upper Cretaceous: Mexico (Sonora).

N. L. Taliaferro, 1933 (Jour. Geol., vol. 41, No. 1, p. 26).

Cacapon sandstone member (pronounced Că'pŏn). (In Clinton formation.)

Silurian: Northern West Virginia and western Virginia.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Cacapon ss.*—Red flaggy ss., somewhat resembling the sss. of Juniata fm., but less massive and of brighter red-brown color. Average thickness about 300 ft. Underlies Rockwood fm. and overlies Tuscarora qtzite.

Is a ss. in lower part of Clinton fm.

Named for exposures on slopes of Cacapon Mtn, Winchester quad., Va. and W. Va.

†Cacaquabic granite.

Name used by J. M. Clements (U. S. G. S. Mon. 45, 1903) and some other geologists for granite exposed on shores and islands of Kekekabic Lake, the spelling adopted by U. S. Geog. Bd. Now replaced by *Kekekabic granite.*

Cache formation.

Early Pleistocene or upper Pliocene: Northern California (Lake County).

G. F. Becker, 1888 (U. S. G. S. Mon. 13, p. 219). *Cache Lake beds.*—Freshwater gravels, sand, and calc. beds of Plio. age, 1,000 ft. thick. Occur E. of Clear Lake, about north fork of Cache Creek. The character of the deposits and fact that area occupied by them is continuous with part of Clear Lake led me to infer that Cache Lake might be regarded as representing Clear Lake at a more or less distant period.

C. A. Anderson, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pp. 632–639, 662, map). *Cache fm.*—Fresh-water sediments described by Becker as *Cache Lake beds,* an unfortunate name, because, while some of the rocks are undoubtedly of lacustrine origin, others are probably of fluvial origin. So it seems desirable to refer to these as *Cache fm.* The sediments are interbedded with basalt flows. The topog. during Cache time bore no relationship to present topog., and statements that a

"Cache Lake" was a former extension of Clear Lake are misleading. G. D. Hanna, who has studied the diatoms from both Clear Lake and the diatomites of Cache fm., has remarked (personal communication) that the differences btw. them are sufficient to indicate there was no connection btw. the lakes of Cache time and present Clear Lake. The Clear Lake Basin was formed after the faulting and folding of Cache fm. Best exposed and have max. thickness (at least 1,700 ft.) in area W. of North Fork of Cache Creek. Rest with marked uncon. on Martinez (Lower Eo.). No reliable fossil evidence. Tentatively regarded as Lower Pleist. but may be Upper Plio.

See also under *Clear Lake sediments.*

Cache Creek group. (Also Cache Creek series.)

Carboniferous; British Columbia.

A. R. C. Selwyn, 1872 (Canada Geol. Surv. Rept. 1871–72, pp. 60–61).

Cache Lake beds.

See *Cache fm.*

Cache Valley group.

Pliocene (?): Northeastern Utah and southeastern Idaho (Cache River Valley).

A. C. Peale, 1879 (U. S. G. and G. S. Terr. 11th Ann. Rept., pp. 603–606, 634, 635, 640, 641). *Cache Valley group.*—Soft marls and sands, best exposed in N. side of Cache Valley [NE. Utah and SE. Idaho] and on Bear River below the middle canyon. They are somewhat variegated and horizontal in position. Deposited in lake, which shows a number of levels. Possibly of same age as Malade Valley group and possibly older.

Now considered probably of same age as Salt Lake fm.

Cactus granite.

Probably late Jurassic: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub. Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 364–365, and map). *Cactus granite.*—Medium coarse-grained intrusive granite, pinkish to yellowish gray.

Named for Cactus Flat, San Bernardino Co.

Caddell clay.

Eocene (upper): Eastern Texas.

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 462). *Caddell clays.*—At base greenish clays and sandy clays with some sand and greensand, which are iron-stained. These weather dark brown and carry calc. concretions, which contain more or less sand and greensand, and are geodic in places. These are overlain by grayish-brown sandy clays with seams of sulphur, which are followed by buff sandy clays with plant fragments, and gray-drab clays with gyp. and sulphur. Included in Jackson beds. Separated from overlying Manning beds by clays and sands, and separated from underlying Frio clays by clays and sands that are believed to be the Wellborn. [E. T. Dumble, 1920 (Univ. Tex. Bull. 1869), called the beds underlying his Caddell clay the *Wellborn ss.*] Named for excellent exposures around Caddell, San Augustine Co. [NE. Tex.].

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 685–686). *Caddell memb. of Fayette fm.* was named by Dumble. It comprises 30 to 45 ft. of basal strata of the Fayette of NE. Tex., which consists of chocolate-colored and greenish clays that weather to brownish and purplish hues and contain dark-brown, calc., fossiliferous ss. concretions, large amount of selenite crystals, and minor amounts of glauconite. Some of clay near top contains layers of fine sand 1 inch or less in thickness. Rests on Yegua fm. and is overlain by Wellborn ss. of Kennedy. Miss Ellisor (ms.) during recent detailed subsurface studies has been able to recognize this memb. in well sections throughout Gulf Coast dist. Lower part of Caddell memb. of Dumble is characterized by *Textularia dibollensis.* Dividing line btw. Caddell and overlying McElroy memb. is drawn at base of Wellborn ss.

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11). *Caddell fm.*, of Jackson group, is divided into upper chocolate phase and lower marl phase. It is overlain by McElroy fm. (which is divided into (descending) 3 mappable units, namely, Manning beds, Wellborn sands, and Wooley's Bluff clays), and rests conformably on the Cockfield [Yegua] fm. Thickness 150 to 300 ft. [Fossils listed.]

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17 and pp. 17–23). *Caddell fm.* (*Moodys marl*) of Walker Co. to Gonzales Co. region is 100 to 200 ft. thick; is basal fm. of Jackson group. It underlies Wellborn fm. (the basal memb. of which is Bedias ss.), conformably overlies Yegua fm., and consists of (1) an upper memb. of chocolate-colored shales and sands, locally lignitic; nonmarine beds and interbedded marine glauconitic shales; and (2) a lower memb., 0 to 25 ft. thick, of gray calc. ss., locally with ferruginous concretions and locally fossiliferous. Dumble confused position of Caddell fm. when he stated that it overlies the Wellborn. [Exposures of Caddell are listed.] The Wooley's Bluff clays of Ellisor are part of Wellborn. At fresh exposures in Angelina Co. and in cores from wells the Caddell fm. is essentially a fossiliferous glauconitic marl. From western Walker Co. to Gonzales Co. the Caddell fm. is mostly gray and tan crossbedded sands and gray and chocolate-colored clays. The glauconitic marl of Caddell fm. is similar in lithology and strat. position to Moodys marl of Miss., and since Moodys has priority perhaps it should be adopted for basal fm. of the Jackson in Tex.

Caddo limestone.

Lower Cretaceous (Comanche series): Southeastern and central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Caddo ls.*—Clay, calc. marls interstratified with white or yellowish marly ls., and semi-crystalline ls., marly beds thickest near base, lower 60 ft. being composed chiefly of clay marls. Top memb. of fm. is bed of oyster shells. Thickness of fm. 150 ft. Underlies Bokchito fm. and overlies Kiamichi fm.

Named for Caddo, Bryan Co.

†Caddo shale.

Ordovician (Lower and Middle): Southwestern Arkansas.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557). *Caddo sh.*—Sh. overlying Crystal Mtn ss. and underlying Bigfork chert.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, pp. 67–68). Crystal Mtn ss. of Purdue, 1909, included Blakely ss. [The Caddo sh. of Purdue, 1909, is therefore exactly = Womble sh. of Miser, 1917.]

Caddo lime.

A term that has been applied by drillers to Home Creek ls. memb. of Caddo Creek fm. (Penn.), also to a ls. in the much older Smithwick sh. (also Penn.), both of central northern Texas. The lime in Smithwick sh. is also called "Smithwick lime," "Breckenridge lime," and "False Black lime" by oil men.

Caddo sand.

A subsurface sand in SW. Okla., correlated with part of Garber ss. (Perm.). The name has also been applied by drillers to a sand correlated with Nacatoch sand (Upper Cret.) in NW. La.

Caddo Creek formation. (In Canyon group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 35). *Caddo Creek fm.*—Top fm. of Canyon group. Discon. underlies Graham fm. and overlies Brad fm., top memb. of which is Ranger ls. Thickness 100 to 150 ft. to N. and 30 to 50 ft. to S. Named for a tributary of Brazos River in Stephens Co., Brazos River region. Divided into Home Creek ls. memb. (above) and Hog Creek sh. memb. (below).

Replaces Eastland fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), redefined Caddo Creek fm. by including in it Jacksboro ls. and Finis sh., which were originally included in overlying Graham fm. He stated that Home Creek ls. includes Jacksboro ls.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+). *Caddo Creek fm.* includes only Home Creek ls. and Hog Creek sh. of Colorado River region. [This definition has been adopted by U. S. Geol. Survey for its publications, and is the one followed by F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534). They included in lower part of overlying Graham fm. the Bunger ls., Gonzales Creek sh., Eastland ss., and Finis sh. of Brazos River region.]

Caddo Gap novaculite.

Devonian (?): Southwestern Arkansas (Montgomery County).

C. L. Cooper, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 211). [See 1933 entry under *Arkansas novaculite.*]

Caddo Levee Board horizon.

Lower Cretaceous: Northeastern Texas and northwestern Louisiana.

See under *Hill sand horizon.*

†Cadent series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 107, 138–140+, and vol. 2, p. 775). Divided into *Cadent upper black sl.* (*Genesee sh. of N. Y.*), 300 ft. thick in Huntingdon Co., Pa.; *Cadent shales* (*Hamilton group of N. Y.*), 600 ft. thick in Huntingdon Co.; and *Cadent lower black sl.* (*Marcellus sl. of N. Y.*), 250 ft. thick in Huntingdon Co.

†Cadent slates.

†Cadent shales.

See under †*Cadent series.*

Cades conglomerate. (In Chilhowee group.)

Cambrian (Lower): Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 2). *Cades cgl.*—Thick beds of sl., ss., graywacke, and cgl. The beds of fine sl. are black and grayish black; the other beds are of various shades of gray. Few beds are over 50 ft. thick, most of them being from 6 inches to 3 ft. thick. Thickness of fm. probably 2,400 ft. Overlies Pigeon sl. and underlies Thunderhead cgl.

Named for exposures near Cade Cove [spelled *Cade Cove* on atlas sheet], Blount Co., Tenn.

Cadiz beds.

Upper Devonian: Western New York (Genesee River region).

G. H. Chadwick, 1934 (Geol. Soc. Am., Prel. list of titles and abstracts of papers to be offered at 47th Ann. Meeting, Rochester, N. Y., Dec. 27–29, 1934, p. 12). *Cadiz beds* introduced for supposed "Volusia" of Genesee-Olean meridian, btw. Cuba and Hinsdale sss., and *Haymaker beds* for those formerly taken for the Chadakoin, btw. Hinsdale ("quarry") ss. and Wolf Creek cgl. The succession [upward] thus becomes Cuba, *Cadiz*, Hinsdale, *Haymaker*.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.* Type loc. not stated.]

Cadiz formation.

Middle Cambrian: Southeastern California (San Bernardino Mountains).

J. C. Hazzard and J. F. Mason, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 2, pp. 229–240). *Cadiz fm.*—In descending order: (1) Nodular buff and gray ls., 75±ft.; (2) greenish platy sh.; (3) sandy platy ss.; (4) purplish and green sh.; (5) platy ss.; (6) buff, oolitic, cross-bedded ls., tentatively treated as base of fm. Thickness of fm. 375± ft. in Marble Mtns, 550 ft. in Providence Mtns. Middle Camb. fossils. Underlies Bonanza King fm. (Middle Camb.) and overlies reddish ss. and sh. containing Lower Camb. fossils. Type section was measured in W.-E. direction up W. front of high ls. ridge 2± mi. N. of National Old Trails Highway where it crosses Marble Mtns about 3 mi. N. of Cadiz.

Cadomin conglomerate.

Lower Cretaceous: Alberta.

B. R. MacKay, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. B, p. 9).

Cadwallader series.

Triassic: British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 79).

Cahil sandstone. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Cahil ss.*—Prevailingly massive, obscurely bedded ss. of dark greenish gray color and medium texture. Includes lenses of pebbly cgl. and beds of dark sh. Includes, 500 ft. above base, a conspicuous foraminiferal ls.—the Calera ls. memb.—60 ft. thick, which is overlain by 2,000 ft. of beds belonging to Cahil fm. On summit of Fifield Ridge a thin lens of obscurely fossiliferous impure ls. occurs in Cahil ss. several hundred ft. above Calera ls. This ls. is apparently not persistent and probably nowhere exceeds 10 ft. in thickness. Thickness of Cahil ss. approx. 2,560 ft. Basal fm. of Franciscan group. Underlies Sausalito chert. Named for exposures on Cahil Ridge, San Mateo Co.

Caimito formation.

Miocene: Panama Canal Zone.

D. F. MacDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 709).

†Cainozoic. See *Cenozoic*, the modern spelling.

Cairo gas sand.

Cairo salt sand.

Cairo oil sand.

Subsurface sands in Pottsville fm. (Penn.) of W. Va. The gas sand is youngest, the oil sand is oldest. The salt sand may correspond to Connoquenessing ss. memb. Named for town in Ritchie Co., W. Va.

Cairo till.

A term applied by C. [R.] Keyes to the oldest (pre-Nebraskan, he stated) till sheet in America. (See Pan-Am. Geol., vol. 58, p. 203, 1932.)

Cajalco quartz monzonite.

Late Jurassic(?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 502). Late Jurassic(?) intrusive rock that covers large areas in Riverside Co. btw. Monument Peak and Arlington Mtn, including Cajalco Canyon.

Calais granite.

Devonian: Northeastern Vermont (Washington County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Quarried at Calais, Calais Twp, Washington Co., in quad. adjoining Montpelier quad. on E.

Calapooya formation.

Tertiary (Eocene ?): Southwestern Oregon.

F. G. Wells and A. C. Waters, 1934 (U. S. G. S. Bull. 850). *Calapooya fm.*—Cgls. tuff, breccia, and lava flows, over 5,000 ft. thick in Black Butte-Elkhead area. In places consists mainly of true volcanic breccias; in places it is largely fine tuff; in places lava flows prevail, the flows ranging from basalt to dacite, but nearly everywhere material of andesitic composition greatly predominates. Lavas are more abundant in upper part and the thick masses of cgl. are confined largely to its base. In E. part of Calapooya Mtns the fm. is mostly sed., with cgl. predominating. Farther E. and SE. lava flows become increasingly abundant until along SE. border of Black Butte-Elkhead area only thin beds of cgl. occur. Makes up western and older part of Cascade Mtns. Fossil leaves (3 sp.) from a thin layer of interstratified tuff may be Mio., Olig., or Eocene, according to R. W. Brown of U. S. Nat. Mus., but Chaney says (orally) they are Eocene. Assigned to Eocene (?) in this rept. Named for occurrence along crest of Calapooya Mtn. *Lies uncon. on Umpqua fm.*

Calaveras formation (also **group**).

Mississippian: Northern California (Calaveras and neighboring counties).

H. W. Turner, 1893 (Am. Geol., vol. 11, pp. 307–324, 425). The term *"Calaveras formation"* as used by U. S. Geol. Survey on geol. maps of Gold Belt [then in preparation] includes all Paleozoic sed. rocks of Sierra Nevada. Is characterized by large masses of associated greenstone. Includes sl., cgl. and ls., associated with igneous rocks of apparently same age as enclosing sed. rocks. Uncon. underlies Mesozoic Mariposa slates. So far as yet known is chiefly lower Carbf., but may extend down into Dev. It is not intended to include in it the Sil. beds described by Mr. Diller nor the upper Carbf. strata of Genesee Valley, called by Mr. Diller *Robinson beds.*

Two of U. S. G. S. geol. maps of Gold Belt referred to by Turner were published in 1894 (folios 3 and 11), and others followed later. These folios describe Calaveras fm. as consisting of a conformable series, 4,000 ft. or more thick, of black micaceous clay-sl., argill. schist, qtzite, chert, and mica-schist, with lenses of ls. and some beds of cgl., all associated and in part interbedded with igneous rocks. Is lower fm. of †Auriferous slate series.

Named for prominent development in Calaveras Co.

†Calciferous group.

†Calciferous sandrock.

†Calciferous sandstone.

Descriptive terms applied originally in early N. Y. repts to beds occupying interval btw. †Birdseye (Lowville) ls. above and Potsdam ss. below. Generally included Beekmantown ls. plus Little Falls dol. of present terminology. The name has been applied in other States to rocks of different ages. (See State correlation charts.)

†Calciferous mica schist.

Silurian and Ordovician: Western New Hampshire and Vermont.

C. H. Hitchcock, 1870 (Geol. and Min. N. H. 2d Ann. Rept., geol. map); 1873 (Am. Ass. Adv. Sci. Proc., vol. 21, pp. 134–135); 1877 (Geol. N. H., pt. 2, pp. 658–675); 1896 (Jour. Geol., vol. 4, pp. 44–62 and Geol. Soc. Am. Bull., vol. 7, pp. 510–512); 1906 (Vt. Geol. Surv. 5th Rept., pp. 86, 115).

Said to include Waits River ls. (Lower Ord.) and Vershire schist (Ord.). The rocks mapped as *Calciferous mica schist* by Hitchcock in SW. N. H. are now classified as Sil.

†Calciferous formation.

Lower Ordovician: Northwestern Michigan (Marquette region).

A. C. Lane, 1907 (Mich. Miner, vol. 9, No. 2, p. 9). The *Calciferous fm.* for Mich. may be conceived as taking its name from Calciferous station of Marquette & Southeastern R. R.

R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14, geol. ser. 11, btw. pp. 22 and 32). *Calciferous or Lower Magnesian ss.* (Prairie du Chien) is 200 to 250 ft. thick in wells along Green Bay. Named for Calciferous Creek, a branch of Au Train River, Mich.

Calderwood formation.

Cambrian (?): Central southern Maine (Vinalhaven Island, Knox County).

G. O. Smith, 1896 (Geol. Fox Islands, Maine, pp. 12, 28–29). *Calderwood's Neck schists.*—Sed. rocks, consisting of the dark qtzitic slates, banded schists (quartzose but varying in color and grain), and quite massive qtzites occurring on NE. part of Vinal Haven Island. Felsitic rocks occur in close proximity to the granite and volcanic rocks and undoubtedly represent contact phases of members of Calderwood's Neck series. These are mottled or variegated, generally a light green. Probably older than Niagara.

G. O. Smith, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 4). *Calderwood fm.*—Name applied to rocks earlier described and mapped as *Calderwood's Neck schists*. Probably belong to either Islesboro or Penobscot fm., but isolated position prevents certain correlation. Assigned to Camb. (?).

On 1933 geol. map of Maine, by A. Keith, these rocks on Calderwood Neck are included in the Ord. and Camb. block.

†Calderwood's Neck schists.

See *Calderwood fm.*

Caldwell series.

Cambrian (?): Quebec.

B. R. MacKay, 1921 (Canada Geol. Surv. Mem. 127, pp. 12, 20).

Caldwell Knob member (of Seguin formation).

Eocene (lower): Southeastern Texas (Brazos River to Rio Grande Valley).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 575, 576, 577, 581). *Caldwell Knob memb.*—Top memb. of Seguin fm. Consists of a layer of oyster shells varying in thickness from a few inches to several ft., the average being about 1 ft. The oysters (in most places *Ostrea multilirata*) lie in matrix of calc. silt, in most places cemented into hard sandy ls. The bed has been traced by Julia Gardner from near Brazos River in Milam Co. to Rio Grande Valley and has been identified on Guerrero structure near Guerrero, Mexico. Is not continuous along outcrops. Type loc. is Caldwell Knob, 10 mi. N. of Bastrop and 2± mi. S. of Colorado River in Bastrop Co.

Caledonia conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 576, 580, 588, 593, 612, and 957). Is cgl. No. 8 [Bohemia cgl.], top fm. of Bohemia Range group.

Probably named for occurrence near old Caledonia mine, Ontonagon Co.

Caledonia group.

Pre-Carboniferous: New Brunswick.

G. A. Young, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 311).

Calera limestone member (of Cahil sandstone).

Jurassic(?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Calera ls.*, foraminiferal, 60 ft. thick. [Shown in table as overlain by volcanics that are older than Bolinas ss. and underlain by volcanics that are younger than Pilarcitos ss.]

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U.S.G.S. San Francisco folio, No. 193). *Calera ls. memb.*—Gray, compact, foraminiferal ls. resembling lithographic ls. and containing lenses of chert. Occurs in lower part of Cahil ss., basal fm. of Franciscan group. Thickness averages about 60 ft.

Named for exposures in sea cliffs at lower end of Calera Valley, San Mateo Co.

Calhoun shale member (of Shawnee formation).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 29). *Calhoun ss. and sh.*—Soft argill. ss., 12 to 20 ft. thick, overlain by 38 to 45 ft. of fine-textured bluish sh. Included in Upper Coal Measures of Shawnee Co., Kans. Overlies Calhoun ls. [Deer Creek] and underlies Topeka ls.

Adopted by U. S. Geol. Survey as a memb. of Shawnee fm. in Mo., underlying Topeka ls. memb. and overlying Deer Creek (†Calhoun) ls. memb. In Kans. the Shawnee is treated as a group and the Calhoun sh. as a fm.

In 1927 (Nebr. Geol. Surv., 2d ser., Bull. 1) G. E. Condra divided *Calhoun sh.* into (descending) Iowa Point sh., Sheldon ls., and Jones Point sh. In Oct. 1932 (revised correlation chart of Kans. and Nebr.) R. C. Moore and G. E. Condra restricted *Calhoun sh.* to the beds previously called *Iowa Point sh.*, and included their Sheldon ls. and Jones Point sh. in Deer Creek ls. In 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11) Condra reverted to his 1927 definition of Calhoun sh., as did R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser.) restricted this sh. as explained in 1937 entry under *Topeka ls.*

Named for exposures in Calhoun Bluffs, about 3 mi. NE. of Topeka, Kans. See Kans-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Calhoun limestone.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 28). *Calhoun ls.*—Three beds of bluish to yellowish gray ls. separated by layers of sh. Thickness 15 to 20 ft. Upper bed massive ls. 7 to 10 ft. thick. Underlies Calhoun sh. and overlies Tecumseh sh.

Same as Deek Creek ls. (older name), according to Hinds and Greene (1915) and R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).

Named for Calhoun Bluffs, about 3 mi. NE. of Topeka, Kans.

Caliche Mountain rhyolite.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co., Prospectus, p. 16).

Calico amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U.S.G.S.P.P. 144, 1929. Derived from variegated color of the rocks, suggesting calico. Lies about 125 ft. above Minesota cgl., according to Butler (personal communication). The mineralized part is the Calico lode. Belongs to Central Mine group.

Calico flow.

Includes Calico amygdaloid and the underlying trap.

†Calico shale.

Descriptive term. See under *Springville sh.* (Upper Dev., SW. Ill.).

Calico marble.

A trade term sometimes applied to beds quarried from Potomac marble of southern Pa. and western Md.

†Calico ledge.

A name applied in some early Mo. repts to Raytown ls.

Calico Bluff formation.

Mississippian (upper): Central eastern Alaska (Nation River region).

A. H. Brooks and E. M. Kindle, 1908 (Geol. Soc. Am. Bull., vol. 19, p. 292, etc.). *Calico Bluff fm.*—Thin-bedded ls., slates, and shales; some igneous rock. Invertebrate fossils of Lower Carbf. age. Conformably overlies Upper Dev. shales and slates. Underlies (uncon.) Nation River fm. Exposed at Calico Bluff and other points on Upper Yukon River, also on Porcupine River.

J. B. Mertie, Jr., 1933 (U.S.G.S. Bull. 836, p. 423), stated that he believed a group of intermediate or transitional rocks, 1,000 to 2,000 ft. thick, exists btw. Nation River fm. and Calico Bluff fm. in Tatonduk-Nation dist., but that this remains to be proved. He assigned Calico Bluff fm. to upper Miss. (Chester), on basis of fossils identified by G. H. Girty.

Calico Peak porphyry.

Tertiary: Southwestern Colorado.

W. Cross and A. C. Spencer, 1900 (U.S.G.S. 21st Ann. Rept., pt 2, pl. 22—map of Rico Mtns). *Dikes of Calico Peak porphyry.* [Text heading is *Porphyry of Calico Peak and vicinity.*]

W. Cross and A. C. Spencer, 1905 (U.S.G.S. Rico folio, No. 130). *Dikes of Calico Peak porphyry* occur on N. slope and elsewhere in vicinity of Calico Peak [about 4 mi. NW. of Rico] and in a sheetlike body in Dakota ss. at head of Priest Gulch. Is a monzonite porphyry characterized by large orthoclase crystals. *Calico Peak porphyry alunitized* (a porphyry changed by solfataric action into a mass consisting chiefly of alunite) forms cone of Calico Peak.

Calico Rock sandstone member (of Everton formation).

Lower Ordovician (Chazy or older): Central northern Arkansas (parts of Baxter, Izard, Fulton, and Stone Counties).

G. C. Branner, 1929 (Ark. Geol. Surv. geol. map of Ark.). [Columnar section on map shows *Calico Rock ss. memb.*, 200± ft. thick, as lying in lower part of Everton ls., possibly a little higher than Kings River ss. memb. of Everton to W. Mapped at and around Calico Rock and other parts of Izard Co., and over parts of Baxter, Fulton, and Stone Counties.]

A. W. Giles, 1930 (Ark. Geol. Surv. Bull. 4, pl. IX and pp. 113+). *Calico Rock ss.*—Named for conspicuous outcrops in river bluffs E. and W. of town of Calico Rock, on White River, in W. part of Izard Co. Lies in lower part of Everton fm., which is of early middle Ord. age and uncon. underlies St. Peter ss. [Mapped over parts of Izard, Shark, Fulton, and Baxter Counties.] Thickness 0 to 150 ft. Interval (0 to 400 ft.) btw. Calico Rock and St. Peter ss. is occupied by beds of massive, white, coarse-grained ss. alternating with thin to massive, blue to gray mag. beds with a few dove-colored layers, the ss. layers being lithologically identical with Calico Rock and St. Peter sss. According to Miser, the Calico Rock ss. rests on beds of Everton age which are not identified as Sneeds ls., the basal memb. of Everton, and which consist of an alternation of blue and gray ls. and some coarse ss. In section W. of Calico Rock measured by writer and Brewster, an uncon. btw. these beds and Calico Rock ss. is suggested. The Calico Rock is unfossiliferous, cross-bedding is common, and ripples conspicuous. In general it is like the St. Peter, very friable; locally it is resistant; is of white or light-cream color; weathers dull brown; green bands are not as noticeable as in the St. Peter, but yellow to brown ferruginous streaks are locally developed along joints and other fractures, as in the St. Peter.

†California sandstone.

See †*San Francisco ss.*

California granite.

Pre-Cambrian: Northwestern New York (Gouverneur quadrangle).

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 52, 61–65). *California granite mass* forms California phacolith, Lake Bonaparte quad., and extends into Antwerp quad. Intrudes Grenville series. [Derivation of name not stated. According to p. 52 the granite belongs to his Alexandria type.]

Callaway limestone.

Middle Devonian (Hamilton): East-central Missouri.

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4, pp. 30, 43). *Callaway ls.*—Dark-colored shaly lss., 70 ft. thick, containing Western Hamilton fossils. Overlies Grand Tower ls. and underlies black shales or Louisiana ls.

C. R. Keyes, 1895 (Mo. Geol. Surv. vol. 8, p. 340). The Dev. rocks along Missouri River have been termed *Callaway beds*, and consist of heavy calc. layers overlain by 30 ft. of highly fossiliferous sh. Contain "Western Hamilton" fauna.

C. R. Keyes, 1896 (Mo. Geol. Surv. vol. 11). *Callaway ls.*, 60 to 70 ft. thick, underlies "Black" sh. and overlies Grand Tower ls. Consists of (ascending) compact blue or buff to brown highly fossiliferous ls.; sh. 30 ft.; thin-bedded ls. passing at top into calc. sh., some of which may be "Black" sh.

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Callaway ls.* assigned to *Upper Dev.* Conformably underlies Craghead Creek sh. and discon. overlies Grand Tower ls.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines, 2d ser., vol. 16, pp. 49, 52). *Callaway ls.*—Underlies Craghead Creek sh. and uncon. overlies Middle Dev., the top fm. of which is St. Laurent ls. Thickness 0 to 59 ft.; max. in Callaway and Montgomery Counties; pinches out to E. and W. in Warren and Boone Counties. Assigned to *Upper Dev.* [This definition was followed by H. A. Buehler on 1922 geol. map of Mo.]

E. B. Branson, 1923 (Mo. Bur. Geol. and Mines, 2d ser., vol. 17, pp. 24–36). *Callaway ls.* presents several phases. Its thickest parts are light to dark blue, compact, fine-grained ls., in many places highly fossiliferous. A light to dark-brown compact ls. is usually present in 3 or 4 beds having a combined thickness of less than 6 ft. A third phase is white to gray coarsely to finely crystalline ls., which occurs in 1 to 3 lentils ranging in thickness from 6 in. to 4 ft. At many places a highly cross-bedded ss., ranging in thickness up to 20 ft., occurs at base of fm. Is conformably overlain by Snyder Creek sh., or, where that is absent, by either Grassy Creek sh., Sylamore ss., Chouteau ls., or Burlington ls. Rests uncon. on fms. ranging from Mineola ls. (Middle Dev.) to Jefferson City ls. (Lower Ord.). Thickness 0 to 52 ft. 7 in. Is of *late Hamilton age* and may include some beds of early Tully age.

Named for development in Callaway Co. Best developed from Cedar Creek eastward through Callaway Co.

Calliham sand.

Eocene (upper): Southeastern Texas (Atascosa and Karnes Counties).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1315, etc.). *Calliham sand.*—Gray fossiliferous sand typically exposed on Frio River N. of Calliham, where Whitsett-Calliham road crosses river. Sam Houston, who suggested the name for this sand and who has traced it from Frio River to Karnes Co. line, found it varies from highly fossiliferous, fine-grained gray sand, as in outcrops on Frio River, to rice-grained and conglomeratic sand cropping out in Atascosa Co. S. of Campbellton. Thickness 20± ft.; absent, both on surface and in wells, in western Karnes Co. Is a zone in Whitsett fm. as here defined, underlying Fashing clays and overlying Dubose sands and clays.

Call Mill slate.

Cambrian (Lower): Southern Quebec.

See under *West Sutton sl.*

Calloway limestone.

Middle Devonian: Missouri.

See *Callaway ls.*, the correct spelling of the county for which the ls. was named.

Callville limestone.

Pennsylvanian: Southeastern Nevada (Muddy Mountains).

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 47) and 1928 (U. S. G. S. Bull. 798). *Callville ls.*—Dark-colored ls., with zones of lighter gray at intervals; many layers almost black; hard and dense, coarse granular texture subordinate; beds regular and massive; occasional thin layers; shaly layers rare; chert less abundant than in the Miss. lss. Thickness 1,100+ ft. [2,000±]. Fossils are Pennsylvanian (Magdalena), according to G. H. Girty. Top not defined because not known. Is uncon. overlain by Supai fm. Name is applied to all Penn. lss. in Callville Mtn, Clark Co., but all sections there are incomplete. Overlies Bluepoint ls., probably uncon.

Caloosahatchee marl.

Pliocene (lower): Southern and northern Florida.

W. H. Dall, 1887 (Am. Jour. Sci., 3d, vol. 34, pp. 161–170). *Caloosahatchie beds.*—The marls of the *Caloosahatchie* contain a large number of species of which perhaps one-tenth are supposed to be extinct; many of the others are known only from deep water. How many of the so-called extinct ones will turn out to be still living when the deeper waters of the Floridian coast are thoroughly dredged remains to be seen. The age of the Caloosahatchie beds is much the same as others which have been called Plio. on our Eastern coast. The time has not yet arrived, nor is our knowledge of any part of our later Tertiaries sufficient to enable us to decide finally as to their chronologic relation to each other, except in a most tentative way. But without reference to their place in the system, the geological history of the Caloosahatchie marls is clearly stated in their structure. [On p. 163 Dr. Dall refers to the *Coloosahatchie Pliocene.*]

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *Caloosahatchee marl* redefined so as to include "Nashua" marl, which is so nearly of same age that two names are unnecessary. As here expanded it includes all known marine Plio. deposits in Fla. and a bed containing extinct fresh-water shells, which, according to Dall, lies at top of fm.

Named for exposures on Caloosahatchee River, Lee Co., especially btw. Labelle and Olga.

†Calumet conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 53–58 and chart). Is cgl. No. 13 of Keweenaw Co.

Same as Calumet and Hecla cgl. of Central Mine group.

Named for occurrence in Calumet mine, Houghton Co.

Calumet amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan (Houghton County).

A. C. Lane, 1907 (Lake Superior Min. Inst. Proc., vol. 12, pp. 89–92). Older than Calumet cgl. and younger than Osceola amygdaloid.

Belongs to Central Mine group. The mineralized part is the Calumet lode.

Named for occurrence at Calumet mine, Houghton Co.

Calumet flow.

Includes Calumet amygdaloid and underlying trap.

Calumet and Hecla conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1895 (Mich. Geol. Surv. vol. 5, pt. 1, p. 117, footnote). According to measurements by James Crawford, the Calumet and Hecla cgl. lies 2,050 ft. below Allouez cgl. and 1,500 ft. above Kearsarge cgl. on Kearsarge location. [In C. Rominger's section of Calumet & Hecla mine in volume above cited, and throughout his rept forming pt. 1 of vol. 5, the cgl. referred to by Hubbard is called Calumet cgl.]

According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 68, 1911) this cgl. is composed almost wholly of pebbles of such extremely angular type that the rock has often been called a felsite breccia.

Belongs to Central Mine group.

Named for occurrence in Calumet & Hecla mine, Houghton Co.

Calvert formation.

Miocene (middle): Eastern Maryland, Delaware, and Virginia.

G. B. Shattuck, 1902. [See under *St. Marys fm.*]

W. B. Clark, 1903 (Md. Geol. Surv. St. Marys Co. Atlas). *Calvert fm.*—Fossiliferous sandy clay, clay, marl, and diatomaceous earth. Thickness 185 ft. Basal fm. of Chesapeake group. Underlies Choptank fm.

G. B. Shattuck, 1904 (Md. Geol. Surv. Miocene vol., pp. lxxii–lxxiv), divided Calvert fm. into Plum Point marl memb. (above) and Fairhaven diatomaceous earth memb., and gave thickness as 50 to 310± ft.

Named for exposures in Calvert Co., Md., especially in Calvert Cliffs, bordering Chesapeake Bay.

Calvert Bluff clay beds (of Rockdale formation).

Eocene (lower): Central and southern Texas (between Brazos and Frio Rivers).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 585, 586, etc.). *Calvert Bluff clay beds.*—Top memb. of Rockdale fm. in central and southern Tex., especially btw. Brazos and Frio Rivers. Type loc. at Calvert Bluff on Brazos River, Jesse Webb League, Robertson Co. Consist of: (a) Gray sand weathering red and buff, varying from coarse qtzitic sand to very fine silty argill. material that stands up like loess in steep banks; (b) dense, black lignitic beds 1 to 9 ft. thick; (c) dark gray, compact, carbonaceous clay in thick beds or in lentils interbedded with silt. Thickness 1,000 ft. Overlies Simsboro sand and underlies marine Sabinetown fm.

Calvin sandstone.

Pennsylvanian: Central, central southern, and central eastern Oklahoma.

J. A. Taff, 1901 (U.S.G.S. Coalgate folio, No. 74). *Calvin ss.*—Thick-bedded hard ss., 145 to 240 ft. thick, becoming friable, ferruginous, and shaly toward S. Overlies Senora fm. and underlies Wetumka sh.

Named for exposures at Calvin, Hughes Co.

†Calvin sand series.

Pennsylvanian: Central Oklahoma.

A. I. Levorsen, 1927 (A.A.P.G. Bull., vol. 11, No. 7, pp. 658–682). *Calvin series.*—A subsurface term which has come into general use for a series of three or four sands found at depths ranging from 1,700 to 2,000 ft., and which form a good marker in most logs. At outcrop on E., as shown on areal map of Okla., the highest memb. of this series is basal sand of Wewoka fm. The two sands occurring below the highest memb. are=Calvin sand [ss.] on outcrop. [Chart on p. 658 correlates the so-called "Calvin series" with Calvin ss., Wetumka fm., and basal part of Wewoka fm. of south-central Okla., and with Oswego lime of NE. Okla. and Palo Pinto ls. of north-central Tex.] The term originated during development of Cromwell field, T. 10 N., R. 8 E., Seminole Co., Okla.

†Calvins Run limestone.

See *Colvin ls. memb.*

Camajuani formation.

Cretaceous: Cuba.

E. L. De Golyer, 1918 (A.A.P.G. Bull., vol. 2, p. 141).

†Camargo schist.

Lower Cambrian and pre-Cambrian: Southeastern Pennsylvania.

A. I. Jonas and E. B. Knopf, 1921 (Wash. Acad. Sci. Jour., vol. 11, p. 447). *Camargo schist* is name given by writers to a porphyritic albite schist that conformably overlies a dol. of probable Beekmantown age. It forms the ridge that flanks Chester Valley on S. and comprises a portion of the fm. formerly known as *Octoraro schist.* It may represent the metamorphosed equiv. of the Normanskill sh. found near Harrisburg, Pa.

This name is no longer used by its proposers, they having found, by additional work, that the rocks are in part pre-Camb. and in part Camb., and include Antietam schist, Harpers albite schist, and the oligoclase mica-schist facies of Wissahickon fm.

Named for village of Camargo, near Quarryville, Lancaster Co., Pa.

Camas basalt.

Tertiary: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 99, map). *Camas basalt.*—Chiefly lava flows; tuffs and breccias occur in places but are not characteristic. No sed. intercalations seen. The basalt in S. part of Co. is typically fine-grained, dense, almost black. Thickness 500± ft. along S. side of Camas Prairie. Rests uncon. on older fms., including Gerome andesite. Assigned to Tert.

Camas sandstone.

Upper Cretaceous: Mexico (Sonora). See under *Cabullona group.*

Cambrian period (or **system**).

The time (and the rocks) of the oldest Paleozoic period, preceding the Ord. period. For definition see U. S. G. S. Bull. 769, pp. 92–101.

Cambric.

A variant of *Cambrian* employed by some geologists.

Cambridge slate.

Carboniferous or Devonian: Eastern Massachusetts (Boston Basin region).

N. S. Shaler, 1871 (Boston Soc. Nat. Hist. Proc., vol. 13, pp. 173–175). *Cambridge slates.*—Dense argill. material with little admixture of foreign substances. Thickness more than 200 ft. Best seen at Cambridge. Assumed to belong to same great series of beds as Roxbury cgl.

J. B. Woodworth, 1895 (Boston Soc. Nat. Hist. Proc., vol. 26, pp. 125–126). *Cambridge slates* of Shaler rest on Roxbury cgl., and name is extended to other parts of Boston Basin where fossils similar to those present in vicinity of Mystic River have been found.

See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597).

L. LaForge, 1932 (U. S. G. S. Bull. 839), treated *Tufts qtzite* as top *memb. of Cambridge sl.,* which he assigned to *Dev. or Carbf.* He also introduced *Boston Bay group* to include Cambridge sl. and Roxbury cgl. The U. S. Geol. Survey in June 1910 adopted *Tufts* as a memb. of Cambridge sl., for foregoing rept, the publication of which, however, was delayed until 1932.

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 99–112), excluded Tufts qtzite from *Cambridge argillite,* as he called the fm., and assigned both to Perm.

Cambridge limestone member (of Conemaugh formation).

Pennsylvanian: Eastern Ohio, western Pennsylvania, and West Virginia.

E. B. Andrews, 1873 (Ohio Geol. Surv. vol. 1, p. 262). *Cambridge ls.,* 0 to 2 ft. thick, lies in Productive Coal Measures, about 225 ft. below Pomeroy coal. Separated from higher Ames ls. by 85 to 90 ft. of sss. and shales.

Adopted as a memb. of Conemaugh fm., for the ls. which in some repts has been called "Upper Cambridge ls." and "Pine Creek ls.;" and *Brush Creek ls. memb.* adopted for what in some repts has been called "Lower Cambridge ls."

Named for exposures near Cambridge, Guernsey Co., Ohio.

Cambridge formation.

Eocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 57–65).

Cambridge red bed. (In Conemaugh formation.)
Pennsylvanian: West Virginia (Wheeling).

C. K. Swartz, 1922 (Md. Geol. Surv. vol. xi, p. 61, pl. 6), applied *Cambridge red bed* to a bed lying a few ft. above Cambridge ls. and underlying the fire clay beneath Anderson coal in Wheeling, W. Va., section. In Freeport, Pa., section he applied the name to beds underlying Upper Bakerstown coal and overlying Lower Bakerstown coal.

Cambridge sand.
A subsurface sand in Cambridge field, Guernsey Co., Ohio, that is said to correspond to Oriskany ss. (See W. Stout et al., Geol. of nat. gas, A. A. P. G., 1935, p. 907.)

Cambridge moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Isanti, Sherburne, and Anoka Counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, p. 80). Second moraine of Rush Lake morainic system. Named for development below Cambridge, Isanti Co.

Cambrovician.
A term proposed by A. W. Grabau "to include the Upper Camb. and Lower Ord. of current usage, these forming a complete pulsation unit." (See Pan-Am. Geol., vol. 66, No. 1, 1936, p. 24.)

†Camden series.
Eocene and Upper Cretaceous: Arkansas, Louisiana, southeastern Oklahoma, and eastern Texas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. for 1888, vol. 2, pp. 49–65, 177, 188). *Camden series.*—Shallow-water, semi-estuarine marine deposits of stratified, micaceous, non-indurated, alternating laminae of sands and clay shales, sandy shales, bituminous shales, lignitic shales, thin sss., etc. Thickness 100 to 700 ft. Includes Arkadelphia shales, Bingen sands, and Cleveland County red lands. Included in Eocene. Underlies Quat. Overlies Cret. rocks.

R. T. Hill, 1902 (Franklin Inst. Jour., vol. 154, No. 2, pp. 143–156, 264–266). *Camden series* includes all rocks from base of Eocene to Nacogdoches oil fm. Kennedy noted strat. unconformities btw. Camden series and overlying Angelina series. [Included Midway fm., Wilcox group, Claiborne group, and Jackson fm.]

Named for exposures in bluffs at Camden, Ouachita Co., Ark.

Camden chert.
Middle Devonian: Western Tennessee.

J. M. Safford and C. Schuchert, 1899 (Am. Jour. Sci., 4th, vol. 7, pp. 429–430). *Camden chert.*—Chert, exposed to a thickness of 60 ft. at Camden, Benton Co., and containing a Lower Oriskany fauna. Overlies Lower Helderberg shaly bluish ls. [Linden fm.]. Occurs also in Henry, Decatur, and Stewart Counties. [Subsequent repts by Safford applied *Camden chert* to all beds in Tenn. btw. Hardin ss. and Linden fm., and assigned it to Oriskany.]

In 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 732–755) C. O. Dunbar restricted Camden chert to upper 200 ft. of beds to which it had formerly been applied, and subdivided the lower part into Harriman chert (0 to 55 ft. thick), underlain by Quall ls. (0 to 10 ft. thick), underlain by Decaturville chert (0 to 6 ft. thick). According to Dunbar the restricted Camden chert is of Onondaga age, the Harriman and Quall are of Oriskany age, and Decaturville chert is of Helderberg age, and the four fms. are uncon. one with the other and also uncon. with both underlying and overlying fms., the Camden chert being uncon. overlain by Pegram ls. and Decaturville chert uncon. underlain by rocks of earlier Helderberg age to which Dunbar has applied name *Birdsong fm.*

Named for exposures along Cypress Creek, SE. of Camden, Benton Co.

Cameron red shale member.

Mississippian: Northwestern Pennsylvania (Cameron County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 142). For the red sh. memb. (or composite memb.) that overlies Loyalhanna ls. memb. on Clarion River, SW. Pa., which in past has been called *Mauch Chunk*, the name *Cameron red sh. memb.* is proposed. These red beds are overlain by Greenbrier ls. memb., which is overlain by another red sh. that has been called *Upper Mauch Chunk sh.* The four members (Loyalhanna ls., Cameron red sh., Greenbrier ls., and Upper Mauch Chunk sh.) comprise *Greenbrier series.* The Cameron memb. can be studied from well sections and exposures in Cameron Co.

Cameron sandstone member (of McAlester shale).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, McIntosh, and adjacent counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Cameron ss. memb. of McAlester sh.*—Commonly thin and regularly bedded, but massive and irregularly bedded in T. 11 N., R. 17 E., and T. 11 N., R. 20 E.; of fine to medium texture; usually light gray but sometimes brown, especially where massive; ripple marks common. Fossils. Thickness in Muskogee-Porum area 15 to 20 ft. Lies 40 ft. above Lequire ss. memb. and 1 to 10± ft. below McAlester (Stigler) coal. Named for exposures NW. and W. of Cameron, in T. 8 N., R. 26 E.

Cameron Bay series.

Pre-Cambrian: Canada (Northwest Territory).

H. S. Robinson, 1933 (Canadian Min. and Met. Bull. 258, p. 615).

Camillus shale member (of Salina formation).

Silurian: Western to east-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, pp. 18–19 and chart). *Camillus sh.* (gyp. and platten dolomites), underlies Bertie waterlime and overlies Syracuse salt. Included in Salina beds.

In later repts thicknesses of 40 to 600 ft. are given for *Camillus memb.*, which is next to top memb. of Salina fm.

D. H. Newland, 1928 (Nat. Research Council Reprint and Circ. ser., No. 85, pp. 37–39). The N. Y. Salina, exclusive of basal strata, is dominantly, but to a varying degree, a fm. of chemical precipitates—fine-grained, mostly nonfossiliferous dol. and mag. ls., heavy rock-salt beds, and smaller seams of calcium sulphate usually in form of anhydrite. In N. Y. type sections sh. has been given undue importance in descriptions, because weathering of the impure lss. produces a calc. clay (called marl in early N. Y. repts), and gives impression the Camillus strata, which constitute bulk of Salina section, are largely sh. This is contrary to actual findings in fresh rock sections, where chemical precipitates compose the main persistent members, and where sh. is a variable sporadic element, more in evidence in lower zone close to contact with Vernon sh. The term *Camillus sh.* therefore seems hardly appropriate, although sanctioned by long usage. Writer favors calling this memb. *Camillus beds,* which term conveniently covers the various components, both of the weathered and diminished sections on outcrop and normal full succession encountered in depth.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 318), placed *Camillus sh.* below Bertie and above Syracuse salt, but on pp. 339–340 she stated: *Camillus sh.* includes, besides shales, abundant gyp. and salt beds and flaggy dolomites. The salt-bearing strata are the Syracuse salt, which includes the main salt layers and associated salty sh. and ls. No sharp bdy exists btw. the salt-bearing strata and rest of the Camillus, and it can only be determined from well records and shafts which reach the salt at depth of 800 ft. or more. Camillus sh. is practically unfossiliferous.

Named for exposures at Camillus, Onondaga Co.

Campagrande formation. (In Trinity group.)

Lower Cretaceous (Comanche series): Western Texas.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 47). *Campagrande fm.*—Ls. cgl., 25 ft. thick, overlain by 350 ft. of gray ls., generally massive but locally containing nonpersistent thin-bedded ls. grading into sh. Basal fm. of Fredericksburg group. Underlies Cox fm. and uncon. overlies Hueco fm. in central part of Finlay Mtns.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745), transferred this fm. to Trinity group.

Named for Campagrande Draw, in Finlay Mtns, El Paso Co.

†Campan group and †Campan series.

See *Campus fm.*

Campbell sand.

A subsurface sand, of Penn. age, in Garber pool, Garfield Co., central northern Okla., which lies at 1,700 ft. depth, the Belveal sand lying at 1,600 ft. and the Crews sand at 1,800 ft.

Campbell Creek limestone. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1885 (The Virginias, vol. 6, pp. 7-16). *Campbell Creek ls.*—Layer of impure ls. with cone-in-cone structure. Thickness 1 foot. Makes its first appearance along Campbell Creek [Kanawha? Co.]. May represent Johnstown cement bed of Pa., since according to my identification of the coals it occurs at the right geological horizon for that bed. Lies 50 ft. below Middle Kittanning (Cedar Grove) coal and 20 to 40 ft. above Lower Kittanning (Campbell Creek) coal. [Later studies showed that Cedar Grove coal is much older than Middle Kittanning coal, and that Campbell Creek ls. is a memb. of Kanawha fm., lying 0 to 20 ft. above Campbell Creek coal and 0 to 5 ft. below Lower Monitor ss. of W. Va. Geol. Surv.]

Campbell Creek beds.

Carboniferous: British Columbia.

G. M. Dawson, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 44B-45B, 129B).

Campbell Creek (Lower) sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western Mercer and Summers Counties, p. 327). *Lower Campbell Creek ss.*, 0 to 30 ft. thick, underlies Campbell Creek coal and overlies Lower Campbell Creek coal.

Campbell Mountain rhyolite.

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). Overlying the Willow Creek rhyolite rather irregularly is a rhyolite flow breccia here named *Campbell Mtn rhyolite.* In most places no evidence was seen of more than one flow, but on East Willow Creek two flows of this type are separated by a few hundred ft. of Phoenix Park quartz latite. Thickness 0 to 1,000 ft. Upper contact of Campbell Mtn rhyolite is everywhere sharp, but some of overlying rocks so closely resemble it that separation was somewhat difficult. Is a fm. in Alboroto group of Potosi volcanic series. Named for Campbell Mtn.

Campbell Run sand.

Drillers' term; western Pa. and W. Va.; probably lies at horizon of Gordon Stray sand, of Catskill(?) age.

Campbell's Ledge black slate. (In Pottsville formation.)

Pennsylvanian: Northeastern Pennsylvania (Lackawanna County).

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 37-42). *Campbell's Ledge black sl.*—Highly bituminous black sl., 0 to 10 ft. thick, with plants and insects. Included in Pottsville cgl., but it underlies the massive cgl. and rests on 0 to 3 ft. of hard gray or creamy-white ss., also included in Pottsville. At Campbell's Ledge, near Coxton, Lackawanna Co., it is 5 ft. thick.

D. White, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, p. 819). The large flora of the dark plant-bearing shales which lie within a few ft. of supposed Mauch Chunk in the very thin section (56± ft.) of Pottsville fm. at Campbell Ledge, near Pittston, cannot be older than Lykens No. 1 coal.

Campbellton formation.

Devonian: New Brunswick.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 207).

Camp Branch sandstone member (of Pottsville formation).

Pennsylvanian: Northern central Alabama (Warrior coal field).

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175). *Camp Branch ss. memb.*—Gray ss., medium grained, generally thick bedded, about 40 ft. thick. Is a memb. of Pottsville fm., near its top. Underlies Cobb coal and lies 210 ft. above Pratt coal in Warrior coal field.

Named for exposures along S. bluff of Camp Branch, Birmingham dist.

Camp Colorado limestone member (of Pueblo formation).

Pennsylvanian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 418). *Camp Colorado bed.*—Chiefly hard, rather brittle, bluish gray ls., rough weathering, and often much fractured. Contains many black or nearly black chert nodules. Thickness 10 to 25 ft. Memb. of Cisco div. Overlies bed No. 13 (reddish clay) and underlies Watt's Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 40; Univ. Tex. Bull. 2132, pp. 172–182 and charts). *Camp Colorado ls.* is top memb. of Pueblo fm. in Colorado River and Brazos River Valleys. Remarkably uniform and persistent. Underlies Watt's Creek sh. memb. of Moran fm. and is separated from underlying Stockwether ls. by 65 to 98 ft. of sh., ss., and ls.

Camp Cove series.

Jurassic (?): British Columbia.

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissertations 1924–26, vol. 1, p. 132).

Camp Creek shale member (of Pueblo formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 416). *Camp Creek bed.*—Red and yellowish sandy clay, with some thin layers of ls. in places and a little ss. Thickness 40 to 50 ft. Memb. of Cisco div. Underlies Coon Mtn bed and overlies Saddle Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, p. 172 and charts). *Camp Creek sh. memb.*—Basal memb. of Pueblo fm. Underlies Stockwether ls., the Coon Mtn bed of Drake having proved to be largely Cret. sands overlapping several Penn. beds.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated Camp Creek sh. of Drake as basal memb. of Pueblo fm., underlying Coon Mtn ss. and overlying Saddle Creek sh.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+), defined Camp Creek sh. memb. of Pueblo fm. as including all beds beneath Stockwether ls. memb. and above Saddle Creek sh.

The present definition of U. S. Geol. Survey treats Camp Creek sh. memb. as basal memb. of Pueblo fm. It underlies Coon Mtn ss. memb. and overlies Saddle Creek sh. memb. of Harpersville fm.

Named for Camp Creek, Coleman Co.

Camp Creek group.

Pre-Cambrian (Belt series): Central western Montana (Mission Range).

C. D. Walcott, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 2–7, 9, 18). *Camp Creek* Basal fm. of Triassic in area mapped [see above], consisting of a coarse cgl., brownish wherever exposed, due mainly to preponderence of brown quartz and chert pebbles. Contains much fossilized wood, in some instances whose free trunks from 6 in. to 2 ft. diam. and 6 in. to 10 ft. long; also many bone fragments, especially from vertebræ of reptiles. Rests on Double Mtn group with slight angular uncon. Best exposed at Camp Springs, near center of E. line of ss. 395 ft.

Named for exposures on Camp Creek, Mission Range.

Camp Creek series.

Devonian: Mackenzie.

T. O. Bosworth, 1921 (Geol. Mag., vol. 58, p. 287).

Campito sandstone.

Lower Cambrian: Eastern California (Inyo Range).

E. Kirk, 1918 (U. S. G. S. P. P. 110). *Campito ss.*—Chiefly ss., which on fresh fracture is dense fine-grained grayish rock with conspicuous fine dark lines that indicate highly complex cross bedding. Weathers reddish brown to dark purplish red. Associated with this ss. are some bands of very dense lighter colored qtzitic ss. separated by thin layers of siliceous sl., which occur as partings in the dense ss. Upper third of fm. is somewhat more slaty and includes zones curiously speckled by ferric oxide. Remarkable cross bedding at several horizons. Rests uncon. on Deep Spring fm. and appears to grade into overlying closely related Silver Peak group, the upper limit of the Campito being placed at lowest horizon at which fissile calc. shales and fairly pure masses of ls. appear. Thickness of fm. 3,200 ft. Named for prominent exposures on Campito Mtn.

Campnelson limestone.

Lower Ordovician: Central Kentucky.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 9, 12). *Campnelson substage.*—Massive compact ls., with conchoidal fracture, characterized by *Maclurita bigbyi;* 285 ft. thick. Lowest div. of Highbridge stage. Overlain by Oregon bed. [A. M. Miller (1925) gave thickness at Camp Nelson as 285 ft.]

Named for Camp Nelson, Jessamine Co.

†Campobello group.

Silurian: Southeastern Maine (Washington County).

N. S. Shaler, 1886 (Am. Jour. Sci., 3d, vol. 32, pp. 47–60). *Campobello series or group.*—A series of very compact and highly metamorphosed, nonfossiliferous schists, slates, and qtzites, considerably cut by dikes. Comprises a set of dark greenish and grayish siliceous and argill. rocks containing very little lime. Thickness at least 4,000 ft. Rocks appear to be destitute of fossils, though they are not so metamorphosed as necessarily to lose by this change all trace of fossils if they had once contained them. On Quoddy Head the Campobello series is highly metamorphosed. Probably rests on gneissoid and granitic rocks, with some mica schist, all of Laurentian age, and may represent the lower Camb. section. Above these Camb. layers, and without observed contacts with them but with scant place for any intermediate deposits, lie the beds of the Cobscook series, which undoubtedly are uncon. on the Campobello.

Appears to be same as Quoddy sh. (Sil.).

Named for development on Campobello Island, off SW. coast of New Brunswick, adjacent to SE. part of Washington Co., Maine.

Camp Springs conglomerate.

Triassic: Northwestern Texas (Coke County northward to Oklahoma line).

D. D. Christner, 1926 (Univ. Tex. Bull. 2607, pp. 16–17). *Camp Springs cgl.*—Basal fm. of Triassic in area mapped [see above], consisting of a coarse cgl., brownish wherever exposed, due mainly to preponderance of brown quartz and chert pebbles. Contains much fossilized wood, in some instances whole tree trunks from 6 in. to 2 ft. diam. and 6 in. to 10 ft. long; also many bone fragments, especially from vertebræ of reptiles. Rests on Double Mtn group with slight angular uncon. Best exposed at Camp Springs, near center of E. line of Scurry Co., Tex.

Camp Supply beds.

Lower Cretaceous: Western Oklahoma (Custer ? County).

R. T. Hill, 1895 (Am. Jour. Sci., 3d, vol. 50, p. 227). *Camp Supply beds.*—Fossiliferous beds near Camp Supply, G Co., Okla., which are undoubtedly a southern extension of Belvidere beds.

Campton sand.

A subsurface sand, of Dev. age, in eastern Ky.

Campus formation.

Pleistocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, p. 398 and map). *Campan series.*—Interbedded fresh-water deposits and volcanic lavas and tuffs. Thickness 800 ft. Includes rhyolite tuff and other tuffs, aggl., cgls., andesites, basalt flows, clays, some ss. and ls., and the Pie Knob andesite. Uncon. overlies Berkeleyan series. Named because of its occurrence within limits of University Campus, Berkeley [on a hill behind the area now covered with buildings].

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Campus fm.*, originally named *Campan*, rests uncon. on Moraga and Siesta fms. of Berkeley group.

Camulos formation.

Pliocene (middle or upper): Southern California (Los Angeles and Ventura Counties).

C. [R.] Keyes, 1925 (Pan-Am. Geol. vol. 43, p. 316). [Name proposed for lower part of Arnold's Fernando fm., or probably for part of beds that Kew in 1921 named *Pico fm.*, which are now assigned to middle and upper Plio. Named for railway hamlet of Camulos, a few mi. directly W. of Saugus Junction, Santa Clara Valley.]

†Canaan limestone.

†Canaan dolomite.

Names applied in early repts to Stockbridge ls. of Canaan, NW. Conn. See J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 4, p. 370) and 1874 (Am. Ass. Adv. Sci. Proc.). In latter publication Dana called it "Stockbridge or Canaan ls." W. H. Hobbs, 1893 (Jour. Geol., vol. 1, pp. 717–736, 780–802), called the fm. "Canaan dol."

†Canaan formation.

Mississippian: West Virginia and adjacent parts of Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Canaan fm.*—Consists of very red clay sh. in lower part; red sandy sh. interstratified with greenish brown to brown fine ss. in upper part. Thickness 570 to 700 ft. Underlies Blackwater fm. and overlies Greenbrier ls. [In Buckhannon quad. it is overlain by Pickens ss.].

Same as Mauch Chunk sh.

Named for exposures in Canaan Mtn, Tucker and Grant Counties, W. Va.

Canaan Mountain fire clay.

Pennsylvanian: Northeastern West Virginia.

D. B. Reger, 1923 (W. Va. Geol. Surv. Rept. Tucker Co., pp. 190, 191, 444). *Canaan Mtn fire clay.*—Flinty fire clay, 5 ft. thick, occurring in midst of Lower Kittanning coal on top of Canaan Mtn, Tucker Co.

Canada Hill granite.

Pre-Cambrian: West Point quadrangle, southeastern New York.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, map and passim). *Canada Hill granite.*—Medium gray, medium-grained rock varying from faintly to very perceptibly streaked; composed of white and gray feldspar, gray quartz, small crudely oriented biotite crystals, and numerous small, rounded, violet-red garnets. Also includes a pegmatitic facies, which is coarser grained, grading into true pegmatite. Penetrates Grenville series. Type loc., Kings quarry, S. of Garrison. Canada Hill, Putnam Co., is in midst of the granite area.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this granite as of post-Glenarm age.

Canadaway group.

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

G. H. Chadwick, 1933 (Geol. Soc. Am., Prel. list of titles and abstracts of papers to be offered at 46th Ann. Meeting, Chicago, Ill., Dec. 28–30, 1933, pp. 19, 82, 83, 84). The so-called "Chemung" strata on Genesee River carry a distinct and later faunal assemblage, herewith named *Canadaway fauna (and group)*, which succeeds the true Chemung biota of Tioga Co., Pa. The Canadaway includes from Dunkirk black sh. to Cuba ss. Assigned to Chautauquan.

G. H. Chadwick, Feb. 28, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 351). All brachiopodous ("Chemung") fms. along Genesee River were deposited after close of true Chemung and while "red beds" were making in Chemung area. To these pseudo-Chemung later beds from base of the Dunkirk to base of Cuba ss., writer proposes to apply the substitute and distinctive name *Canadaway group*, and to those from base of Cuba ss. to base of Wolf Creek (or Panama) cgl., in which the fauna has been modified by loss of *Delthyris mesacostalis* and accession of *Camarotoechia (?) duplicata*, the name *Conneaut group*. The respective type sections are along Canadaway Creek, in western N. Y. [Chautauqua Co., near Dunkirk], and Conneaut Creek crossing Pa.-Ohio line. Both are, of necessity, chosen where the fms. are thinner and are, therefore, passing over into the "Naples" (usually called "Portage") facies. Conneaut and Canadaway groups belong to the Chautauquan. [On p. 323 he stated:] Canadaway group includes, on Canadaway Creek, in descending order, Northeast sh., Shumla ss., Westfield sh., Laona ss., Gowanda beds, and Dunkirk black sh.; on Genesee River it includes Machias beds (=Northeast sh.), Rushford sss. (=Shumla ss., Westfield sh., and Laona ss.), Chemung facies, locally Caneadea sh.; and Canaseraga ss. (=Dunkirk sh.). Fall Creek cgl. of Tioga Co., Pa., is included in Dunkirk sh.

G. H. Chadwick, Feb., 1935 (Am. Jour. Sci., 5th, vol. 29, p. 136). Latest count shows 250 true Chemung sp. (assigned to Senecan) fail to cross line into overlying Canadaway group (Chautauquan), as against only 90, mostly long range, forms that do; and in their place 135 new sp. with a dozen new genera appearing for the first time above this line, which corresponds westward with top of the old (type) Portage.

G. H. Chadwick, Nov. 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 859, 862). The fossiliferous strata formerly called "Chemung" on Genesee River are now known to differ in presence of 130 sp. not found in true Chemung strata below, and in absence of 240 sp. (including many characteristic forms) of typical Chemung fauna, while there are less than 100 sp. in common. These beds, with the "*Athyris angelica* fauna" constitute *Canadaway group*, which traced eastward goes wholly above type Chemung. On Lake Erie the Canadaway is readily subdivided into (descending): Northeast sh. (I. C. White's "Portage"); Shumla ss.; Westfield sh.; Laona ss.; Gowanda (formerly Portland beds, preoccupied); and Dunkirk black sh.

†Canadian series.

†Canadian period (or system).

As originally defined by J. D. Dana (Am. Jour. Sci., 3d, vol. 8, p. 214, 1874, and Man. Geol., 2d ed., pp. 142, 163, 182, 1875) the unit included Chazy and Beekmantown. As now used by some geologists it excludes Chazy and is synonymous with Beekmantown. Named from development in Canada. (See U. S. G. S. Bull. 769, pp. 87–88, for original definition.)

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed that *Canadian system* be used to include rocks of all ages occupying time interval from top of Beekmantown to base of Little Falls dol. of N. Y.

Canadian system of E. O. Ulrich corresponds to Beekmantown group of U. S. Geol. Survey and other geologists.

The present definition of N. Y. State Surv. includes in their *Canadian system* not only Beekmantown group but underlying Tribes Hill ls. and Schaghticoke sh. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931.)

Canajoharie shale.

Middle Ordovician: Eastern New York (Mohawk and Hudson Valleys).

J. M. Clarke, April 1911 (N. Y. State Mus. Bull. 149, pp. 10–12). *Canajoharie sh.*—Contains undoubted upper Trenton fauna, and is therefore separated from Utica sh., in which it was formerly included. Much of the [so-called Utica] sh. along the Hudson and in Albany and Saratoga Counties belongs to this fm., which rapidly thins out westward and does not reach meridian of Utica. Underlies Utica sh.

E. O. Ulrich, August 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), divided the Trenton of east-central N. Y. as follows (descending): Hiatus representing upper Trenton; *Canajoharie sh.;* Dolgeville sh.; Snake Hill sh.; and basal Trenton. On p. 720 of same vol. R. Ruedemann stated that *Canajoharie sh.* is of upper Trenton age, that it thins out rapidly westward, and is absent at Utica.

W. J. Miller, 1911 (N. Y. State Mus. Bull. 153, pp. 8–38), stated that *Canajoharie black sh.* of Fulton and Saratoga Counties consists of an undet. thickness of dark-gray to black, fine-grained, thin and straight-bedded shales, usually calc., especially toward base, lithologically indistinguishable from overlying Utica black sh., but fauna very different and of uppermost Trenton age. Rests on Trenton ls. Formerly included in Utica sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 40). Westward from Mohawk Valley the *Canajoharie sh.* (of Trenton age but formerly included in Utica sh.) passes into middle and lower Trenton ls., while on E., at Hoffmans, it is cut off by a fault, but reappears N. of Schenectady and in Hudson River Valley, where it is overlain by Schenectady beds.

In N. Y. State Mus. Bull. 162, 1912, R. Ruedemann estimated thickness of Canajoharie sh. of lower Mohawk Valley at 1,200 ft., and stated that it is of lower and possibly middle Trenton age, and is overlain by Schenectady fm.

H. P. Cushing and R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169). *Canajoharie sh.* of Saratoga Springs and vicinity is more than 700 ft. thick. Consists of soft, black, carbonaceous, more or less calc. argill. shales. Of lower Trenton age. Underlies Schenectady fm. (middle and upper Trenton fauna) and overlies Glens Falls ls. (basal Trenton). Essentially contemp. with Snake Hill sh., but formed in another basin, and has been brought in contact with Snake Hill sh. through later diastrophic movements.

W. J. Miller, 1916 (N. Y. State Mus. Bull. 182), gave thickness of *Canajoharie sh.* in Lake Pleasant quad., Hamilton Co., as 15 to 20 ft.; R. Ruedemann (N. Y. State Mus. Bull. 227, 228, pp. 108–116, 1921) gave thickness in Champlain region, at Panton, Vt., as 400 to 1,000 ft., all of Trenton age, but formerly considered as Utica. It there underlies Stony Point sh. and overlies Trenton ls. On N. Y. side of Champlain Basin it is replaced by Cumberland Head sh.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 414), showed *Canajoharie sh.* as of Trenton age, as underlying Schenectady sh., and as overlying Glens Falls ls.

Named for outcrop at Canajoharie, Montgomery Co.

Canal limestone.

Pennsylvanian: Northeastern Pennsylvania (Luzerne County).

C. A. Ashburner, 1886 (2d Pa. Geol. Surv. Ann. Rept. 1885, pp. 445+). *Canal ls.*—Siliceous nonfossiliferous ls., much softer than overlying Mill Creek ls., from which it is separated by 25 to 30 ft. of ss. Thickness about 2 ft. Outcrops on SE. bank of the canal, 800 ft. SW. of mouth of Mill Creek.

†Canandaigua shale.

Middle Devonian: Western and central New York.

Same as Ludlowville sh. See explanation under *Centerfield ls.*

Cananea granite.

Age(?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 319).

Canary lime.

Carboniferous: Cape Breton Island, Nova Scotia.

P. D. Trask, 1929 (Nova Scotia Rept. on Mines 1928, p. 281).

†Canaseraga sandstone.

Upper Devonian: Western New York (Allegany County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [Shown (in table) as underlying Gowanda, overlying Wiscoy sh., as=Dunkirk sh., and of basal Chemung age.]

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 150). East of the Genesee [River], above Dalton and Swains, the increase in sand is so rapid that in Slader Creek near Canaseraga only two thin courses of black sh. remain in lower part of 150 ft. of heavy aren. beds with full Chemung fauna that we propose to call *Canaseraga ss.* Massive character of the Canaseraga has led to its confusion with the Nunda at some points to E., under name *Highpoint*. It is believed that the Dunkirk-Canaseraga corresponds in horizon with *Dalmanella danbyi* zone at base of Cayuta sh. in Ithaca region.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 200), showed *Canaseraga* ss.=Dunkirk and as overlain by Caneadea (=Gowanda). On p. 278 he said: Shortly after crossing the Genesee the Dunkirk becomes so predominantly sandy that in its new facies I have temporarily called it *Canaseraga ss.*, meaning the whole mass.

The U. S. Geol. Survey has discarded *Canaseraga ss.*, upon recommendation of G. H. Chadwick and W. H. Bradley, who now call the beds *Dunkirk ss.*, because they are a ss. development of Dunkirk sh.

Cañazas formation.

Age(?): Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 247).

Canby latite.

Tertiary (Olig.? or Mio.?): Southwestern Colorado (Silverton quadrangle).

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Canby type* (also *Canby latite*).—In SE. part of Silverton quad. the Niagara Gulch latite (of Burns latite complex) gives way to a rock of similar composition but somewhat different texture, which is regarded as representing practically the same magma as Niagara Gulch type. No distinction has been made in mapping, as the differences seem trivial in comparison with the similarities of the two rocks. The Canby latite occurs in several flows of varying textures. Hornblende is prominent and augite is often of equal importance; this distinguishes it from Niagara Gulch latite. Named for prominence in Canby Mtn, Silverton quad.

Is a facies of Burns latite, of Silverton volcanic series.

Canby moraine.

Pleistocene (Wisconsin stage): Southwestern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 93–94). Lies btw. Gary moraine and Marshall moraine. Village of Canby, Yellow Medicine Co., stands on this moraine.

Candelaria formation.

Lower Triassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Müller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Candelaria fm.*—Essentially shales, sandy shales, and sss, some of tuffaceous aspect, and occasional thin layers and lenticular bodies of ls. Marine invertebrates in belt 75 ft. thick and 150 to 225 ft. above base. Fauna is Lower Triassic, but appears to be older than any of Lower Triassic marine faunas heretofore recorded from N. Am. Thickness 3,000+ ft. Overlain, probably uncon., by Excelsior fm. (Middle Triassic). Rests, with marked erosion uncon., on Perm. strata, and, where these have been eroded, on folded and bevelled Ord. strata. No basal cgl. is present near Candelaria, but a few mi. to E., where Perm. is missing, the basal part of fm. consists of 500± ft. of basal cgl. derived from underlying Ord. chert. Named for mining camp of Candelaria, in low hills S. of Mina. Type loc. is about 2 mi. SE. of Candelaria. This name was first used by J. A. Burgess in an unpublished rept on Candelaria min. dist.

Caneadea shale.

Upper Devonian: Southwestern New York (Olean to Genesee River).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 200), in a section of rocks from Olean to Genesee River, placed *Caneadea* below Rushford sss., above Dunkirk sh. (=Canaseraga) and opposite Gowanda. On p. 203 he stated: If Gowanda beds of western N. Y. should prove not strictly coterminous with those we have so identified on Genesee River, then to the beds btw. the Dunkirk and the Rushford sss. on this meridian the term *Caneadea sh.* will naturally apply, for it is on Caneadea Creek, below the new power dam (near its mouth), that they have their finest section, just under the type exposures of the Rushford, but, unfortunately, the bottom (i. e., the Dunkirk top) is not reached.

Cane River formation. (In Claiborne group.)

Eocene (middle): Western Louisiana and northeastern and eastern Texas.

W. C. Spooner, 1926 (A. A. P. G. Bull., vol. 10, No. 1, p. 7; No. 3, pp. 220, 224, 227, 235–236). *Cane River beds.*—Name suggested by H. V. Howe, for basal part of St. Maurice fm. as originally defined and heretofore used. In the Cane River are included the 75 to 150 ft. of beds above Wilcox fm. and below the massive Sparta sand, which outcrop in narrow belt trending NE. across southern Sabine and Natchitoches Parishes. Basal memb. consists of glauconitic sand and sandy clay, but in some places marine tuff is present at base. Glauconitic clays predominate in S. part of outcrop, but N. from Bienville Parish they become sandier, until in northern Bossier Parish they are represented entirely by sands, in part glauconitic. The Cane River beds in records of wells drilled E. and SE. of the outcrop are made up chiefly of glauconitic clays with subordinate beds of sand. The fauna was identified by Vaughan in 1900 as corresponding to that of Lisbon beds. Named for excellent exposures on Cane River at Natchitoches, La.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Cane River memb. of Claiborne fm.*—As restricted in this paper is a glauconitic, sandy marl and a glauconitic, clayey sand, characterized by *Ostrea sellæformis* var. *lisbonensis* and *Orthophragmina advena.* Type loc. is at Baden Hill on Cane River, ½ mi. N. of Natchitoches, La. Occurs stratigraphically above Wilcox fm. and below Reklaw memb. in La. Is basal memb. of Spooner's Cane River fm., which extended to top of Weches memb. of this rept.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, p. 1355). Near E. edge of Nacogdoches Co., immediately W. of Attoyac Bayou, the Queen City memb. pinches out and the Reklaw and Weches members combine to form *Cane River fm.*

In NE. Tex. *Cane River* is applied by A. C. Ellisor to beds that are said to underlie Reklaw memb. and to compose basal part of Mount Selman fm. In western La. (type loc.) the Cane River has been treated as a marine memb. of St. Maurice fm. (now discarded), including all beds btw. Sparta sand above and Wilcox below, thus including equivalents of Weches, Queen City, and Reklaw of Ellisor. (See H. K. Shearer, A. A. P. G. Bull., vol. 14, No. 4, pp. 433–450, 1930; C. L. Moody, A. A. P. G. Bull., vol. 15, No. 5, 1931; and H. V. Howe, A. A. P. G. Bull., vol. 17, No. 6, pp. 613+, 1933.) The original definition is that in current use by U. S. Geol. Survey.

Caney shale.

Mississippian: Central southern and southeastern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Caney sh.*—Occurs in two small areas in this quad., one in SW. corner and the other in SE. corner. At both places about 800 ft. of rock is exposed, approx. upper half of fm. This part is blue clay sh., with thin beds of clay, ironstone, lenticular concretions, and a few blue ls. septaria. In lower part, in adjoining Atoka quad., the blue sh. grades into black, friable, bituminous sh. with dark-blue ls. segregations. The Caney sh. throughout is laminated, fissile, and friable, and consequently rarely exposed. Underlies Wapanucka ls.

See 1909 and 1924 entries under *Jackfork ss.*

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 24). There has been considerable controversy regarding age of Caney sh., but present consensus of opinion seems to be that upper part of fm. is Penn. and lower part is Miss.

H. D. Miser and C. W. Honess, 1927 (Okla. Geol. Surv. Bull. 44, pp. 11–12). (See 1927 entry under *Jackfork ss.*)

H. D. Miser, 1927 (Okla. Geol. Surv. Bull. 44, pp. 22–23, footnote dated Oct. 5, 1927). Since writing of this paper E. O. Ulrich presented at Tulsa, Okla., in March 1927, a paper that was based on extensive field investigations by him in 1908 and previous years and also on recent office studies of fossils. In his paper he expresses opinion that fauna in the black sh. (his Johns Valley sh.) on top of Jackfork ss. is not in place but has been transported from exposures of Mississippian Caney sh., and that the fauna is now really embedded in a black sh. of Penn. age. After presentation of Mr. Ulrich's paper I spent 3 months making a special field study of age relations of Carbf. rocks in Ouachita Mtns, Okla. Among the things I did was to examine carefully the Caney sh. at its type loc., which is now known as Johns Valley. This locality is also type loc. of Johns Valley sh. of Mr. Ulrich. The sh. in Johns Valley lies on top of Jackfork ss. in a broad, long synclinal basin. In lower 50 to 100 ft. of the sh. there are numerous ice-borne boulders and blocks of many kinds of rock, including ls., flint, and ss. The ls. masses, which are more numerous than the other kinds, range in size from small particles an inch or less in diam. to blocks measuring 30 ft. across, though I observed one block measuring 200 ft. in length, another measuring 110 by 195 ft., and a third about 50 by 369 ft. Fossils obtained from many of the masses have been studied by Mr. Ulrich, and his conclusions concerning them are that the represented faunas range in age from *that of Arbuckle ls. (Lower Ord.) to that of Sycamore ls. (Kinderhook).* The boulder bed just mentioned is apparently overlain by black, platy, hard sh. perhaps several hundred ft. thick. In several fresh clean exposures of the sh. there are hundreds of small phosphate nodules—most of them nearly spherical, like toy marbles—and many concretionary masses of ls. The ls. concretions all lie parallel with bedding of the sh., and the phosphate nodules are rather uniformly disseminated through portions of the sh. The nodules and the ls. concretions contain fossils, all of which belong to fauna of Mississippian Caney sh. Every feature of the sh., as revealed in the exposures, can be matched with exposures of Caney sh. in the areas where it rests upon Woodford chert. The lithology of the shales in the two different strat. positions—one on the Jackfork and the other on the Woodford—is the same. The character and arrangement of the ls. concretions are the same, and also the character and distribution of the phosphate nodules are the same. To me, as well as to several other geologists who accompanied me to Johns Valley in June 1927, the conclusion which we reached while looking at the field relations was obvious that the fauna represented in the phosphate nodules and ls. concretions lived, died, and was buried where it is now found. If the fauna had been transported by floating ice, as is believed by Mr. Ulrich, there would surely have been some admixing of Caney fossils with those of pre-Caney age, and also there would surely have been an admixture of rocks of pre-Caney age. The excellent exposures of the Caney that were examined by me and by my geologist companions do not reveal a single pre-Caney fossil nor a single specimen of rock of pre-Caney age.

E. O. Ulrich, Nov. 1927 (Okla. Geol. Surv. Bull. 45, pp. 6, 21–23). I would restrict *Caney sh.* to Miss. part of beds heretofore included under that name, or to the non-boulder-bearing black sh. which contains a Miss. (Meramec) fauna and is confined to N. and W. of Ouachita area. The black sh. of Penn. age in Ouachita geosyncline, carrying fossiliferous erratic boulders in lower part, which had formerly been included in Caney sh., I have named *Johns Valley sh.* It is younger than Wapanucka ls. [On p. 24 *of book cited* Ulrich *stated*: The Wapanucka should include the shaly lower beds with essentially same early Penn. fauna that Morgan (1924) describes in his rept on Stonewall quad. as "Upper Caney." On p. 25 he stated: There is a break btw. the sh. with the Middle Miss. Caney fauna and the "Upper Caney" with the early Penn. fauna, and this hiatus is very great and= fully 5,000 ft. of strata in SW. Va. Also that the Caney as here restricted rests on the Sycamore. On p. 30 he restricted Caney sh. to Arbuckle uplift, defined it as of middle Meramec age, and as uncon. overlain by Wapanucka ls. and uncon. underlain by Sycamore ls.]

H. D. Miser, 1934 (A. A. P. G. Bull., vol. 18, No. 8). ***Caney sh.*** of some earlier U. S. G. S. repts (Tishomingo and Atoka folios) included (at top) Springer sh. (Penn.), which is overlain by Wapanucka ls. and is=Jackfork ss., Stanley sh., and Hot Springs ss. of western Ark. and adjacent areas in Okla. The name *Caney sh.* is here restricted to the Miss. sh. (of Chester and Meramec age) overlying the Woodford chert (Dev. ?) and underlying Springer sh. This Miss. sh. is not exposed in region that has been cited as type loc. of Caney sh., where all Carbf. rocks beneath Atoka fm. are of Penn. age. [Also further discusses the Johns Valley sh. (Penn.) and the erratic masses of Miss. Caney sh. contained in it.]

Named for Johns Valley, formerly called Caney Basin or Cove, in upper Cane Creek Valley, 6 mi. N. of Eubanks, Pushmataha Co., Okla. There are 6 or 7 Caney Creeks in this part of Okla., and this Caney Creek is now known as Johns Creek, but the Miss. sh. to which the name *Caney sh.* is now applied is not exposed in this region.

Caney sand.

A subsurface sand, of Upper Ord. age, in Ky., said to be same as Upper Sunnybrook sand. Named for Caney Creek, Morgan Co.

Caneyville limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas, northeastern Oklahoma, and southeastern Nebraska.

R. C. Moore, May 1, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14), showed *Caneyville ls.* underlying Pony Creek sh. and overlying French Creek sh. Not defined.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 143, 241). *Caneyville ls.* is here proposed to include beds from base of ls. previously designated *Nebraska City* up to top of ls. called *Grayhorse.* Field studies have shown Nebraska City ls. is a molluscan bed that represents No. 3 phase of a cyclothem for which no fusulinid-bearing, or No. 5 phase, was known until recently, when outcrops in Chautauqua Co., Kans., of this expected phase were discovered. Above this fusulinid-bearing ls. in Chautauqua Co. is a fragmental, algal and molluscan ls., that clearly represents the No. 7 phase of this cyclothem. It is traced S. into Grayhorse ls. of Osage Co., Okla., and it is thus determined that Nebraska City and Grayhorse lss. are parts of a single cyclothem which includes the unnamed fusulinid-bearing ls. btw. them in southern Kans. Neither *Nebraska City* nor *Grayhorse* is available as a name for the 3 lss. and shales btw. them. Hence *Caneyville* is introduced. No name is proposed for the fusulinid-bearing ls. memb. of the Caneyville, and it is thought that none is needed. The terms *Nebraska City* and *Grayhorse* happen to have been introduced and it is perhaps not necessary to kill them. The *Nebraska City memb.* of Caneyville ls. is bluish or greenish gray rather soft sandy ls. that weathers light yellowish brown, and is 1 to 5 ft. thick, averaging 1½± ft. It is basal memb. of Caneyville ls. The Grayhorse memb. of Caneyville ls. is very different in appearance from the other 2 ls. members. It is medium to coarse-grained; appears fragmental or coquinoid; is rather strongly ferruginous; and thickness averages 1 ft. It lies 5 to 15 ft. above the fusulinid-bearing lss. of the Caneyville ls. Total thickness of Caneyville ls. is 15 to 20 ft. It is named for Caneyville Twp. Chautauqua Co., Kans. Underlies Pony Creek sh. and overlies French Creek sh. Extends from northern Okla. across Kans. to southern Nebr.

Caneyville shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, late in 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Caneyville sh.*, 17 ft. thick, underlies Greyhorse ls. and overlies Nebraska City ls., all included in Pony Creek sh. fm. of Wabaunsee group. Top part of Caneyville is gray and shaly; middle and lower parts shaly or sandy, with plant leaves. [Derivation of name not stated.]

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of Caneyville sh. is sec. 11, T. 32 S., R. 8 E., Caneyville Twp, Chautauqua Co., Kans.

Cannelton limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

I. C. White, 1885 (The Virginias, vol. 6, pp. 8, 15). *Cannelton ls.* (also *Cannelton cement*).—Frequently exhibits cone-in-cone structure. Is 2 to 2½ ft. thick. Lies 75 ft. below Lower Kittanning [not Lower Kittanning] coal. Once burned for cement at Cannelton, Kanawha Co., by Mr. Stockton, and hence is often called "*Stockton*" *ls.* No fossils found, but is correlated with Ferriferous [Vanport] ls. of Pa. [This correlation has been abandoned in all later repts of W. Va. Geol. Survey.]

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, pp. 511, 586). *Cannelton* (*Stockton*) *ls.*—The ls. at Cannelton, which Mr. Stockton once burned for cement, is often termed *Stockton cement bed.* It is usually quite siliceous, frequently exhibits cone-in-cone structure, and has no fossils so far as writer knows. Its usual place is 75 to 100 ft. below Campbells Creek coal and 45 to 50 ft. above Eagle coal. If Eagle coal is Clarion bed of Allegheny series then Cannelton ls. would correspond to Ferriferous ls. of western Pa. [According to all later repts of W. Va. Geol. Survey the Eagle coal is much older than Clarion coal and belongs in Kanawha fm., a considerable distance below Campbells Creek coal. See W. Va. chart I. In Logan-Mingo Co. Rept., 1914, the thickness of Cannelton ls. was given as 0 to 4 ft.]

Cannelton sandstone. (In Pottsville group.)

Pennsylvanian: Southwestern Indiana.

Name applied to a massive bed of lemon yellow to light or dark gray ss. quarried at Cannelton, Perry Co. Belongs to Mansfield ss. (See T. C. Hopkins, Ind. Dept. Geol. and Nat Res. 20th Ann. Rept., 1896, p. 314.)

Cannelton shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, pp. 151–152, 170+). *Cannelton (Stockton) sh.*—Sandy black sh., 15 to 34 ft. thick, containing marine fossils. Underlies Cannelton (Stockton) ls. and rests on 2 ft. of black sl. containing fossil plants, or, where that is absent, on Matewan coal.

Cannes de Roche formation.

Pennsylvanian: Quebec and New Brunswick.

F. J. Alcock, 1935 (Canada Dept. Mines Bur. Econ. Geol., Mem. 183, p. 93).

Cannon limestone.

Middle Ordovician (Trenton): Central and eastern Tennessee and southwestern Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 417, 418, 429, pl. 27). *Cannon ls.*—Several hundred ft. of ls. of Trenton age on E. flank of Nashville dome, covering time interval of Bigby, Flanagan, and Perryville lss. and Catheys fm. Thins rapidly to W., and finally wedges out in vicinity of Nashville. Overlies Hermitage fm. and is older than Eden group.

W. A. Nelson, 1924 (A. A. P. G. Bull., vol. 8, No. 4, pp. 455–457). Exact relationship of *Cannon ls.* to Trenton group was worked out during summer of 1922 by R. S. Bassler and E. O. Ulrich. The Cannon is composed of layers of dove and gray ls., both porous and tight. Well exposed just SW. of Kettle Creek pool, in Cannon Co., Tenn., where it is 250 ft. thick, but at Nashville it is absent or only 5 to 25 ft. thick.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol., Bull. 28, p. 34), and C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, chart opp. p. 80), show *Cannon ls.* of Tenn. as underlying Catheys ls., overlying Bigby ls., and as 50 to 300 ft. thick. This is present accepted definition. They extend name into SW. Va., and consider the fm. to be of Trenton age.

Cannonball marine member (of Lance formation).

Upper Cretaceous: Southwestern North Dakota and northwestern South Dakota.

E. R. Lloyd, 1914 (U. S. G. S. Bull. 541, pp. 248, 249). The *Cannonball marine memb.* comprises upper 250 or 300 ft. of Lance fm. It is typically exposed in bluffs of Cannonball River, in Twps 132 and 133 N., R. 8 W. [Morton Co., N. Dak.], where it consists of 144½ ft. of strata, as follows (descending): (1) Calc. ss., 6 inches; (2) gray, partly consolidated ss. containing numerous layers cemented with iron, 10½ ft.; (3) yellow consolidated ss., 5 ft.; (4) hard red ss., 6 inches; (5) dark-gray sh. with "cannonball" concretions, 25 ft.; (6) very dark-gray sh., very sandy, with a layer of marine shells 20 ft. from base and with "cannonball" concretions, 103 ft.; base concealed. Top of above section lies 50± ft. below top of memb. Similar sections are exposed at other places along Cannonball River and in bluffs of Cedar Creek and Heart River. Several collections of marine invertebrates have been identified by T. W. Stanton as belonging to a modified Fox Hills fauna. Underlies Fort Union fm. and rests on 400 to 450 ft. of somber-colored sh., yellow ss., and thin lignite beds composing lower part of Lance fm.

E. R. Lloyd and C. J. Hares, 1915 (Jour. Geol., vol. 23, pp. 523–547). In a large region W. of Missouri River in N. Dak. and S. Dak. the Lance fm. consists of 2 distinct parts, a lower nonmarine part containing a flora very similar to, if not identical with, that of the Fort Union, and an upper marine memb. containing a fauna closely resembling, but not identical with, that of Fox Hills ss. This upper part, on account of its peculiar fauna, has been mapped separately and named *Cannonball marine memb. of Lance fm.* Farther W. nonmarine beds bearing lignite and occupying a similar strat. position have been named *Ludlow lignitic memb. of the Lance.* The Cannonball marine memb. has been mapped from Mandan to a point 4 mi. W. of Haley, N. Dak., a total distance of about 130 mi. The presence of brackish-water fossils, *Ostrea glabra,* near Yule on Little Missouri River in Billings Co., N. Dak., shows that the sea probably extended some distance farther to W. than its sediments have been mapped. The extent of this memb. E. of Missouri River is unknown. Cannonball memb. becomes gradually thinner to W., and sea in which it was deposited perhaps did not extend as far W. as Mont. line. The oyster beds near Yule, Billings Co., may represent western limit of Cannonball sea. This sea presumably advanced into western N. and S. Dak. from E. or NE., and by inference the Cannonball memb. continued with undiminished or with increased thickness to N. and NE., but region is too deeply drift covered to prove this. It is contemp. with Ludlow lignitic memb. and overlies 400 to 525 ft. of somber-colored sh., yellow ss., and thin lignite beds composing the lower (nonmarine) memb. of the Lance. It consists chiefly of dark sandy sh. or shaly ss. with subordinate amount of dark-yellow and gray ss. and some thin lss. All the strata are lenticular and individual beds can be followed for only short distances. [Gives detailed section in some of which beds belonging to Cannonball marine memb. are shown as overlying Ludlow lignitic memb. and in others as grading laterally into the Ludlow.] A peculiar feature of both Fox Hills ss. and Cannonball memb. of Lance is abundance of round concretions commonly known as "cannonballs." They are formed by cementation of the sandy sh. by deposition of calcium carbonate. No definite line could be drawn btw. Cannonball marine memb. and lower part of the Lance, it being impossible to tell where nonmarine beds stop and marine beds begin. [Lower part of Lance later named *Hell Creek memb.*]

See U. S. G. S. Bull. 627, 1916, by D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks, and U. S. G. S. P. P. 128A, 1920, by T. W. Stanton. The U. S. Geol. Survey now classifies the Cannonball memb. and the demonstrably equiv. part of Ludlow lignitic memb. as Upper Cret.

See also *Torrington memb. of Lance fm.*

Cannonballian series.

A term employed by C. [R.] Keyes instead of *Cannonball marine memb. of Lance fm.*

Cannon Corners moraine.

Pleistocene (Wisconsin stage): Northeastern New York. Named for Cannon Corners, Clinton Co. See Jour. Geol., vol. 32, pp. 645, 665, 1924.

Cañon rhyolite.

Age (?): Nevada.

J. C. Merriam, 1910 (Calif. Univ. Dept. Geol. Bull., vol. 6, pp. 29, 30, 31).

Canter limestone.

Mississippian: Southern Ohio (Jackson County).

E. B. Andrews, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 158, 163). [Mentioned occurrence of Maxville ls. near Enoch Canter's (p. 158), and mentioned ore found on *Canter ls.* (*Maxville or lower Carboniferous*) in Hamilton Twp, Jackson Co.]

Cantera.

Cretaceous: Mexico.

J. P. Kimball, 1869 (Am. Jour. Sci., 2d, vol. 48, pp. 379–388).

Canterbury granite gneiss.

Late Carboniferous or post-Carboniferous (?): Eastern Connecticut and southern Massachusetts.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 136, 142, and map). *Canterbury granite gneiss.*—Essentially a muscovite-biotite gneiss, varying from a rock of fine and even grain to one of porphyritic texture with feldspar crystals a quarter of an inch long. Extends for 15 mi. through Pomfret, Brooklyn, Hampton, and Canterbury, and smaller detached areas occur in neighboring towns. Is intrusive.

Canton shale member. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1921 (Ill. Geol. Surv. Extr. from Bull. 38). Overlying the calc. sh. above the ls. cap rock of Springfield (No. 5) coal in Avon and Canton quads. there is usually a bed of gray sh. exposed in several places along Big Creek and its tributaries S. of Canton. It is here named *Canton sh. memb.* Thickness is 0 to 30 ft.

Canton schist.

Cambrian or pre-Cambrian: Northwestern Georgia (Tate quadrangle).

W. S. Bayley, 1928 (Ga. Geol. Surv. Bull. 43, pp. 43–46, map). *Canton schist.*—Graphitic garnet mica schist. Possibly same as Hiwassee schist, to which it is remarkably similar, but the two schists are so widely separated in Tate quad. that correlation is not certain; therefore the new local name. Bordered on both sides by Carolina gneiss, into which it grades by inter-layering. Best exposed in neighborhood of Canton, at SW. corner of quad. Is Camb. or Archean.

Canton phacolithic complex.

Pre-Cambrian: Northwestern New York (Canton, Gouverneur, and Ogdensburg quadrangles).

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 65–76). *Canton phacolithic complex.*—The Canton granite masses form a phacolithic complex, consisting of 2 granite shells with an intervening zone of Grenville. Passes through village of Canton. Intrudes Grenville series. Occurs in Canton, Gouverneur, and Ogdensburg quads. [According to p. 52 the Canton phacolith belongs to his Alexandria type of granite.]

Cantrell sand.

A subsurface sand, of Penn. age, in Stephens Co., southern Okla., lying at 1,800 ft. depth in Empire pool, the Surber sand lying at 1,700 ft. and the Shelton sand at 1,900 ft.

Cantua sandstone member.

Eocene: Southern California (north of Coalinga region).

R. Anderson and R. W. Pack, 1915 (U. S. G. S. Bull. 603, pp. 33, 59–63, and map). *Cantua ss. memb.*—A huge lens of massive, medium to fine-grained, gray, concretionary ss. and interbedded clay sh. that forms lower and major part of Martinez (?) fm. within a small area. Max. thickness at least 4,500 ft. Rests uncon. on Moreno fm. Is overlain by and in places grades laterally into dark clay sh. that composes the rest (400 to 1,100 ft.) of Martinez (?) fm. Named for fact it reaches greatest development at head of W. branches of Cantua Creek, Fresno Co.

According to B. L. Clark, 1921 (Jour. Geol., vol. 29), these beds belong to his Meganos group and are younger than the Martinez.

B. L. Clark, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, p. 1050). *Cantua ss.* is regarded as memb. of Capay fm. [On pl. 89 he mapped Cantua ss. memb. separately.]

†Cantua shale.

Oligocene or Eocene: Southern California (Coalinga region).

C. C. Church, 1930 (Pan-Am. Geol., vol. 54, No. 1, p. 79). At the well-known loc. of *Cantua sh.* in Phoenix Canyon impressions of foraminifera are abundant and at other places well-preserved fossils have been found. The affinities of the fauna seem to be with Mio. rather than Eo. [The fm. was not defined.]

G. D. Hanna, 1930 (pp. 79–80 of book cited above), mentioned fossils collected from *Cantua sh.* but did not define the fm. He stated that in 1927 52 sp. of diatoms were listed from *Cantua sh.*, mostly from Phoenix Canyon, near Coalinga, and that fossils seem to indicate lower Mio.

In corrected copies of above abstracts of Symposium of 29th Ann. Meeting Cordilleran sec. of Geol. Soc. Am., published in Geol. Soc. Am. Bull., vol. 42, No. 1, 1931, pp. 302–307, the name *Lillis sh.* was used instead of *Cantua sh.*, preoccupied.

Cantwell formation.

Upper Cretaceous: Southern Alaska (Cantwell River region).

G. H. Eldridge, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, p. 16, map). *Cantwell cgl.*—Cgls. and coarse sss.; matrix quartz; pebbles are of dark sl., perhaps derived from Sushitna slates, on which they presumably rest. Outcrop for mi. or two along banks of Cantwell River. Thickness 600 to 700± ft. Older than Kenai series.

This fm. was for many years classified as Eo., on basis of fossil plants derived from it, but with recognition of possibility it might be late Cret., as structural relations seemed to indicate. In Feb. 1937 the Upper Cret. age of the fm. was accepted by U. S. Geol. Survey, on the basis of fossil plants collected from it and identified by R. W. Chaney.

Canville limestone.

Pennsylvanian: Southeastern Kansas and western Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 91, 97). [See under *Dennis fm.*]

J. M. Jewett, 1932 (pp. 99, 102, 103, of book cited above). *Canville ls.* is proposed for ls. next above Galesburg sh. and below Stark sh. Named for Canville Creek, Neosho Co. Been traced by writer from T. 18 S., to T. 29 S. Generally about 8 ft. thick, bluish gray, fossiliferous. In S. part of its outcrop it sets off the ss. and sandy sh. (Dodds Creek ss.) of underlying Galesburg sh. from overlying black platy Stark sh., and in N. part it separates the yellow sh., the Galesburg, from the black Stark sh. In N. part of Linn Co. it is represented by very calc. sh. less than 1 ft. thick. Its horizon is known at Kansas City by the plane btw. Galesburg and Stark shales, which are easily recognized by their color and fossils.

See also J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, pp. 131–136).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Jewett is author of this name.

Canyon formation (also **Canyon group**).

Pennsylvanian: Central northern and central Texas.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361–374). *Canyon div.*—Largely massive, heavy-bedded lss., 930 ft. thick. Underlies Cisco div. and overlies Strawn div.

In Palo Pinto Co., type region, consists of 750 ft. of massive lss., sss., and gray shales, with a heavy ls. at base. Canyon group is now divided into (descending) Caddo Creek, Brad, Graford, and Palo Pinto fms.

Named for Canyon, Palo Pinto Co.

†Canyon conglomerate.

Pliocene: Yellowstone National Park.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Nat. Park folio, No. 30). *Canyon cgl.*—Thinly bedded light-colored cgls. and gravels exposed only in stream cuttings along Lamar River and the Grand Canyon. Composed of well-rounded pebbles of Archean gneisses and andesitic material derived from underlying breccias. Capped by recent basalt. Named for occurrence in Grand Canyon of the Yellowstone.

Replaced by geographic name *Tower Creek cgl.*

Canyon City group.

Upper Cretaceous (Montana): Southeastern Colorado (Canyon City region).

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 89–91). Near Hardscrabble Creek, a small branch running into Arkansas River just below Canyon City, there is a small area, about 8 mi. square, occupied by coal strata, for which I propose the provisional name of *Canyon City group.* I have but little doubt careful study will show that it is a fragment of the great lignite group of the North.

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 162–169). The coal-bearing strata of Canyon City region belong to Vermejo fm.

Canyon Creek member (of San Juan tuff).

Tertiary (Miocene? or Oligocene?): Southwestern Colorado (Ouray district).

W. S. Burbank, 1930 (Colo. Sci. Soc. Proc., vol. 12, p. 186). *Canyon Creek memb. of San Juan tuff.*—Lower memb. of San Juan tuff in vicinity of Canyon Creek, Sneffels, and Ouray. Is most important cliff-forming part of San Juan. Ranges from fine sandy tuffs to coarse aggl. and breccia, with interbedded conglomeratic beds, which differ from the others by being composed partly or largely of distinctly rounded waterworn boulders of the volcanic rocks. It is mainly by reason of presence of these cgl. beds and their character that the two fold division of San Juan tuff has been made. Thickness 300 to 1,200 ft. Underlies Sneffels memb. of San Juan tuff, which is comparatively free from cgl. layers. The rock fragments composing Canyon Creek memb. comprise a great variety of lavas, many of them porphyritic andesites and latites. Characteristic color of memb. is dull greenish gray, but some reddish or purplish beds are present. The coarse aggls. are commonly chaotic and exhibit bedding only when viewed at a distance, but the tuffs, cgls., and conglomeratic beds with which they are interbedded form distinct layers and give a bedded appearance to whole fm. Along Canyon Creek just below Camp Bird mill this memb. is normally 1,100 to 1,200 ft. thick. Uncon. overlies Telluride cgl.

Canyon Creek slate.

Middle (?) Cambrian: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A2, p. 123).

†Canyon Largo group.

Eocene and older (?): Southwestern Colorado and northwestern New Mexico.

W. H. Holmes, 1877 (U. S. Geol. and Geog. Surv. Terr. 9th Ann. Rept., for 1875, pls. 35, 38), showed *Canyon Largo of Newberry* and underlying Puerco marls of Cope as=Wasatch fm. The compiler has been unable to find that Newberry ever published the term *Canyon Largo group*. He did describe the rocks of Canyon Largo, but did not apply to them, even in a descriptive way, the term *Canyon Largo group*. On pl. 38 of book cited above Holmes, however, used the term *Cañon Largo group*, and on pl. 35 he used *Cañon Largo of Newberry*.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, p. 6), showed Canyon Largo group of Holmes, 1877, as=Wasatch, Torrejon, Puerco, and Ojo Alamo fms. of present terminology.

Named for Canyon Largo, in NE. part of San Juan Co. and W. part of Rio Arriba Co., N. Mex.

Canyon Largo sandstone.

Eocene: Northwestern New Mexico.

C. R. Keyes, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 725). *Canyon Largo sss.*, 700 ft. thick, underlie Chaco marls and overlie Torreon fm. [Torrejon]. [Derivation of name not given.]

Appears to be lower part of Wasatch fm. of NW. N. Mex.

†Cap au Gres sandstone.

Lower Ordovician: Northeastern Missouri, western Illinois, and southeastern Iowa.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 60). *Cap au Gres ss.*—Very massive, fine-grained, soft sand rock, homogeneous in texture, of white or yellowish color. Thickness 125 ft. Underlies Folley ls. and overlies Cambrian Winfield dol. Typically developed at Cap au Gres, a headland on Ill. side of Miss. River in [Calhoun Co.] Ill.

Same as St. Peter ss., older name.

Capay formation.

Eocene (middle): Northern California (Sacramento Valley).

T. H. Crook and J. M. Kirby, June, 1935 (Geol. Soc. Am. Proc. 1934, pp. 334–335). *Capay fm.*—Recent reconn. work in Sacramento Valley has resulted in discovery, in Capay Valley W. of Rumsey Hills, of Eo. deposits extending continuously 14 mi.

These grade in character from purely channel cgls. occupying a bed in tilted Cret. shales at N. end to presumably estuarine deposits bearing fauna identical with that in Butte gravels of Marysville Buttes and probably correlative with that of Lillis Ranch, N. of Coalinga. Max. thickness at least 2,400 ft. There is evidence that much of material was locally derived.

B. L. Clark, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, pp. 1036, 1050, pl. 89). Lower part of middle Eo. in Riggs Canyon fault zone of Mount Diablo area is=*Capay fm.*, a name proposed by T. H. Crook and J. M. Kirby for a series of Eo. deposits in Capay Valley, W. of town of Winters [Yolo Co.]. These deposits are found along SW. border of Sacramento Valley. In this paper the name is used as a stage name to designate strata which are apparently contemp. with the deposits of type loc. Stratigraphically, the deposits of Capay stage lie btw. those of the Meganos (below) and the Domengine (above). [Page 1036. On pl. 89 Clark mapped *Capay fm.* in Coalinga region, and placed it above Cantua ss. memb. On p. 1050 he described *Capay fm.* N. of Coalinga as mostly dark-colored shales, 1,000 ft. thick, and included in it *Cantua ss. memb.*]

†Cape Ann granite.

Devonian or Carboniferous: Northeastern Massachusetts (Essex County).

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.), stated that *Cape Ann granite* is same as Quincy granite. See B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 188–189 and map). Named for occurrence at Cape Ann, Essex Co.

Cape Barré beds.

Devonian: Quebec.

J. M. Clarke, 1905 (N. Y. State Mus. Bull. 80, p. 151).

†Cape Beaufort coal measures.

Cretaceous: Alaska.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 249), and W. H. Dall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp 819–820). [Assigned to Carbf.]

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 456–457). "Cape Beaufort coal measures" of Dall and of Dall and Harris is Corwin fm. (Cret.). Probably reason Schrader introduced *Corwin*, instead of using the older name "Cape Beaufort," was the suspicion that Carbf. rocks might have been included under latter name.

Cape Blanc formation.

Upper Ordovician: Quebec (Percé).

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 161–170). [See under *Whitehead fm.*]

†Cape Blanco beds.

Miocene: Southwestern Oregon (Port Orford quadrangle).

See 1902 and 1913 entries under *Empire fm.* (Mio.).

Cape Bon Ami limestones.

Devonian: Quebec (Gaspe Peninsula).

J. M. Clarke, 1900 (N. Y. State Mus. Mem. 3, vol. 3, pp. 80–81). Mr. Charles Schuchert and writer have thought that the passage beds of Billings (Nos. 3, 4, 5, 6) which are displayed in the fine 700-foot vertical escarpment at Cape Bon Ami W. of Cape Gaspe, may receive the name of *Cape Bon Ami lss.* Underlie Grande Grève lss. (Oriskany) and overlie St. Alban lss. (Helderbergian).

Cape Canon formation.

Upper Ordovician: Quebec (Percé).

J. M. Clarke, 1908 (N. Y. State Mus. Mem. 9, p. 59). *Cape Canon massive.* Silurian, Percé, Quebec.

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 161–164). *Cape Canon fm.* is of Upper Ord. age. Oldest known fm. in Percé area. Light-blue, thin-bedded lss. separated by thin zones of black argill. shales. Much disturbed. Exposed thickness 630 ft. Has yielded no fossils to anyone. No Middle Ord. or Sil. are present about Percé. As the younger Whitehead fm. may be 2,000 ft. or more thick, it is probable Cape Canon fm. is only a part of this younger series, and this appears to be proved by the fossils of Limekiln cgl., which was thought by Clarke to be part of Cape Canon fm. All of these fms. are Upper Ord.

Cape Cod series.

Tertiary and Quaternary: Massachusetts.

N. S. Shaler, 1898 (U.S.G.S. 18th Ann. Rept., pt. 2, p. 535). Includes Nashaquitsa and Barnstable series and other unnamed later deposits.

Cape Dauphin formation.

Pennsylvanian: Nova Scotia.

W. A. Bell, 1923 (Canada Geol. Surv. Mem. 133, p. 93).

Cape Elizabeth formation. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Cape Elizabeth fm.*—Graywacke schists, gray gritty slates, sericite phyllites, and calc. laminae. Included in Casco Bay group.

F. J. Katz, 1917 (U.S.G.S.P.P. 108, p. 170). *Cape Elizabeth fm.*—An assemblage of mostly thin-bedded, light-gray siliceous and sericitic slates, heavier beds of graywacke sl., schist, and qtzite, containing at short intervals thin layers or laminae of black micaceous phyllite and light-bluish calc. schist or sl. Thickness estimated at 600 ft. Basal fm. of Casco Bay group. Underlies Spring Point greenstone and overlies Kittery qtzite. Assigned to Penn. (?). Named for development at Cape Elizabeth, Cumberland Co.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as Penn.

†Cape Fear formation.

Cretaceous (Upper): Coastal plain of North Carolina.

L. W. Stephenson, 1907 (Johns Hopkins Univ. Circ. No. 71, pp. 93–99). *Capefear fm.*—Arkosic and micaceous sands and clays and various intergradations of aren. clays and argill. sands. Beds range in thickness from a few ft. to 10 or 12 ft. *Name used tentatively, since future investigations may prove equivalency with* established fms. elsewhere. Believed to be approx. synchronous with Patuxent div. of Potomac series of Md. and Va., although it may include a portion of the Potomac younger than the Patuxent. Thickness 300 ft. Uncon. underlies Bladen [Black Creek] fm.

By 1910 the equivalency of †Cape Fear fm. with the Lower Cret. Patuxent fm. was believed to have been established, and local name "Cape Fear" was dropped. Further work, however, furnished satisfactory proof that the deposits are chiefly if not wholly of Upper Cret. age, and that if they contain any representative of Patuxent fm. it must be in their lower part. (See C. W. Cooke, U.S.G.S.P.P. 140F, pp. 138–139, 1926.) Additional work established fact that these deposits are chiefly if not wholly the northward extension of Tuscaloosa fm., and they are now called by that name, although some beds of Lower Cret. age may be included; but if present they will hereafter be excluded. (See C. W. Cooke, U.S.G.S. Bull. 867, 1936.)

Named for exposures on Cape Fear River.

†Cape Girardeau marble.

Middle Ordovician: Southeastern Missouri (Cape Girardeau County).

B. F. Shumard, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pt. 2, p. 155), divided the so-called Trenton ls. (overlain by *Cape Girardeau ls.*) at Cape Girardeau into (descending): (1) Fine-grained reddish brown argill. ss., 10 ft.; (2) white and bluish white, massive-bedded crystalline ls., of fine texture, carrying Trenton fossils, 60 ft.—the well-known *Cape Girardeau marble;* (3) white crystalline ls., in heavy beds, 35 ft.; (4) blue schistose ls., highly fossiliferous, 2 ft.

Is a part of Kimmswick ls.

†Cape Girardeau limestone.

See *Girardeau ls.*

†Cape Girardeau sandstone.

Upper Ordovician (Richmond): Southeastern Missouri.

B. F. Shumard, 1868 (St. Louis Acad. Sci. Trans., vol. 2, p. 156). *Cape Girardeau ss.*—Ss., 80 to 100 ft. thick, composing middle fm. of Hudson River group in Cape Girardeau Co. Separated from overlying Cape Girardeau ls. by 25 ft. of blue sh. overlain by 25 ft. of yellow sh. Underlain by 60 ft. of dark sh., which overlies Receptaculites ls.

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser.). Thebes ss., 0 to 100 ft. thick, is *Cape Girardeau ss.* of Shumard.

J. Bridge, 1930 (personal communication) stated that †Cape Girardeau ss. is = lower part of Thebes ss.

Named for Cape Girardeau, Cape Girardeau Co.

Cape Horn slate.

Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U.S.G.S. Colfax folio, No. 66). *Cape Horn sl.*—The characteristic rocks are fissile typical clay slates, almost black when fresh and weathering to a gray or silvery white color. Small ls. lenses are found below Cape Horn, in Bear River Canyon W. of Dutch Flat, and in canyon of South Fork of Yuba River S. of Relief; they are ordinarily only few ft. thick. Meager fossils not diagnostic as to age. The fm. corresponds to part of Calaveras fm., and is assigned to Carbf. Overlies Relief qtzite and underlies Delhi fm. Named for occurrence at Cape Horn, overlooking North Fork of American River, in Placer Co.

Cape John formation.

Carboniferous: New Brunswick, Prince Edward Island, and Nova Scotia.

H. M. Ami, 1899 (British Ass. Adv. Sci. Rept. 1899, p. 756).

Cape May formation.

Pleistocene (late): New Jersey and southeastern Pennsylvania.

R. D. Salisbury, 1898 (N. J. Geol. Surv. Ann. Rept. State Geol. 1897, pp. 19–20). *Cape May fm.*—Those deposits of late glacial and early postglacial time, which were made beyond region directly affected by the ice or its drainage. Includes much of loam which has heretofore been referred to under name "low-level Jamesburg." In places overlain by high-level loam which in earlier repts was referred to under name "high level Jamesburg loam." Overlies Pensauken fm. Probably at least partly contemp. with drift of last [Wisconsin] glacial epoch. Covers whole of Cape May Co., N. J.

Is top fm. of Columbia group, of nonglacial origin. Now considered to be of same age as glacial deposits of Wisconsin stage.

Cape Neddick gabbro.

Devonian (?): Southwestern Maine (York County).

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, p. 151). *Cape Neddick gabbro.*—A small oval stock measuring about ½ by ¾ mi. Shows four phases—the contact phase, a dark coarse-grained phase, a very dark, almost black phase, and a light-colored central phase. Of Dev. (?) age. Occurs at Cape Neddick, York Co.

Capistrano formation.

Upper Miocene or Pliocene: Southern California (between Santa Ana and Oceanside).

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, pp. 169, 184, 216–217). *Capistrano fm.*—The light-colored Monterey sh. is everywhere overlain by thin-bedded dark gray sh., the contact being nearly or quite conformable. This sh. and the associated ss. cover a large synclinal area centering about Capistrano. Mica is prominent in the gray sh., and foraminifera and other organisms are common both in it and in the sometimes abundant small ls. nodules or lenses. The sh. rarely contains beds of fine ss., which is usually high in quartz, and sometimes highly feldspathic. At top of fm. this ss. predominates. Occasionally the gray sh. has white partings which resemble the Monterey. The Capistrano beds may properly belong with the Monterey, but because of their different lithology and local development of breccia at or near their base, they are here distinguished as a separate fm. The shales are practically identical with those which uncon. overlie the Monterey in the nearby Huntington Beach oil field, and which are commonly called *Fernando Pliocene*. Thickness 1,200 ft. Classified as upper Miocene (?), as uncon. (?) overlying Monterey sh., and as uncon. overlain by San Mateo fm. (Plio.?). Suggests correlation with San Pablo fm. (upper Mio.), but "fossil evidence is inconclusive," and the beds may be lower Plio. [Mapped.]

Named for development around Capistrano, Orange Co.

Capitan limestone. (Of Guadalupe group.)

Permian: Western Texas and southeastern New Mexico (Pecos Valley).

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 41). *Capitan ls.*—Massive white ls., 0 to 1,800 or more ft. thick. Conformably overlies Delaware Mtn fm. in Guadalupe Mtns. Top not seen but believed to uncon. underlie Castile gyp.

Upper fm. of Guadalupe group. According to N. H. Darton and J. B. Reeside, Jr. (Geol. Soc. Am. Bull., vol. 37, p. 420, 1926) the Castile gyp. uncon. overlies Capitan ls. K. H. Crandall (A. A. P. G. Bull., vol. 13, pp. 941–943, 1929), R. E. King (Univ. Tex. Bull. 3042, p. 13, 1931), W. B. Lang (A. A. P. G. Bull., Feb. 1935), and other geologists are also now satisfied (1) that Castile gyp. is younger than Capitan ls. (although there is diversity of opinion regarding the uncon.); (2) that typical Delaware Mtn fm. of Delaware Mtns includes in its upper part the time equiv. of Capitan ls.; and (3) that the beds underlying Capitan ls. and called Delaware Mtn fm. in Guadalupe Mtns are=only lower part of Delaware Mtn fm. of Delaware Mtns.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 925, etc.), extended *Capitan ls.* into eastern Glass Mtns, and included in it the Tessey, Gilliam, and Vidrio deposits.

R. C. Moore, 1933 (see under †*Glass Mtns fm.*), called the Capitan ls. in Glass Mtns the *Glass Mtns fm.*, a name (preoccupied) proposed by P. B. King.

P. B. King, 1934 (Am. Jour. Sci., 5th, vol. 45, p. 736). *Glass Mtns fm.* abandoned (preoccupied) and *Capitan ls.* applied in Glass Mtns to include (descending). on E. side of the mtns, Tessey massive memb., Gilliam thin-bedded memb., and Vidrio massive memb.; and, in lower part of Capitan ls. on W. side of Glass Mtns, the Altuda shaly memb. (=lower part of Vidrio memb.).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). In Pecos Valley of SE. N. Mex. the nonbedded Capitan ls. of reef zone grades laterally into Carlsbad ls. and is in places overlain by a thin wedge of the Carlsbad, and in other places it grades laterally into the Carlsbad ls. (here treated as a distinct fm.). It also grades laterally into upper part of Delaware Mtn fm. of fore-reef zone.

P. B. King, 1937 (U. S. G. S. P. P. 187), treated *Tessey ls.* as a distinct fm., instead of including it in Capitan ls. This is present adopted definition of U. S. Geol. Survey.

Named for El Capitan Peak, El Paso Co., Tex., which is formed of the ls.

†Capitol limestone.

Middle Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 277–278). *Capitol ls.*—Ls. having appearance of laminated ss., being in fact a consolidated bed of calc. sand composed of comminuted fragments of shells and corals. Thickness 20 to 25 ft. Included in Nashville fm. Overlies *Orthis* bed [Hermitage fm.], lowest div. of Nashville fm. Underlies Dove ls.

Nongeographic name. Beds represent lower part of Bigby ls., of Trenton age. Have also been called "Mount Pleasant phosphate."

Named for fact the beds supplied the rock to build Tennessee State Capitol.

Capitol Creek shale.

Middle Cambrian: Montana.

A. Rothpletz, 1915 (Die fauna der Belt formation bei Helena in Mont., Munich, 1915).

C. D. Walcott, 1916 (Smithsonian Misc. Coll., vol. 64, p. 291). Capitol Creek sh. of Rothpletz is same as Park sh.

Cap Mountain formation.

Upper Cambrian: Central Texas.

S. Paige, 1911 (U. S. G. S. Bull. 450, p. 23). *Cap Mtn fm.*—At base gradual transition from ss. to ls., but predominantly ls., capped by 15 to 75 ft. of cross-bedded glauconitic ss. Thickness 90 ft. Overlies Hickory ss. and underlies Wilberns fm.

Named for Cap Mountain, Llano Co.

Capote limestone.

Age (?): Mexico.

W. P. Blake, 1905 (Am. Inst. Mg. Engrs. Trans., vol. 35, p. 551).

Capote quartzite.

Pre-Cambrian: Mexico (Sonora).

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 319).

Capps limestone member (of Mineral Wells formation).

Pennsylvanian: Central Texas (Brown County, Colorado River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 35; Univ. Tex. Bull. 2132, pp. 96, 97). *Capps ls. lentil.*—A thin lentil of ls. near base of Brownwood memb. of Graford fm. in Brown Co. Very irregular in lithologic character. In places almost nothing but corals; in other places composed of rounded ls. and chert pebbles cemented by calc. carbonate to form a solid ls. layer. Is "Coral" ls. of Drake. Thickness 4 ft. Is traceable for only short distances on either side of Pecan Bayou. To NE. of Brownwood it extends from a point near Capps well to beyond Frisco R. R., a total distance of about 3 mi. To SE. of Brownwood it is exposed from near Santa Fe tracks to Cret. overlap E. of Cedarton. Has not been recognized in borings in Brownwood oil field W. of area of its outcrop. Named for Capps farm, 3 mi. E. of Brownwood, Brown Co., where it is well developed.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105–109), revised the definitions by transferring Capps ls. from Brownwood memb. of Graford fm. to top of underlying Strawn group.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, p. 201), stated, under the heading of Brownwood sh. memb. (of Graford fm): The name *Brownwood* is applied to the shales lying btw. top of Capps ls., or in some places the Rochelle cgl., and Adams Branch ls. Further along, on same page, they stated: In some areas, especially N. of Colorado River, there occurs, near base of Brownwood sh., a thin lenticular ls. known as *Capps ls. lentil.* In section on p. 198 they included Rochelle cgl. in Graford fm., but do not show Capps ls.

The U. S. Geol. Survey at present treats *Capps ls. memb.* as top bed of Mineral Wells fm., the upper fm. of Strawn group.

†Caprina limestone.

A paleontologic name applied in early Tex. repts to the ls. later named *Edwards ls.*

†Caprotina limestone.

A paleontologic name applied in some early repts to Fredericksburg group of Lower Cret. of Tex. and to a part of that group; also to Glen Rose ls. of Trinity group.

Captain Creek limestone member.

Pennsylvanian: Central eastern and northeastern Kansas.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pt. 1, pp. 76–79). *Captain Creek ls. memb.*—Basal memb. of Stanton ls. and most easily recognizable unit of Lansing group in NE. Kans. In Johnson and Miami Counties it is gray to dark-gray, massive, evenly bedded ls., sugary to dense. Thickness 4½ to 10 ft. Underlies Eudora sh. memb. and overlies Vilas sh. Named for stream near Eudora, Douglas Co.

See also Newell, 1936 (Jour. Geol., vol. 44, No. 1, pp. 23–31); R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 132, 191); and Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Moore stated (1936) type loc. is on Captain Creek 2 mi. E. of Eudora, roadcut near SE. cor. sec. 3, T. 13 S., R. 21 E.

†Carbon group.

Tertiary: Wyoming.

L. Lesquereux, 1876 (U. S. Geol. Surv. Terr. Bull. 5, 2d ser., pp. 244–248). *Carbon group (middle Mio.)* underlies Green River group (upper Mio.) and overlies Evanston group (upper Eo. or lower Mio.).

Probably same as Wasatch group, of Eo. age.

Carbon.

Upper Cretaceous: Southern Wyoming.

A. C. Veatch, 1907 (Jour. Geol., vol. 15, pp. 547–549, and Am. Jour. Sci., 4th, vol. 24, pp. 18–22), in several places referred to "Laramie (Carbon) group" in Evanston section of southern Wyo. He also expressed opinion that *Laramie* should be restricted to "Upper Laramie," and that a new name should be applied to "Lower Laramie," suggesting, for the latter, "Bow fm. or group" (from Medicine Bow River, Carbon region) or "Golden fm. *or group*" (from Golden, Colo.).

Carbonado formation. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

B. Willis, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 400–436). *Carbonado fm.*—Basal fm. of Puget group. Consists of sss., shales, and coals. Is the productive series of Puget group. Includes all the coal veins below Wilkeson ss. down to lowest bed developed in the field. Named for town [in Tacoma quad.]. Thickness 1,100 to 2,000 ft.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), repeated 1898 definition, and stated that *Carbonado fm.* included 20 ft. of massive ss. at top.

Carbondale formation.

Pennsylvanian: Illinois and western Kentucky.

E. F. Lines, 1912 (Ill. Geol. Surv. Bull. 17, p. 74). *Carbondale fm.*—Series of beds of sh., ss., coal, and ls., 200 to 460 ft. thick, extending from bottom of Murphysboro or No. 2 coal below to top of Herrin or No. 6 coal above. Overlies Pottsville fm. and underlies McLeansboro fm. Combines "La Salle fm." and "Petersburg fm." of previous rept.

E. W. Shaw and T. E. Savage, 1912 (U. S. G. S. Murphysboro-Herrin folio, No. 185), also defined Carbondale fm. as extending from base of No. 2 coal to top of No. 6 coal.

Top of underclay of Murphysboro or No. 2 coal is now the U. S. Geol. Survey's accepted base of fm. The Carbondale was correlated by D. White with all but uppermost part of Allegheny fm.

Named for Carbondale, Jackson Co., Ill.

Carbonic.

A variant of *Carboniferous* employed by some geologists.

Carboniferous period (or system).

The time (and the rocks) of the youngest Paleozoic **system, succeeding the** Devonian period and preceding the Triassic period. **Divided by U. S. Geol.** Survey into (descending) Permian, Pennsylvanian, and **Mississippian** epochs (or series). For definition see U. S. G. S. **Bull. 769, pp. 65–78.**

†Carboniferous limestone.

A term applied in some early geologic repts to Mississippian series.

Carbon River [coal] series.

Eocene: Western central Washington (Puget Sound region).

B. Willis, 1886 (U. S. 10th Census, vol. 15, pls. 81, 84). [See under *Evans Creek coal series.*]

Carcajou Mountain beds.

Devonian: Mackenzie, Canada.

E. M. Kindle, 1936 (Sci., n. s., vol. 83, No. 2140, pp. 14–15). *Bosworth ss. and sh.* (preoccupied), replaced by *Carcajou Mtn beds.* Named for mtn 43± mi. below Bosworth Creek.

Cardenas formation.

Cretaceous: Mexico.

V. R. Garfias, 1915 (Econ. Geol., vol. 10, pp. 199, 202).

Cardiff conglomerate.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania, Maryland, and Virginia.

E. B. Mathews, Feb. 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143). *Cardiff qtzite* [in table on p. 143 he calls it *Cardiff quartz cgl.*].—A somewhat intermittent poorly developed qtzitic cgl. Present in strongly marked synclinal basin with its greatest depth in neighborhood of Cardiff [Harford Co.], Md. Underlies Peach Bottom slates and overlies Wissahickon phyllite, mica schist, and mica gneiss.

W. B. Clark, 1904 (Md. Geol. Surv. Harford Co. geol. map). *Cardiff.*—Qtzite and quartzose cgl. A fm. of slight extent. Underlies Peach Bottom and overlies Wissahickon. Thickness 500 ft.

The conception of Wissahickon fm. has in recent years been modified. The fm. that underlies Cardiff cgl. is now called *Peters Creek schist.* All belong to Glenarm series, which was formerly classified by U. S. Geol. Survey as "Algonkian," but, that term having been discarded, the Glenarm is now classified as *pre-Camb.*

This fm. has also been called "Cardiff qtzite."

Cardiff shale.

Upper Devonian: Western to east-central New York.

J. M. Clarke and D. D. Luther, June, 1904 (N. Y. State Mus. Bull. 63, p. 16). *Cardiff shale.*—Dark calc. and black slaty shales with thin layers of fossiliferous ls., both of which weather light ashen gray. Thickness 50 to 100 ft. Top div. of Marcellus beds or stage [broad sense]. Overlies Stafford ls. and underlies Skaneateles sh. of the Hamilton. Finely shown in and about village of Cardiff, Onondaga Co. [In this same bull. Clarke and Luther recommended that *Marcellus sh.* be restricted to the basal black sh. (see under *Marcellus sh.*).]

In subsequent repts these beds have been both included in and excluded from Marcellus sh. The greatly predominant usage, however, has been to restrict Marcellus sh. to the scantily fossiliferous black shales beneath the Cardiff. These black shales, with the included Cherry Valley ls., aggregate 62 to 145 ft. in thickness btw. Unadilla Valley and Seneca Lake region, to W.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 129–236). *Cardiff memb. of Marcellus fm.*—In 1904 Clarke and Luther subdivided Marcellus into Marcellus and Cardiff in region E. of eastern limit of typical Stafford ls. But they fell into confusion because further W. the sh. below the Stafford is jet black and the sh. above the Stafford is lithologically like the Cardiff. They therefore defined the Cardiff as lying above the Stafford, when actually it lies on the Marcellus and is overlain by the Mottville, which is E. equiv. of the Stafford. Since the Stafford is actually=basal bed of the Skaneateles it is necessary to exclude it from the Marcellus. The Marcellus of eastern N. Y. is here divided into (descending): Cardiff memb. (light-colored); Chittenango memb. (black); Cherry Valley ls. memb. (black); and Union Springs memb. (black). In Cayuga and Seneca Lakes region the Marcellus is divided into (descending): Oatka Creek memb.; Cherry Valley memb.; and Union Springs memb.; the Oatka Creek memb. (black sh., 30 to 50 ft. thick) being correlated with Chittenango (black) and Cardiff (gray sh. and ss.) members. Farther W. the Union Springs (black) and Cherry Valley (black) members thin out and the black Oatka Creek is sole representative of Marcellus. A striking change in facies is seen as Cardiff beds are traced E. and W. from their type section. In Chenango Valley and eastward the Cardiff sh. is represented by three members, a sandy Solsville memb. separating an upper [Pecksport] and lower [Bridgewater] gray sh. memb. West of Chenango Valley the sandy memb. disappears and entire sequence is one of nearly homogeneous dark gray sh. Still farther W. it becomes black sh. and forms part of Oatka Creek sh. The eastward change in facies in Chenango and Unadilla Valleys is attended by marked change in faunal facies. The dark shales of the Cardiff are characterized by a "Leiorhynchus fauna," but as those become sandier in E. part of State, true Hamilton forms replace those of the Cardiff, and in upper part of Marcellus fm. (Pecksport and Solsville members) in Unadilla Valley, Hamilton species predominate. In vicinity of Schoharie and Catskill the jet-black Marcellus is succeeded directly by strata having a Hamilton fauna, the Mount Marion beds, suggesting that the replacement of the "Leiorhynchus or Marcellus facies" by that of the Hamilton is complete in E. part of the State.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). Skaneateles sh. includes supposed Cardiff sh. with Stafford ls. at base; and it overlies Marcellus sh. and underlies Ludlowville sh. [On p. 392 she stated: *Cardiff sh.* is now regarded as a modified Marcellus facies of Skaneateles sh.; also that it "grades above into Skaneateles sh." Thickness 50 to 175 ft.]

The U. S. Geol. Survey has adopted the definition of Skaneateles sh. that includes in it the Cardiff sh. of N. Y. repts.

Cardium sandstones.

Cretaceous: Alberta.

D. B. Dowling, 1914 (Canada Geol. Surv. Mem. 52, p. 9).

Caribbean group.

Lower Cretaceous (?): Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trinidad, pp. 13–33). [No age assigned.]

Subsequent repts assigned *Caribbean series* to pre-Cret. and to Paleozoic (?). C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 703), assigned *Caribbean group* of Trinidad to Lower Cret.

Caribbean limestone.

Tertiary (Pliocene): Panama Canal Zone.

D. F. MacDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 710).

Cariboo schists.

Pre-Cambrian: British Columbia.

A. Bowman, 1889 (Canada Geol. Surv., n. s., vol. 3, pt. 1, pp. 22C–25C).

†Caribou formation.

Mississippian: Northern California (Plumas County).

J. S. Diller, 1892 (prel. proof sheet edition of U. S. G. S. Lassen Peak folio, No. 15). *Caribou fm.*—NW. of Caribou bridge [Plumas Co., in SE. part of Lassen Peak quad.] a series of slates and sss., with a heavy mass of fossiliferous ls., forms for several mi. the crest of divide btw. Musquito and Yellow Creeks. The ls. is of Carbf. age and one of most widely distributed strata yet recognized by fossils in northern Calif. It forms a prominent hill near Bass's ranch on Stillwater and on McCloud River opposite U. S. fishery, as well as near Gazelle, NW. of Mount Shasta. Is younger than Grizzly fm. and older than Spanish fm.

J. P. Smith, 1916 (Calif. State Min. Bur. Bull. 72, pp. 28, 29). "The Caribou ls. of Taylorsville region of Plumas Co., with *Fusulina cylindrica*, is mapped under Carbf. heading."

In the published Lassen Peak folio (No. 15) these rocks were mainly included in Calaveras fm.

Carlile shale. (In Colorado group.)

Upper Cretaceous: Eastern Colorado and Wyoming, northeastern New Mexico, Nebraska, South Dakota, Kansas, and southeastern Montana.

G. K. Gilbert, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 565). *Carlile sh.*—Chiefly medium gray sh.; at top a thin purplish ls. or a thicker yellow ss. Thickness in Arkansas Valley region, eastern Colo., 175 to 200 ft. Top fm. of Benton group. Underlies Timpas ls. and overlies Greenhorn ls. Named for Carlile Spring and Carlile Station, 21 mi. W. of Pueblo, Colo.

The Niobrara and Benton are not now treated as groups, the broader term Colorado group, which includes them both, being considered the more useful group name. Where the Niobrara deposits and Benton deposits are not subdivided, they are called *Niobrara ls.* and *Benton sh.*, respectively. (See also under *Niobrara ls.*)

Carlim limestone.

Lower Ordovician: Central Pennsylvania (Blair to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 526, 533, 537). *Carlim ls.*—Dark, fine-grained ls. extensively quarried for flux, with at top *Lemont ls. memb.* Thickness 180 [0 to 400] ft. Underlies Lowville ls. and overlies Bellefonte dol., of Beekmantown group. Is of middle Chazyan age. Correlates with Crown Point ls. of N. Y. Named for quarry town a few mi. NE. of Williamsburg, Blair Co.

Carlinville limestone member (of McLeansboro formation).

Pennsylvanian: Southwestern and central western Illinois (Macoupin and Sangamon Counties).

A. H. Worthen, 1873 (Ill. Geol. Surv., vol. 5, pp. 287, 290–301, 309). *Carlinville ls.*—Hard, compact, brownish gray ls., 6 to 12 ft. thick, upper portion concretionary or pebbly in structure, in Coal Measures of Macoupin and Sangamon Counties, being bed No. 11 in Virden shaft, Macoupin Co. Overlain by argill. sh. and underlain by bituminous sh. including coal No. 9. Probably same as Shoal Creek ls.

According to G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. ser., Bull. 26) and 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 257, etc.), the Carlinville ls. lies 100± ft. below Shoal Creek ls. and 20 to 60 ft. above coal No. 8. E. W. Shaw, 1923 (U. S. G. S. Carlyle-Centralia folio, No. 216), also identified Carlinville ls. as older than Shoal Creek ls. According to Wallace Lee, 1926 (U. S. G. S. Gillespie-Mount Olive folio, No. 220), the Carlinville ls. lies 53 to 81 ft. below Shoal Creek ls. H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, p. 804), placed Carlinville ls. nearly 100 ft. below Shoal Creek ls.

G. E. Ekblaw, 1933 (Ill. State Acad. Sci. Trans., vol. 25, No. 4, pp. 143–145), stated that *Carlinville ls.* is identical with Shoal Creek ls. and that Carlinville should be abandoned.

Named for outcrops in vicinity of Carlinville, Macoupin Co.

Carlinville cyclical formation.

A name applied by H. R. Wanless (Geol. Soc. Am. Bull., vol. 42, 1931, pp. 801–812) to a middle portion of McLeansboro fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes Carlinville ls. Derivation of name not stated.

Carlinville sand.

A subsurface sand in Pottsville fm. of central Ill.

Carlos sandstone member.

Eocene (upper): Southeastern Texas (Grimes, Brazos, Lee, Fayette, Gonzales, and Burleson Counties).

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and pp. 31–32). *Carlos ss. memb.*—Top memb. of Wellborn fm. of Jackson group in Grimes, Brazos, Lee, Fayette, Gonzales, and Burleson Counties, in all of which it is exposed. [Exposures listed.] Consists of massive gray to white ss., more argill. than older Bedias ss. memb. of the Wellborn; locally semiqtzitic; contains impressions of stems. Thickness 5 to 22 ft. Underlies Manning fm. and lies 10 to 120 ft. above Bedias ss. memb. Rests conformably on middle memb. of Wellborn. Well exposed along Southern Pacific R. R. right-of-way, now abandoned, 0.25 mi. N. of Carlos Station, Grimes Co.

Carlsbad limestone.

Permian: Southeastern New Mexico.

O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926 (U. S. G. S. W. S. P. 580A, pp. 12–13 and map), and N. H. Darton, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 419). *Carlsbad ls. memb. of Chupadera fm.*—Ls., with thin beds of ss. and possibly some rock salt, underlying Castile fm. and overlying Seven Rivers gypsiferous memb. of Chupadera fm. According to Darton it is top memb. of Chupadera fm., and also forms upper part of Capitan ls., which caps El Capitan at S. end of Guadalupe Mtns in Tex. Thickness 40 to 800 or more ft.

A. G. Fiedler and S. S. Nye, 1932 (U. S. G. S. W. S. P. 639): *Carlsbad ls. tongue of Capitan ls.*—In Roswell artesian basin it is almost entirely thin-bedded dolomitic ls., 35 to 40 ft. thick, but disappears entirely E. of Lakewood. Overlies Seven Rivers tongue of Pecos fm.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). Further studies show: (1) Uppermost part of *Carlsbad ls.* is younger than Capitan ls. and the rest of it is contemp. with and grades laterally into the Capitan. (2) In places the Carlsbad is overlain by a thin wedge of uppermost part of Castile anhydrite, and in other places its uppermost part grades laterally into Three Twins memb. of Chalk Bluff fm. (3) Lower part of the Carlsbad grades laterally into Seven Rivers gypsiferous memb. of Chalk Bluff fm. (4) In places a thin tongue (Azotea tongue) of upper part of Carlsbad ls. overlies Seven Rivers gypsiferous memb. of Chalk Bluff fm. (5) The Carlsbad rests on Queen sand memb. of Chalk Bluff fm. [This is present approved definition of U. S. Geol. Survey.]

Carlton porphyry.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 136). *Carrollton Mtn porphyry.*—Two types of porphyry, including rhyolites, amygdaloids, and some tuffs. Assigned to Archean (?). The *Saddle Mtn porphyry*, of slightly different type, probably belongs here.

C. N. Gould, 1904 (Okla. Geol. Surv., Dept. Geol. and Nat. Hist., 3d Bien. Rept., pp. 18, 20), mentions *Carlton porphyry*, which apparently is same as Carrollton Mtn porphyry of Bain, the geographic feature being now spelled *Carlton*.

Named for Carlton Mtns, Comanche Co.

Carlton moraine.

Pleistocene (Wisconsin stage): Western New York. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), 1913, p. 17. Named for Carlton, Orleans Co.

Carlton granophyre.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

M. G. Hoffman, 1930 (Okla. Geol. Surv. Bull. 52, pp. 39–48). *Carlton granophyre.*—Porphyritic granophyre; fine-grained; purple when fresh; weathers tan. Composes nearly all of Carlton Mtns. Resembles Davidson granophyre, but differs in that it carries phenocrysts of quartz, and orthoclase or microperthite, or both, which comprise about 11 per cent of the rock. Considered later than Davidson granophyre, and is intruded by Lugert granophyre.

Carlton limestone. (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12). *Wellington sh.* (*restricted*) divided into (descending): (1) Carlton ls. (thin-bedded ls., massive ls., thin sh., and, at base, cgl.), 17± ft. thick; (2) *Buckeye sh.*, 45± ft. thick. [Derivation of new names *Carlton* and *Buckeye* not stated.]

Carltonian formation.

Pre-Cambrian (Keweenawan): Northeastern Minnesota (shore of Lake Superior).

A. C. Lawson, 1893 (Minn. Geol. Nat. Hist. Surv. Bull. 8, pp. xxi, 22–23). *Carltonian fm.*—New local name for anorthosite intrusive into Archean of Minn. shore of Lake Superior. Assigned to Norian [Laurentian]. Named for extensive exposures in Carlton Peak, NE. Minn.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 374), assigned the anorthosite of Carlton Peak to Keweenawan series, and stated they considered it a facies of Duluth gabbro.

†Carlyle limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 119). *Carlyle ls.*—Ls., 4 to 20 ft. thick, overlain by Le Roy shales and separated from underlying Iola ls. by 75 ft. of sh.

According to Hinds and Greene (Mo. Bur. Geol. and Mines vol. 13, 1915) the ls. exposed at Carlyle is Plattsburg ls., but the ls. to which name *Carlyle* has been applied is an older bed—the Farley ls. bed in their Lane sh. memb.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 127). Field work shows †Carlyle ls. at type loc. is exact equiv. of Plattsburg ls. Adams was correct in considering †Carlyle a synonym of Stanton, inasmuch as type Stanton is shown to be type Plattsburg ls.

Named for Carlyle, Allen Co.

Carlyle sand.

A subsurface sand in Chester group (Miss.) of Clinton Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Carmack basalt.

Tertiary or Pleistocene: British Columbia and Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 51).

Carmack limestone.

Mississippian (early): Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, p. 37). *Carmack ls.*—Uniformly thin-bedded, brownish or bluish gray ls. that breaks into thin shaly layers on exposure. Thickness 100 ft. max. To E., in Ala., it becomes more cherty and grades into chert of Lauderdale fm. Contains early Kinderhook fossils. Named for a small stream (containing a 60-foot fall) tributary to Tenn. River N. of Whetstone Branch [Tishomingo Co., Miss.].

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23, passim), gives many details of *Carmack ls.*, which was included in Yellow Creek beds of Lowe.

Carmanah formation.

See under *Carmanah Point beds.*

Carmanah Point beds.

Miocene: British Columbia (Vancouver Island).

J. C. Merriam, 1896 (Univ. Calif. Dept. Geol. Bull., vol. 2, pp. 101–108). *Carmanah Point beds.*—Fossils listed. Fauna seems to be Mio. and older than that of Sooke beds. A section of the rocks near Carmanah Point light-house, forwarded to writer by Dr. C. F. Newcombe, of Victoria, shows 150± ft. of ss., sh., cgl., and drift mantle. The fossils occur chiefly in the cgl.

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 90), 1911 (Canada Geol. Surv. map 17A), and 1912 (Canada Geol. Surv. Mem. 13, p. 136). *Carmanah fm.*, Olig.-Mio., Vancouver Island, B. C.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 575). Dr. Merriam states he never intended to name a Carmanah Point fm., but the name has passed into the literature. The beds at this point are San Lorenzo shales (Olig.) overlain uncon. by Monterey cgl. in cliff beneath lighthouse. Dr. Newcombe's collection came from San Lorenzo shales, from Sooke boulders in Monterey, and from Monterey itself.

Carmel formation. (In San Rafael group.)

Upper Jurassic: Southern, central, southeastern, and northeastern Utah, southwestern and northwestern Colorado, northwestern New Mexico, and northern Arizona.

J. Gilluly and J. B. Reeside, Jr., 1926 (U. S. G. S. Press Bull. 6064, March 30, 1926). (Name adopted at joint conference of H. E. Gregory, R. C. Moore, J. Gilluly, and

J. B. Reeside, Jr., from area specially studied by Messrs. Gregory and L. F. Noble.) *Carmel fm.*—Dense ls. and buff and red ss. at base; toward top dominantly red and green sh. with thin sss. and heavy beds of gyp. Thickness 200 to 650 ft. Overlies Navajo ss., with possible uncon., and conformably underlies Entrada ss. Is basal fm. of San Rafael group.

Named for occurrence at Mount Carmel, western part of Kane Co., Utah.

For additional details see U. S. G. S. P. P. 164, 1931 (by H. E. Gregory and R. C. Moore), and U. S. G. S. P. P. 183, 1936 (by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.).

Carmelo series.

Eocene (?): Western California (Carmelo Bay region, southwest coast of San Mateo County).

A. C. Lawson, 1893 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 1, pp. 1–59). *Carmelo series.*—Several hundred ft. of thick-bedded cgls. of dark color and thinly bedded tawny sss. with some argill. shales. No fossils at Carmelo Bay, but the series appears to be identical with the coal-bearing sss. of Malpaso Canyon, about 2 mi. distant, which carry coal and appear, from fragmentary fossils found, to be of Tejon (Eocene) age. Overlain uncon. by Mio. Monterey series, and uncon. underlain by Santa Lucia granite.

H. J. Hawley (Geol. Soc. Am. Bull., vol. 28, p. 225, 1917) and P. D. Trask (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, p. 142, 1926) regard these rocks as of Chico age.

Carmichael sand.

A subsurface sand, of Penn. age and 19 to 50 ft. thick, in central northern Okla., reported to correlate with a part of Nelagoney fm. In Tonkawa pool it lies at 2,050 ft. depth, and below Lower Hoover sand and above Endicott sand.

Carmichaels formation.

Pleistocene (Illinoian): Western Pennsylvania.

M. R. Campbell, 1902 (U. S. G. S. Masontown-Uniontown folio, No. 82). *Carmichael clay.*—Clay, sand, and boulders on terraces and in abandoned channels of the larger streams. Thickness 50 to 80 ft. Exposed at Carmichaels, Greene Co.

Carneros sandstone member.

Miocene: Southern California (Kern County).

G. M. Cunningham and W. F. Barbat, 1932 (A. A. P. G. Bull., vol. 16, No. 4, pp. 419–421, from unpublished ms. of A. R. May and J. D. Gilboe). *Carneros ss. memb.*, basal bed of type Temblor; 168 ft. thick; *Scutella merriami.* [Apparently named for Carneros Creek.]

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169), divided Temblor fm. in McKittrick-Midway-San Emigdio region into (descending): Gould sh., Button bed ss., Media sh., *Carneros ss.*, Santos sh., and *Phacoides* reef.

E. L. Packard and R. Kellogg, 1934 (Carnegie Inst. Wash. Pub. 447, Contr. to Pal., p. 17). *Carneros ss. memb.* is a name used first by H. G. Schenck and F. E. von Estorff in a ms. for the "main reef" of type Temblor. The term has crept into literature and is now fairly well known by local stratigraphers.

Carolina gneiss.

Pre-Cambrian: Northwestern North Carolina and South Carolina, northern Georgia, eastern Tennessee, and western Virginia.

A. Keith, 1901 (U. S. G. S. Washington folio, No. 70, p. 2). *Carolina gneiss.*—Alternating layers of mica gneiss and mica schist, of prevailingly gray color; dark bluish-gray when fresh, greenish or yellowish-gray when weathered. Both kinds of layers highly siliceous. Includes small bodies of granite, schistose granite, and diorite, and in places numerous small crystals of garnet. Thickness doubtless many thousand ft. Oldest rocks in region. Overlain by Archean granite gneiss.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 2). *Carolina gneiss.*—An immense series of interbedded mica schists, mica gneiss, and fine granitoid layers.

Most of them are light or dark gray in color, weathering to dull gray and greenish gray. Lenses and veins of pegmatite, and some layers of white granitic material. That part of fm. adjacent to overlying Roan gneiss contains some thin interbedded layers of hornblende schist and hornblende gneiss precisely like Roan gneiss, constituting transition btw. the fms. The Carolina gneiss is oldest in this region. Named for its great extent [on the Piedmont Plateau] in North and South Carolina. Both Carolina gneiss and Roan gneiss are Archean.

Carolina slate belt.

A term that has sometimes been loosely applied to the great belt of pre-Camb. rocks of western North Carolina and northwestern South Carolina.

†Carolina bed.

An abbreviation of Ruffin's name "Carolinian bed."

Carolina-Texas sand.

A subsurface sand in Cook Mtn fm. (of Claiborne group) of southern Tex. Lies lower than Webster sand.

†Carolinian bed.

Eocene: Eastern South Carolina and North Carolina.

E. Ruffin, 1843 (Agric. Surv. S. C. 1st Rept., pp. 6–24). *Great Carolinian bed.*—The next oldest fm. of marl in S. C. Extends from E. of the Santee to far across the Savannah. Is younger than Peedee marl (Cret.) and older than the Mio. marl. In general is of dingy yellowish white or pale buff color, of different shades; sometimes a dull greenish color is added to the ordinary shades. Texture close and firm; fracture something like that of chalk, though the mass is generally softer; in a few cases more indurated. Very few fossils. In some places greensand forms a large ingredient of the marl. Exposed on Ashley and Cooper Rivers and their branches, also on Santee River and its branches, and on the Savannah and its branches.

Includes Cooper and Santee marls and other beds. As used by some authors included Mio. (See C. W. Cooke, U. S. G. S. Bull. 867, 1936.)

Named for extensive development in Coastal Plain of S. C. (C. W. Cooke, personal communication.)

†Carolinian.

A term introduced by A. Heilprin (Phila. Acad. Nat. Sci. Proc. 1882, pp. 179–185, 1883) for "Upper Atlantic Miocene deposits of South and North Carolina ('Sumter' epoch of Dana). The South and North Carolina deposits represent approx. the same geological horizon. The Virginia deposits indicate a horizon lower (older) in the geological scale than that of either of the formations just mentioned. The Maryland deposits indicate two well-marked faunal horizons, of which the upper one is the correspondent of the Virginian." Included all of Chesapeake group of current nomenclature.

Caroni series.

Tertiary: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trinidad, pp. 41–45).

Carpenter bed.

Upper Cretaceous (Gulf series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 733, 735.) *Carpenter bed.*—Local name for Eagle Ford or Benton shales in El Paso Co. Consists of (descending): (1) Very fissile, black, slightly aren. clay sh., with numerous Inocerami and oysters, 300 ft.; (2) flaggy, fissile, calc. argill. ss., with numerous oyster shell fragments and Inocerami, 430 ft.; (3) siliceous ls. with oysters, 30 ft. Top fm. of Upper Cret. Overlies Lower Cross Timber or Dakota sand.

Apparently named for Carpenter Spring, E. side of Eagle Mtn, El Paso Co.

Carpenter Creek porphyry.

Tertiary: Central Montana (Little Belt Mountains).

L. V. Pirsson, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 501). *Carpenter Creek type of granite porphyry* is variant of Wolf Butte type of granite porphyry. Named for occurrence (locally) above Carpenter Creek, Little Belt Mtns.

P. A. Schafer, 1935 (Mont. Bur. Mines and Geol. Mem. 13, map, pp. 10–15). *Carpenter Creek porphyry.*—In valleys of Carpenter and Snow Creeks is a swarm of dikes corresponding to what Weed and Pirrson have called *Carpenter Creek porphyry.* [Assigned to Tert.]

Carper sand.

Devonian or Mississippian: Southeastern Illinois (Clark County).

G. F. Moulton, 1926 (Ill. Geol. Surv. Press Bull. No. 4, pp. 1–2). *Carper sand.*—Fine-grained ss., which occurs in lenticular bodies of considerable areal extent in black sh. underlying the Miss. ls. in Martinsville pool, Clark Co. Yields oil on John Carper farm, sec. 30, T. 10 N., R. 13 W. Commonly the ss. occurs in 2 or more beds separated by 10–15 ft. of sh. In a few places as many as 4 separate beds of ss. are found. Usually the top sand is barren of oil. The second sand is generally the producing memb. of Carper sand zone.

L. A. Mylius, 1927 (Ill. Geol. Surv. Bull. 54, table 5), placed this sand in Kinderhook.

Carpinteria formation.

Pleistocene: Southern California (Santa Barbara County).

R. W. Chaney and H. L. Mason, 1934 (Carnegie Inst. Wash. Pub. 415, pp. 48–52; preprint 1932). *Carpinteria fm.*—Name suggested for the deposits at Carpinteria that contain Pleist. flora, but the name may perhaps be appropriately extended to cover all of Pleist. alluvium mapped by R. Arnold (U. S. G. S. Bull. 321, 1907) along this part of Calif. coast. Deposits on Santa Cruz Island that contain a closely related flora have been termed *Santa Cruz Island fm.* The *Carpinteria fm.* lies horizontally across upturned edges of Monterey fm. as mapped by Arnold in Bull. 321, the relations of the 2 fms. being clearly shown for considerable distance E. and W. along the sea cliff. Thickness 10 to 38± ft. [Thickest section described consists of (descending):] (1) Light-gray to yellowish compact sands, 10 ft.; (2) cobble gravel, well rounded, 3 ft.; (3) light-gray to yellowish sands, 10 ft.; (4) cobble and boulder gravel, with cross-bedded sand pockets containing cones and wood, 15 ft. Most of organic remains occur at about middle of fm. [Flora described.]

†Carquinez series.

Eocene: Western California.

R. Arnold, 1902 (Sci., n. s., vol. 15, p. 416), and A. C. Lawson, 1903 (Geol. Soc. Am. Bull., vol. 13, p. 545). *Karquinez* includes Tejon (2,100 ft. thick) and Martinez (2,200 ft. thick), or all of Eo. of western Calif.

A local geographic name synonymous with *Eocene series* in this region. Probably named for occurrence at Carquinez Bay, Carquinez Point, or Carquinez Strait, connecting Suisun and San Pablo Bays. *Carquinez* is spelling adopted by U. S. Geographic Board.

Carr sand.

A subsurface sand, 35 ± ft. thick, in upper (Trinity) part of the Comanche Cret. of Talco field, Titus and Franklin Counties, Tex., lying higher than Galt sand. Named for fact it was first encountered in C. M. Carr discovery well.

Carrasco limestone.

Upper Cambrian (?): Southwestern New Mexico (Silver City region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 5). *Carrasco ls.*—Main calc. memb. of Late Ordovicic age well displayed back of Carrasco smelter property near Silver City. Thickness 75 ft. [On p. 4 he puts it in "Late Cambric;" on p. 5 in "Late Ordovicic."]

Carrigan black lands.

Pleistocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. vol. 2, Ann. Rept. 1888). *Carrigan black lands.*—Transported soils covered by gravel and filled with gravelly debris. Included in Prairie de Roan div.

Carrizo sand. (In Claiborne group.)

Eocene (middle): Southern and eastern Texas and just enters Louisiana.

J. Owen, 1889 (Tex. Geol. and Min. Surv., 1st Rept. Prog., pp. 70, 73–74). *Carrizo ss.*—A line drawn from point on Neuces River S. of town of Uvalde to point 10 mi. W. of Carrizo Springs, thence S. to Rio Grande, will represent outcrop of a very loose, coarse, friable sand bed nearly 200 ft. thick. Supplies the numerous wells at Carrizo Springs. Lies conformably on late Cret. rocks. W. line of Dimmit Co. passes near W. limit of Carrizo ss. Top stratum, 40 ft. of red sand; base, gray and brown sand; some of more indurated strata answer for building stone.

E. T. Dumble, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 924–932). *Carrizo sands.*—Interbedded sands and sandy clays, of white or yellow color, containing ferruginous matter and nodules, strings of concretions and laminae. Sands somewhat calc. and in places indurated to buff ss. excellently adapted for building purposes. Included in top of Lignitic [Wilcox group]. Strat. equiv. of Queen City beds of Kennedy. Overlie series of red and white clays with iron, forming middle part of Lignitic. In places overlap underlying Lignitic beds and Midway. Underlie Lower Claiborne stage. [In 1911 (Tex. Acad. Sci. Trans., vol. 11, pp. 52–53) Dumble included these deposits in the Claiborne.]

E. W. Berry, 1922 (U. S. G. S. P. P. 131A). The age of *Carrizo ss.* has heretofore been somewhat uncertain. Referred originally to the Wilcox it has been considered by several Tex. geologists to be of Claiborne age. The plants found in it, as well as those found above and below it near Rio Grande, definitely settle its upper Wilcox age, and show that it is in nature of a lens, which becomes thinner toward Rio Grande, where its upper part is replaced with more typical and more argill. Wilcox deposits, also carrying characteristic fossil plants. *Type exposure is in quarries about ½ mi. W. of Carrizo Springs, Dimmit Co.*

A. C. Trowbridge, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 75; U. S. G. S. P. P. 131D), divided Wilcox group of southern Tex. into (descending) Bigford fm., Carrizo ss., and Indio fm. and stated that Bigford fm. is in part contemp. with Carrizo ss. and in part younger, and that the Carrizo rests on Indio fm. with uncon. and overlap. Thickness of Carrizo 118 to 400± ft.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Carrizo sands memb. of Claiborne fm.*—In Tex., on W. side of Sabine uplift, occurs a fine-textured, clean, white, micaceous sand below Reklaw memb. of Claiborne and above Wilcox fm. On the surface this sand can be traced into Carrizo sands of Milam Co. It is lithologically different from the Wilcox and separated from it by an uncon. For these reasons it is placed in the Claiborne, rather than in the Wilcox.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 614). Owen did not designate type loc. Berry stated type loc. is the outcrop in the quarries ½ mi. W. of Carrizo Springs. These quarries are now thought to lie in base of the Reklaw and not in the original series of underlying sands defined as Carrizo. Geologists working in dist. agree that if a type loc. is to be designated, it should be the exposure known as Brand Rock on Peña Creek W. of Carrizo Springs. The Carrizo sand is basal fm. of Claiborne group. Grades into overlying Reklaw memb. of Mount Selman fm. and is uncon. on Wilcox. So closely resembles the younger Queen City sand that for long time it was believed to be same as Queen City.

The Carrizo sand is now assigned by most geologists to Claiborne group. (See under *Mount Selman fm.*, 1932 and later entries.) It is treated by Tex. Geol. Surv. and U. S. Geol. Survey as a distinct fm. underlying Mount Selman fm. and overlying the Wilcox. But A. Deussen (1934 and 1936, A. A. P. G. Bull.) treated it as basal memb. of Mount Selman fm.

†Carrizo formation.

Pre-Cambrian: Western Texas (Van Horn region).

See *Carrizo Mtn schist*, 1891 entry.

†Carrizo formation.

Miocene: Southern California (Imperial and San Diego Counties).

J. P. Smith, 1910 (Jour. Geol., vol. 18, No. 3, chart opp. p. 226). *Carrizo fm.*, sss. with *Pecten carrizoensis* and *P. cerrosensis.* Of upper Mio. age. Older than San Diego.

W. S. W. Kew, 1914 (Calif. Univ. Pub. Dept. Geol. Bull., vol. 8, pp. 39–46 and map). [Called *Carrizo fm.* on map; no text heading; throughout description called *Carrizo fm.* and *Carrizo Creek fm.*] At type loc. divided, on lithologic and biologic grounds, into Lower Division and Upper Division. The upper div. is about 2,000 ft. thick in Carrizo Valley, and consists of fine-grained muddy ss. and sh. It extends N. along W. side of Salton Sea to Santa Rosa Mtns, which is most northerly limit of the beds in this region. The lower div. consists of about 200 ft. of more or less coarse arkosic ss., locally conglomeratic, underlain by a coarse angular cgl. of subaqueous origin and reddish color. Total thickness of fm. probably 2,500 ft. Rests on eroded surface of basement complex or, in places, on a flow of andesite.

J. P. Buwalda and W. L. Stanton, 1930 (Sci., n. s., vol. 71, pp. 104–106). *Carrizo fm.* is Mio. or lower Plio.

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1–25). "Carrizo fm." of Kew (preoccupied) included the marine Imperial fm. (late lower Mio.) and at least basal part of overlying nonmarine deposits of upper or middle Mio. age here named *Palm Spring fm.*

See also †*Carrizo Creek beds* and *Imperial fm.*

Named for exposures in broad valley of Carrizo Creek immediately N. of Coyote Mtn, Imperial Co.

†Carrizo Creek beds.

Miocene: Southern California (Imperial County).

C. R. Orcutt, 1890 (Calif. State Min. Bur. 10th Ann. Rept., p. 915). *Carrizo Creek oyster beds.*—Shales and clays of light-brown or pinkish color, through which Carrizo Creek has been cut. Tentatively assigned to Mio.

T. W. Vaughan, 1917 (U. S. G. S. P. P. 98, pp. 355–386). The fauna of *Carrizo Creek* is related to Plio. and post-Plio. faunas of Fla. and West Indies and can scarcely be older than lower Plio.

W. S. W. Kew, 1920 (U. S. G. S. Press Bull. 447, June 1920). These beds are known as *Carrizo Creek beds*, from extensive outcrops on Carrizo Creek, but can also be seen along W. side of valley around Coyote Mtn, at Yuba Buttes and at Superstition Mtn, as well as at San Felipe Valley, W. of Salton Sea, and at places N. of San Gorgonio Pass, in Riverside Co. Remnants of these beds rest on the crystalline rocks at elev. as high as 2,000 ft. above present level of valley. The Carrizo Creek beds consist mainly of tan-colored well-bedded sandy shales or silts, but include small amounts of ss. and clayey sh. At some places, as on Carrizo Creek, they contain numerous marine fossils, the remains of animals that lived probably in Plio. time.

See also †*Carrizo fm.*, W. S. W. Kew, 1914.

In 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, p. 434) G. D. Hanna named these beds *Imperial fm.*

In 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1–25) W. P. Woodring divided these beds into Palm Spring fm. above (nonmarine) and Imperial fm. (restricted) below (marine).

Carrizo Mountain schist.

Pre-Cambrian: Western Texas (Van Horn region).

W. H. von Streeruwitz, 1891 (Tex. Geol. Surv. 2d Ann. Rept., 1890, pp. 681–683). *Carrizo schists.*—The S. part of Carrizo Mtns is built up of reddish, gray, and lighter and darker greenish crystalline schists, with numerous quartz dykes, tilted and upheaved by this quartz and by granitic and granitoid rocks, which on N. and NW. side protrude through the schists. On S. side these schists disappear under lss., and these under the recent soil of the flats and gravel hills. * * * The crystalline schists cross Texas & Pacific Ry near Allamore, running into a low ridge, which 6 mi. W. of Van Horn Station disappears in the flat at foot of the Carbf. cliffs, which rest on non-fossiliferous red and brown sss. and grit. * * * The grit in its most southern exposure in Carrizo Mtns occurs in Round Mtn at

Allamore, rising above the flat and the low Carbf. ls. hills that run parallel with Texas & Pacific Ry to about 1 mi. W. of Allamore. On E. side of this gritty butte the red schistose rocks disappear under the grit strata, reappearing occasionally in the more northern part of Carrizo Mtns, together with serpentinous, basaltic, and greenstone intrusions.

G. B. Richardson, 1914 (U. S. G. S. Van Horn folio, No. 194, p. 3). *Carrizo fm.*—A complex of qtzite, sl., a variety of schists, and metamorphosed igneous rocks, which outcrops in Carrizo Mtns S. of Texas & Pacific Ry. The schists are chiefly of sed. origin, but a small part of fm. consists of schists which presumably represent igneous sills that were injected in thin layers btw. the sediments. Oldest exposed fm. in Carrizo Mtns in Van Horn quad. Underlies (sequence concealed) Millican fm.

Because of conflict of *Carrizo* with the Eocene Carrizo sand of Tex., the Tex. Geol. Survey and U. S. Geol. Survey now call this fm. *Carrizo Mtn schist.*

Named for Carrizo Mtns, El Paso Co.

Carroll moraine.

See under *Bethlehem moraine.*

Carroll sand.

A subsurface sand in Monongahela fm. (Penn.) of W. Va., that lies at or near horizon of Uniontown ss. memb.

†Carrollton limestone.

Mississippian: Northwestern Arkansas (Eureka Springs-Harrison region).

H. S. Williams, 1900 (Ark. Geol. Surv. Ann. Rept. 1892, vol. 5, pp. 334–337). *Carrollton ls.*—Gray ls., exposed in cliff in ravine in Carrollton [Carroll Co.] carrying fauna evidently more recent than that of Red Marbles [St. Joe ls. memb.] of other parts of State, but sections observed do not present the two fms. in strat. sequence. Contains Burlington and Keokuk fossils and represents about same fauna as that of Boone chert.

Is upper 90 ft. of Boone ls. (See A. H. Purdue and H. D. Miser, U. S. G. S. Eureka Springs-Harrison folio, No. 202, p. 10, 1916.)

Carrollton Mountain porphyry.

See *Carlton porphyry.*

Carson lava.

Age (?): Southwestern Washington (near Carson).

I. A. Williams, 1916 (Oreg. Bur. Mines and Geol., Min. Res. Oreg., vol. 2, No. 3, pp. 95–96). *Carson lava.*—Dark-gray beds of blocky lava that obviously came as a series of heavy flows. Rises above Carson Station, Wash., and extends E. to the deeply incised canyon of Wind River [Skamania Co.].

Carson Creek formation.

Age (?): Northern California (Calaveras County).

F. A. Moss, 1927 (Eng. and Min. Jour., vol. 124, pp. 1010–1011). In Carson Hill area the oldest rocks constitute a sed. and volcanic series at least 5,000 ft. thick, to which I have given local name of "*Carson Creek fm.*" It is best exposed W. of Carson Hill. Sediments in lower part are chiefly cgls. with a few thin partings of ss. Near bottom is a series of hornblende-dacite lava flows and rhyolite tuffs 900 to 1,700 ft. thick. Upper part of fm. is sl., mostly tuffaceous, with several lenses of ls. and beds of andesitic crystal tuff. At top is a thick and massive bed of andesitic tuff, in places containing much admixed sediment.

Carsonian series.

A term proposed by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 78), "for the Mid Quaternic sands and gravels overlying the Lahontan lake beds, especially well exposed in the valleys of the Carson and Truckee Rivers in western Nevada."

Cartago formation.

Eocene (?): Costa Rica.

E. B. Branson, 1928 (Mo. Univ. Studies, vol. 3, No. 1, p. 62). [Assigned to Eo. (?).]

Carters limestone member (of Lowville limestone).

Middle Ordovician: Central Tennessee (Nashville dome).

J. M. Safford, 1869 (Geol. Tenn., pp. 258–268). *Carter's Creek ls.*—Heavy-bedded, light blue or dove-colored, fossiliferous ls., upper part often gray. Thickness 50 to 100 ft. Top fm. of Trenton or Lebanon [Stones River] group. Underlies *Orthis* bed [Hermitage fm.] of Nashville group, and overlies Glade [Lebanon] ls. [This definition of Carters ls. (for beds underlying Hermitage fm. and overlying Lebanon ls.) was followed in all Tenn. repts up to 1932, although paleontologists have in recent years excluded it from Stones River group and assigned it to Lowville epoch.]

E. O. Ulrich and C. W. Hayes, 1903 (U. S. G. S. Columbia folio, No. 95), included Carters ls. in Stones River group, as did E. O. Ulrich in 1911 (Geol. Soc. Am. Bull., vol. 22).

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 1), stated that Lebanon ls. is top fm. of Stones River group, but did not say where Carters ls. belongs.

R. S. Bassler, 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51), replaced Carters ls. with Lowville ls., and showed two fms. (which he called *Upper Decorah sh.* below and *Curdsville* above) separating the *Lowville* (*Carters*) from Hermitage ls. in Nashville dome, but without explanation as to whether these two fms. were subtracted from the Hermitage or the Carters of previous Tenn. repts.

J. J. Galloway, 1919 (Tenn. Geol. Surv. Bull. 22), described *Carters ls.* of Rutherford Co., Tenn., as of Black River age, as uncon. underlying Hermitage fm., and as uncon. overlying Lebanon ls., and in his section and map showed no intervening fm., but in his text he stated that Black River group in this Co. possibly includes an unnamed fm. occurring as a lens above the Carters in SE. part of Co., of Decorah age.

P. E. Raymond, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 585), stated that there is no fm. intervening btw. Carters and Hermitage in central Tenn.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 31, p. 16), defined Carters ls. as 110 ft. thick, as of Lowville age, and as uncon. overlain by Hermitage sh. and uncon. underlain by Lebanon ls.

R. S. Bassler, 1932 (Tenn. Dept. Ed., Div. Geol. Bull. 38), restricted Carters to lower beds of Lowville age in Tenn., correlated the upper beds with Tyrone ls. of Ky., and called them *Tyrone* in Tenn. The upper beds of Lowville age (their Tyrone) are said by Ulrich and Bassler not to be present at Carters type loc., but Bassler stated (p. 63) that they outcrop a short distance beyond the Carters Creek area.

A. M. Piper, 1932 (U. S. G. S. W. S. P. 640, p. 52), adopted Bassler's restricted definition, applying *Lowville ls.* to beds called Carters ls. since 1869; restricting *Carters* to lower part of beds heretofore included under that name, or to the massive, compact, white, or light-gray cherty ls., which he designated as *Carters ls. memb. of Lowville ls.*, and did not apply any name to upper memb. of Lowville ls.

Named for exposures on Carters Creek, Maury Co.

†Carters Creek limestone.

Middle Ordovician: Central Tennessee.

See *Carters ls.*, adopted name.

Cartersville formation.

Lower Cambrian: Northwestern Georgia (Cartersville district).

H. K. Shearer, 1918 (Ga. Geol. Surv. Bull. 34, pp. 48–49, 128–163). *Cartersville fm.*—(Name suggested by L. LaForge.) Sh., sl., and feldspathic ss., most of it characterized by an unusually high content of potash. Soft light-colored sh. makes up greater part of fm. The sl. is gray or purplish gray and forms minor beds and lenses, the thickness of any single lens rarely exceeding 50 ft. The fm. contains a number of thin beds of common siliceous ss., some of it so hard as to properly be called qtzite. In vicinity of Cartersville the fm. is entirely soft shales. Thickness about 1,000 ft. Underlies Conasauga fm., and might be considered a memb. of Conasauga, but it carries more potash than latter and lss. are lacking. Overlies Beaver [Shady] ls. Is probably contemp. with Rome fm., Apison sh., and Watauga sh., but exposures are not continuous with those fms. and lithology is very different, hence the local name *Cartersville fm.*

Named for exposures in vicinity of Cartersville, Bartow Co.

Cartersville granite.

Pre-Cambrian: Central Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Cartersville granite.*—Muscovite granite intrusive into Glenarm series. Mapped at and around Cartersville, Cumberland Co.

Carterville formation.

Mississippian (late): Southwestern Missouri.

C. E. Siebenthal, 1907 (U. S. G. S. Joplin folio, No. 148). *Carterville fm.*—Light to dark shales and shaly and oolitic lss. with some massive soft to hard sss. Thickness 0 to 50 ft. Uncon. underlies Cherokee fm. and uncon. overlies Boone fm., the upper 100 ft. of which, above Short Creek oolite memb., consists of ls. containing the Carthage quarry beds. The Carterville fm. contains Chester fossils (listed). Named for exposures just W. of Carterville, Jasper Co.

E. B. Branson, 1918 (Univ. Mo. Bull. vol. 19, No. 15, p. 71). *Carterville fm.* is contemp. with Aux Vases ss. Was formed in a bay that advanced in SW. Mo.

Carthage limestone. (In McLeansboro formation.)

Pennsylvanian: Western Kentucky and southern Illinois.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pp. 60, 61) and 1857 (Ky. Geol. Surv. vol. 3, p. 18). *Carthage ls.*—Lies in upper part of Coal Measures of southwestern coal field bordering Ohio River 1 mi. below Uniontown [Union Co., Ky.], where it is about 8 ft. thick. Separated from overlying coal No. 18 by 50 ft. of ss. and sh.

Named for Carthage Settlement (no longer in existence) on Ohio River, in Union Co., Ky., just above mouth of Wabash River.

Lies in upper part of McLeansboro fm.

Carthage limestone.

Mississippian (Warsaw): Southwestern Missouri.

J. A. Gallaher, 1898 (Mo. Geol. Surv. Bien. Rept. pp. 30, 37, 38). *Keokuk or Carthage ls.*—Crystalline ls. distinguished by numerous crinoids. Forms, with Burlington ls., principal country rocks of marvelous lead and zinc deposits of SW. Mo.

E. R. Buckley, 1911 (Types of ore deposits, p. 117). *Carthage ls.* consists of 100 ft. of practically noncherty crystalline ls. forming top memb. of Burlington fm. [not Burlington]. Overlies Short Creek oolite memb. and underlies, uncon., Chester.

Is upper part of Boone ls. The Short Creek oolite and the overlying ls. are now considered to be of Warsaw age.

Named for exposures at Carthage, Jasper Co.

Carthage moraine.

Pleistocene: Northwestern New York (Lewis and Jefferson Counties).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). In Antwerp and Carthage quads. Named for town.

Cartright sand.

A subsurface sand in Yegua fm. (Eocene) of Pettus area, Bee Co., SE. Texas.

Carwood formation.

Mississippian: Southeastern Indiana.

P. B. Stockdale, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170). See under *Borden group*.

P. B. Stockdale, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 197).

P. B. Stockdale, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 709). *Carwood fm.*—At S., in Ind., it is at most places a massive, fine-grained ss. or siltstone. Here and there a silty facies displays a shaly appearance where weathered. In places highly fossiliferous. [Fossils listed.] In N. part of unglaciated outcrop area the fm. displays a number of lithologic facies varying from argill. sh. and shaly siltstone to a bedded succession of thin, resistant ss. beds and shaly layers. Thickness 105 to 150 ft. Underlies Floyds Knob fm. and overlies Locust Point fm.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 54, 55, 76, 120–124, 147). Above Locust Point fm. is a fm. 115± ft. thick, slightly coarser in texture, more massive in structure, and which weathers less readily to a shaly appearance. It has commonly been referred to as a ss., but in reality is more properly designated a sandy siltstone in Floyd Co. Contains a few small geodes and concretions and locally a fauna of large brachiopods; in some places many bryozoans. In part this fm. is *Holtsclaw ss.* of Butts. A number of factors make it advisable to propose a different name. The term *Carwood fm.* is proposed in this paper, from village of Carwood (Bridgeport), Clark Co., Ind., 4¾ mi. SE. of Borden. Underlies Floyds Knob fm. and overlies Locust Point fm. [On p. 109 he gives thickness of 240 to 275 in southern Ind. and 210 in Jefferson Co., Ky. In this rept. geographic names are applied to several local *facies* of the fm. See also under *Rosewood sh.*]

Cary substage.

Pleistocene: Mississippi Valley.

See under *Mankato substage* and under *Wisconsin stage.*

Casadepaga schist.

Early Paleozoic or pre-Paleozoic: Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 70–75, maps). *Casadepaga schist.*—Metamorphic schists of igneous origin, seldom auriferous. Assigned to post-Ord. (?). Determination of igneous origin rests more upon areal and structural relations than upon chemical composition. Covers 100 sq. mi. in Solomon and Casadepaga quads, one belt along E. part of quads and another along W. part of quads.

Cascade series.

Carboniferous (?): British Columbia.

A. R. Selwyn, 1872 (Canada Geol. Surv. Rept. 1871–72, p. 60).
G. M. Dawson, 1879 (Canada Geol. Surv. Rept. 1877–78, pp. 63B, 67B, etc.).

†Cascade sandstone. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania (Susquehanna County).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 74–79, 82, 98). *Cascade ss.*—Rather coarse, very hard, yellow sand rock, full of shells in lower layers. Thickness 25 ft. in Susquehanna Co. Makes the fine cliffs which wall in Cascade Creek where Erie R. R. crosses it. I identify this Cascade ss. with Mr. Sherwood's Fall Creek cgl. of Rept. G, on Bradford and Tioga Counties, p. 90. [Sherwood called this cgl. on Fall Creek *Chemung cgl(?)*, not *Fall Creek cgl.*] Underlies Mansfield reds, and lies about 130 ft. below top of Chemung.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 593). Perhaps White's correlation of the Fall Creek with Cascade ss. was nearer the truth than is usually supposed.

†Cascade formation.

Pre-Cambrian: Northwestern Michigan (Marquette district).

M. E. Wadsworth, 1890 and 1891 (Lake Superior along the south shore, by Julián Ralph, pp. 77–99; 1st ed., 1890; 2d ed., 1891). *Cascade fm.*—Hornblende schist and granite of Cascade or Palmer and nonfragmental jaspilite and ore of Ishpeming and Negaunee. Best seen at Cascade Range, Marquette dist. Underlies Republic fm.

Applies to lower part of "Archean," according to C. R. Van Hise and C. K. Leith (U. S. G. S. Bull. 360, p. 147, 1909).

†Cascade formation.

Lower Cretaceous: Central Montana (Little Belt Mountains and Fort Benton region).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Cascade fm.*—Alternating sss. and shales, 225 to 520 ft. thick, overlying Ellis fm. and underlying Dakota fm. Contains Lower Cret. leaves resembling those from Kootanie fm. of Canada.

Includes Kootenai and Morrison (?) fms.

Named for development in Cascade Co.

Cascade formation.

Pleistocene: Central northern Oregon and southwestern Washington.

See under *Cascades fm.*, 1931 and 1932.

Cascade Creek sandstone. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania (Susquehanna and Wayne Counties).

J. J. Stevenson, 1892 (Am. Geol., vol. 9, p. 22; Am. Ass. Adv. Sci. Proc., vol. 40, p. 235). *Cascade Creek ss.* is same as Falls [Fall] Creek ss. of Bradford Co., Allegrippus cgl. of Bedford and Huntingdon Counties, and Lower Chemung cgl. of Fulton Co. [I. C. White named it *Cascade ss.*]

Cascades formation.

Pleistocene: Central northern Oregon and southwestern Washington.

I. A. Williams, 1916 (Oreg. Bur. Mines and Geol., Min. Res. Oreg., vol. 2, No. 3). *Cascades fm.*—Andesitic and basaltic lava flows, at least 300 to 500 ft. thick. Younger than Satsop fm. (preglacial Pleist.). Overlies The Dalles tuff btw. forks of Mill Creek. May prove to be a recent valley flow.

J. P. Buwalda and B. N. Moore, 1930 (Carnegie Inst. Wash. Pub. 404, p. 25). *Cascades fm.*—Mainly basaltic lavas and tuffs uncon. overlying The Dalles beds. Age unknown.

E. T. Hodge, 1931 (Geol. Soc. Am. Bull., vol. 42, Dec. 1931, p. 965). *Cascade fm.*—Middle Pleist. Chiefly lava flows; sed. material almost nonexistent. Comprises entire series of flows that form Cascade Mtns. Lies on Dalles fm. (Pleist. or late Plio.).

E. T. Hodge, 1932 (Oreg. Univ. Pub. Geol. ser., vol. 1, No. 5. p. 5). *Cascade fm.* proposed for the great mass of lavas that cap northern two-thirds of Cascade Mtns in Oreg. and that lie on top of Madras fm. and are older than the intercanyon lavas that occur in the valleys cut in its surface. Tentatively, therefore, it includes all lavas younger than Madras fm. and older than Recent. Dominantly andesitic with a few basalts and some trachyte. Btw. the lava flows are thin beds of volcanic ash which thicken to W. [Accompanying geol. map, of a part of central northern Wash. (120° to 121° 30′, 44° to 46°), shows *Cascade fm.* (*Pleist. and Plio.*) underlain by Madras fm. (Plio.), and states that Madras fm. of this map includes beds to N. that have been variously known as *The Dalles beds* and *Satsop fm.*]

Cascadia formation.

Oligocene and Miocene (?): Central northern Oregon (Cascade Mountains).

E. T. Hodge, 1928 (Pan-Am. Geol., vol. 49, pp. 341–356). *Cascadia fm.*—A number of widespread basic aggls., tuffs, and some basaltic lava flows, which constitute an important part of terranal succession on W. sides of the Cascades. Uncon. underlies Columbia basalts and uncon. overlies what looks like typical Clarno rhyolite. Is strat. equiv. of John Day fm. Exposed near Cascadia [Linn Co.]. Assigned to Olig.

Cascadian stage.

Pleistocene: Oregon.

E. T. Hodge, 1930 (Monthly Weather Rev., vol. 58, pp. 405–411). *Cascadian stage* (*Pleist.*).—The older epoch of glaciation in Oreg. Possibly correlates with the Admiralty, the oldest ice epoch in Wash. Separated from the younger (Jeffersonian) glacial stage by Willamettian inter-glacial stage. There is evidence of intense glaciation on E. side of Cascade Plateau.

Cascadian revolution.

A term that has been applied (C. Schuchert, Textbook geol., pt. 2, p. 612, 1924) to the period of uplift of Cascade Mtns, Oreg., beginning in middle Miocene and continuing into present time. The 1933 Textbook geol. of C. Schuchert and C. O. Dunbar assigned this revolution to upper Plio. and Pleist.

Cascadilla shale member.

Upper Devonian: Central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). *Cascadilla sh. memb.*, 150 ft. thick, basal div. of Ithaca facies subgroup of Ithaca-Enfield group of fms. in Ithaca region. Contains *Paracyclas lirata* fauna in middle. Overlies Middlesex sh. [Derivation of name not stated.]

Casco Bay group.

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Casco Bay group.*—Occupies an area about 12 mi. wide and 30 mi. long, extending along coast from Saco, Maine, to head of Casco Bay. Consists of (descending) Mackworth sl., Jewell phyllite, Spurwink ls., Scarboro phyllite, Diamond Island sl., Spring Point greenstone, and Cape Elizabeth fm. [See also U. S. G. S. P. P. 108, pp. 170–172.] Assigned to Penn.(?). Named for development in and around Casco Bay.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as Penn.

Casey limestone.

Middle Devonian (Hamilton): Southern central Kentucky (Casey County).

T. E. Savage, 1930 (Ky. Geol. Surv., ser. 6, vol. 33, pp. 12, 143–144). *Casey ls.*—Upper 3 to 8 ft. or more consists of thick-bedded, gray, rather fine-grained ls. with numerous irregular masses of chert. Lower 2 or more ft. consists of somewhat sandy ls., in lower part of which is a 2-inch band crowded with shells of *Ambocoelia umbonata.* Is of Hamilton age. Underlies Duffin layer (basal bed of New Albany sh.) and uncon. overlies Beechwood memb. of Sellersburg ls. Exposed near Kidd's store, in SW. part of Casey Co. Named for Casey Co., where relation of this ls. to Beechwood ls. memb. was first distinguished. In central Ky. the Casey ls. is top memb. of Boyle ls.

Casey limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Clark County).

See 1934 entry under *LaSalle ls. memb.*, which records the only known use of name. Derivation unknown.

Casey sands.

Name applied to some shallow subsurface sands high in Carbondale fm. (Penn.) of Clark, Coles, Cumberland, and Edgar Counties, central eastern Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Caseyville sandstone. (Of Pottsville group.)

Pennsylvanian: Western Kentucky and southeastern Illinois.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pp. 48, 49, 62, and plate showing section of Lower Coal Measures). *Caseyville ss.* (also *Caseyville cgl.*).—Pebbly ss. and cgl. [thickness not stated] resting on Millstone Grit in western Ky. [In some places in this rept these beds seem to be treated as part of "Millstone grit," but in plate showing section of Lower Coal Measures they rest on "Millstone grit."]

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 27). *Caseyville cgl.*—Coarse, cross-bedded, conglomeratic, cliff-forming sss., in 20 to 60-foot beds, alternating with thin beds of sh. up to 20 ft. thick, containing thin coal seams. Thickness about 200 ft. Uncon. overlies Miss. and underlies Tradewater fm. [This is adopted definition.]

Named for Caseyville, Union Co., Ky.

Cashaqua shale.

Upper Devonian: Western and central New York.

J. Hall, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 390–391, 409, 423, 452–455). *Cashaqua sh.*—On the Genesee it consists of a mass of green crumbling sh. 110 ft. thick, occasionally containing thin concretionary layers of ss. On Cayuga and Seneca Lakes, more particularly at Penn Yan, it consists of ss., sh., etc. Named for exposures on Cashaqua Creek [Livingston Co.], above junction of Genesee Valley canal. Occupies interval btw. Ithaca group above and upper black sh. that overlies Tully ls., but in central N. Y. the Ithaca is absent, and Gardeau or Lower Fucoidal group overlies the Cashaqua.

J. Hall, 1843 (Geol. N. Y., 4th dist.). *Cashaqua sh.* is 110 ft. thick on the Genesee, 33 ft. on Eighteen-Mile Creek, on Lake Erie. Overlies Genesee sl. (= Upper Black sl. and Black sh. and sl. of previous Ann. Repts). Included in Portage or Nunda group. [The immediately overlying sh. (which was included in Gardeau "group" of Hall) is now called *Rhinestreet sh.*, and the underlying sh. (which was originally included in Genesee sh.) has been named *Middlesex sh.* This is present generally accepted definition of *Cashaqua sh.*]

Casmalia gypsiferous shale.
Casmalia red beds.

Miocene: Southern California (Santa Maria district).

H. W. Hoots and S. C. Herold, 1935 (Geol. of nat. gas, A. A. P. G., p. 156). *Casmalia gypsiferous sh.*—Gypsiferous clay sh. contemp. with *Casmalia Red Beds* (red beds with ls. lentils), probably of continental origin. Of Mio. age. Thickness 2,800± ft. Occur in Casmalia Hills, Santa Maria dist. Conformably underlie "Monterey" and are younger than, but not in contact with, Vaqueros fm.

Cason shale.

Upper Ordovician (Richmond): Northern Arkansas.

H. S. Williams, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 325–331). St. Clair ls. of Dr. Penrose includes beds ranging in age from Cincinnati to Niagara, and should be divided into three fms., here named (descending): *Cason ls.* (containing Clinton-Niagara fauna) [later replaced by St. Clair ls. underlain by Brassfield ls.]; *Cason sh.* (the manganese-bearing shales); and *St. Clair ls.* (restricted to beds containing Trenton fauna). The Cason sh. and underlying St. Clair ls. [later replaced by *Polk Bayou ls.* and now divided into Fernvale ls. and Kimmswick ls.] are separated by an erosion uncon., the Cason sh. either resting on St. Clair ls. [Fernvale ls.] or in hollows in it, or in hollows in older Izard ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28, pp. 421, 486, 558, 559) restricted St. Clair ls. to beds of Niagaran age, and extended Brassfield ls. westward to cover the beds of Medina age previously included in St. Clair ls. [The Cason sh. as now defined therefore underlies Brassfield ls., overlies Fernvale ls. (upper part of †Polk Bayou ls.), and contains Richmond fossils.]

Named for Cason tract, near Batesville, Independence Co.

†Cason limestone.

Silurian (Niagaran and late Medina): Northern Arkansas.

H. S. Williams, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 325–331). *Cason ls.*—Upper part of St. Clair ls. of Dr. Penrose, or beds immediately overlying the manganese-bearing beds here named *Cason sh.* Contains fauna about = Waldron fauna of Ind. and Clinton-Niagara fauna of N. Y. Is lithologically distinct and should be separated from underlying beds, which contain an Ord. fauna. Thickness 100 to 110 ft. Underlies Sylamore ss., or, where that is absent, Eureka [Chattanooga] sh.

H. S. Williams, 1900 (Ark. Geol. Surv. Ann. Rept. 1892, vol. 5, pp. 281–301). Name *Cason ls.* abandoned and name *St. Clair ls.* restricted to ls. overlying the manganese-bearing beds (Cason sh.), which outcrops at St. Clair Springs. For ls. underlying Cason sh., which does not outcrop in region of St. Clair Springs, J. C. Branner's suggested name *Polk Bayou ls.* is adopted. St. Clair ls. as here restricted underlies Sylamore ss. or Eureka sh.

Replaced by St. Clair ls. (restricted sense of E. O. Ulrich, 1911) and Brassfield ls.

Named for Cason tract, near Batesville, Independence Co.

Casper formation.

Pennsylvanian, and in some areas Mississippian: Southeastern Wyoming (Laramie Basin).

N. H. Darton, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 407, 413, 414, 416, 418–430). From Casper Range southward Tensleep ss., Amsden fm., and Madison ls. give place to *Casper fm.*, 500 to 1,000 ft. thick, consisting of lss. generally lying on and overlain by gray ss. In Laramie region and southward these rocks merge into red grits. [Page 407.] The name *Casper fm.* is proposed for the lss. and sss. constituting greater part of sed. rocks in Casper and Laramie Mtns. These rocks represent SE. extension of Amsden and Tensleep fms., but are so changed in character and indefinite in strat. limits that correlation is not desirable and new name is required. The Casper lies uncon. on pre-Camb. rocks in greater part of area, but possibly to N. the basal ss. represents an attenuated E. extension of Deadwood fm. [Upper Camb.], and in eastern Carbon and Natrona Counties there may also be a small amount of Madison ls. at base, but at present there is no evidence on which to separate these. The plain on which the fm. lies rises to S., so that lowest beds included in N. part of area are not present at Laramie and southward. The fm. caps Casper Mtn and the series of high ridges extending from E. of Freeland nearly to Douglas. It extends along both slopes of Laramie Mtns, but in places is hidden by Tert. deposits, especially in NW. part of Laramie Co. It extends around S. end of Laramie Basin and along W. side of that basin as far N. as Jelm Mtn, beyond which it is dropped far beneath surface by the great fault which follows E. side of Medicine Bow Mtns. In Colo., along E. side of Front Range, the fm. consists mostly of red beds and becomes Fountain fm. As there is overlap of higher beds to S., it is probable that at latitude of Laramie, and even for some distance farther N., the Casper fm. is entirely of Penn. age.

S. H. Knight, 1929 (Univ. Wyo. Pub. Sci., Geol., vol. 1, No. 1). *Casper fm. restricted.*—W. T. Lee (U. S. G. S. P. P. 149, p. 67, 1927) pointed out that Casper fm. as used by Darton is composite fm. and in his opinion name should be abandoned. In view of fact that Casper has for 20 years been used to designate the sediments flanking Laramie Range, and is appropriate, it does not seem advisable to abandon it and substitute the later name *Ingleside,* as suggested by Lee. The Ingleside rests on Fountain fm., and writer considers it as representing the southern attenuate extension of the Casper [restricted]. In this paper *Casper fm.* is restricted to the rocks to which the name was originally applied, except that Fountain fm. and Madison ls. are not included. Writer believes that Fountain and Casper fms. are, in part at least, contemp., and that Casper as here restricted in part overlies Fountain fm. Evidence does not substantiate marked uncon., as suggested by Lee. Thickness of Casper fm. as here restricted ranges from 208 ft. in Centennial section to max. of 695 ft. in Plumbago Canyon section.

A. K. Miller and H. D. Thomas, 1936 (Jour. Pal., vol. 10, No. 8, pp. 715 +). In type region, around Casper Mtn, the lower part of the sequence is Miss. and is now generally eliminated from the Casper. It seems to us that it is impossible, without a great deal of additional strat. knowledge, to devise a satisfactory nomenclature for the beds in Laramie Basin which were called Casper by Darton. For present, therefore, it will perhaps be best in areas where the Fountain is present, as in S. part of Laramie Basin, to use *Casper* in Knight's restricted sense. But in N. part of basin, where the Fountain beds seem to be replaced by others of different lithology, there is no name to use except Casper in Darton's sense, excluding, of course, the Miss. strata which in some places occur btw. the Casper and the pre-Camb. granite.

The U. S. Geol. Survey still uses the local name *Casper fm.* as defined by Darton. As thus defined the fm. rests uncon. on pre-Camb. granite.

Cass limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 41, 58). *Cass ls.,* 12 ft. thick, overlies Plattford sh. and lies 13± ft. below White Cloud sh., all in Scranton sh. Named for exposures along Platte River NW. of South Bend, Cass Co.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). *Cass ls.* is abandoned, as another name [what?] has priority.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 210). †*Cass ls.* abandoned. Does not belong in Scranton sh. [Did not explain where it does belong.]

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). *Cass ls.* is still being used in Nebr. It is not yet definitely known which bed in Kans. and Mo. is its equiv., and until this is decided *Cass* will be used. We believe it may be = Amazonia or Haskell ls.

Cassada-Garden gravels.

Miocene to Eocene: West Indies (Antigua).

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 500). [No age assigned. C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 759) assigned *Cassada gravels* of Antigua to "lower Mio. to upper Eo."]

Cassin formation.

A name applied by H. P. Cushing (N. Y. State Mus. Bull. 95, p. 362, 1905), J. F. Kemp (N. Y. State Mus. Bull. 138, p. 68, 1910), and C. A. Hartnagel (N. Y. State Mus. Hdb. 19, p. 34, 1912) to Lower Ord. rocks typically exposed at old Fort Cassin, Addison Co., Vt., and called *Fort Cassin fm.* by other geologists. See explanation under *Beekmantown group.*

Cassville shale member (of Washington formation).

Permian: Northern West Virginia (Monongalia County) and southwestern Pennsylvania.

I. C. White, 1891 (U.S.G.S. Bull. 65, p. 41). *Cassville plant sh.*—Dark gray sh., 5 to 15 ft. thick, which very frequently separates Waynesburg ss. from underlying Waynesburg coal. This sh. is prolific in fossil plants, especially so in vicinity of Cassville, Monongalia Co., W. Va. Is basal bed of Dunkard Creek series (Perm.).

The lower fm. of Dunkard group has for many years been called *Washington fm.*, and *Cassville sh. memb. of Washington fm.* is adopted name of U. S. Geol. Survey.

Castanea sandstone.

Silurian (early): Central Pennsylvania.

F. M. Swartz, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 83, 91, 102, 109). *Castanea ss.*—A body of red and green argill. ss. that overlies the white ss. beds of Tuscarora ss. through central Pa. Many beds are pierced by *Scolithus* tubes, and bedding surfaces are frequently marked by irregular lumpy masses, suggestive of worm castings. Underlies Rose Hill sh., basal fm. of Clinton group. Thickness 58 ft. at Mount Union; 75 ft. in Lock Haven-Williamsport area; 20 ft. near Altoona. In previous repts evidently included in Tuscarora, and would have been considered a memb. of Tuscarora in this paper except for difficulty of treating it in section descriptions without naming the remaining beds. Named for Castanea, a suburb of Lock Haven. Replaces *Howard ss.* (proposed for this fm. in 1933), which is preoccupied.

Castile gypsum (in some areas), **Castile anhydrite** (in Delaware Basin), and **Castile formation** (in New Mexico).

Permian: Western Texas and southeastern New Mexico (Pecos Valley).

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 43). *Castile gyp.*—Massive white granular gyp., in places of grayish or dark color, in other places stained red by iron oxide. Some thin beds of ls. Thickness 50 to more than 300 ft. Underlies Rustler fm., and believed to uncon. overlie Capitan ls., but may be contemp. with part of Capitan.

R. E. King, 1931 (Univ. Tex. Bull. 3042, p. 13). SE. of reef escarpment [of Capitan ls.] of Guadalupe Mtns the Frijole ls. is overlain by Castile gyp. and Rustler ls. At one time these were believed to be laterally = Capitan ls. The revised interpretation of Frijole ls. (that is = top part of Capitan ls.) now makes it clear that these 2 fms. are younger than the Capitan, as originally announced by Darton and Reeside (Geol. Soc. Am. Bull., vol. 37, p. 420, 1926) and later by Crandall and others.

In Delaware Basin of SE. N. Mex. and western Tex. there occurs, btw. Rustler ls. and Castile gyp. of Richardson, an unexposed series of salt beds (1,400 ft. thick in well borings) known as "upper salt series," in contradistinction to "lower salt series" or Castile anhydrite. To these unexposed rocks W. B. Lang in 1935 (A.A.P.G. Bull., vol. 19, No. 2) applied the name *Salado halite*. Neither the Castile nor the Rustler fm. is restricted by the introduction of the name *Salado*, because in all surface exposures the Rustler rests upon the Castile. (See under *Salado halite.*)

W. B. Lang, 1937 (A.A.P.G. Bull., vol. 21, No. 7), discriminated *Castile anhydrite* much farther N. in Pecos Valley, where it is overlain by Salado halite and rests on Chalk Bluff fm. (new name).

Named for Castile Spring, El Paso Co., Tex., which is in midst of the gyp.

Castine volcanics.

Cambrian (?): Central southern Maine (Penobscot Bay quadrangle).

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 5). *Castine fm.*—Light-colored altered lavas and pyroclastics, including rhyolites, dacites, and andesites. Relations indicate Castine fm., Islesboro fm., and North Haven greenstone are nearly contemp. Assigned to Camb. (?). Named for exposures on Castine Peninsula, Hancock Co.

On 1933 geol. map of Maine, by A. Keith, the rocks of Castine Peninsula that were mapped as *Castine fm.* in Penobscot Bay folio are mapped as Dev.

†Castle limestone member (of Madison limestone).

Mississippian (lower): Central northern Montana (Fort Benton quadrangle) and central southern Montana (Little Belt Mountains quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Castle ls.*—Massive heavy lss. forming top memb. of Madison ls. Rest on Woodhurst ls. and overlain by Quadrant fm.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Upper part of Madison ls. consists of very massive lss. showing no bedding, and designated *Castle ls.*

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 293). *Castle ls.* Named for town of Castle [Little Belt Mtns quad.], where it is well developed.

Castle granite.

Miocene or Pliocene: Central southern Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Intrusive granite that forms central core of Castle Mtn. Light-gray to pinkish; loose textured; well jointed. In S. part of area is a true granite; to N. it grades into true granite porphyry, but whole is mapped as granite. Is of Neocene age.

†Castle conglomerate.

Oligocene: Eastern Colorado.

See *Castle Rock cgl.* (1902 entry), which replaces it.

Castle volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Castle volcanics.*—Bedded cinders, bombs, and spatter composing a partly eroded cinder cone from which a lava flow, over 100 ft. thick, extends for half a mile. Included in middle part of Honolulu volcanic series. Named for occurrence on Castle ranch.

Castlegate sandstone member (of Price River formation).

Upper Cretaceous: Eastern Utah (Wasatch Plateau and Book Cliffs region) and 3½ mi. into western Colorado.

J. B. Forrester, 1918 (Utah Acad. Sci. Trans., vol. 1, p. 24). *Castlegate ss.*, 500 ft. thick, lies at top of Laramie [so-called] coal-bearing series in Book Cliffs coal field, and is materially different from the other sss. in this fm. It is very compact and broken by joints and cross joints into large blocks. Rests on a layer of sh.

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 150–151, 445). *Castlegate ss. memb.*—Massive cliff-forming conglomeratic ss. 150 to 400 ft. thick. Contains abundant cgl. Forms basal memb. of Price River fm. Rests, with at least local uncon., on Blackhawk fm. in Wasatch Plateau.

Named for Castlegate, Carbon Co., Utah, where it forms a gate-like passage in Price River Canyon 2± mi. above the town.

Castlegate coal group. (In Blackhawk formation.)

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793), applied this name to 100 to 125 ft. of strata overlying Aberdeen ss. memb. of Blackhawk fm. in Book Cliffs, and including (descending) Castlegate C coal, Royal Blue coal, Castlegate B coal, and Castlegate A coal. The Castlegate D coal is same as Kenilworth coal and is younger than the strata for convenience assembled under the name *Castlegate coal group.*

Castle Hayne marl.

Eocene (upper): Coastal Plain of southern North Carolina.

B. L. Miller, 1910 (Geol. Soc. Am. Bull., vol. 20, pp. 674–675; also chart opp. p. 646). *Castle Hayne fm.*—A distinctly calc. fm. with little or no glauconite present. Fine-grained calc. marls or lss. Vaughan states the fossils form an entirely distinct fauna, unlike any known in S. C. or northward. Assigned to Eocene. Uncon. overlain by St. Marys fm. (Mio.), and uncon. underlain by Trent fm.

Later work by T. W. Vaughan established (1918) the Jackson age of the marine Castle Hayne marl. It ranges in thickness from 0 to 50 ft., and is known only S. of Hatteras axis in N. C. Still later studies by L. B. Kellum proved that the Trent marl is of lower Mio. age, and that it overlies the Castle Hayne, which rests on Upper Cret. (See U. S. G. S. P. P. 143, 1926.)

Named for exposures at Castle Hayne, New Hanover Co.

Castle Hill andesite.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 114, 169, 174). *Castle Hill andesites.*—Andesites, commonly amygdaloidal or even slightly brecciated and ashy; associated with them is an abundance of true volcanic ash with lapilli. Constitute Castle Hill. There is no common local usage as to limits of Castle Hill, and in this rept the term will be applied to the masses of andesite and volcanic clastics which lie btw. Aroostook River and the State road from Ashland to Presque Isle, partly in Castle Hill Twp and partly in Wade Plantation.

On 1933 geol. map of Maine, by A. Keith, these andesites are assigned to Dev.

Castle Hill tuff.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 119, 120–121, 122–125). *Castle Hill tuffs.*—Volcanic tuffs (a normal type and a silicified type) exposed in open fields and along roadside about 1 mi. W. of Castle Hill Hotel, on Castle Hill Ridge, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the tuffs of this region are assigned to Dev.

Castle Mountain group.

Lower, Middle, and Upper Cambrian: Alberta and British Columbia.

R. G. McConnell, 1887 (Canada Geol. and Nat. Hist. Surv. Ann. Rept. 1886, pt. D, pp. 15D, 24D–29D).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 1–4). McConnell's typical section studied. He proposed "*Castle Mtn group*" for the great series of lss. and shales btw. the qtzitic sss. and siliceous shales of "Bow River group" below and superjacent Ord. graptolitic shales on W. and Banff ls. on E. This includes upper part of Lower Camb. fauna at base and lower part of Ord. fauna at top. The term "Castle Mtn" is useful for the series, but I think local names can be applied with advantage to several of the fms. It includes (descending) the following fms. herein newly named: Sherbrooke, Paget, and Bosworth fms., all Upper Camb.; Eldon, Stephen, Cathedral, and Mount Whyte fms., all Middle Camb. [The Mount Whyte fm. is now considered to be Lower Camb.]

Castle Rock conglomerate.

Oligocene (lower): Eastern Colorado (Castle Rock region).

W. T. Lee, 1902 (Am. Geol., vol. 29, pp. 96–109). *Castle cgl.*—Youngest fm. in Castle Rock region. Consists of massive compact cgl. overlying the lava and having max. thickness of 90 ft. Contains fragments (some 5 ft. diam.) of rhyolite from the underlying flow, and is composed of coarse, angular, subangular and rounded masses firmly set in finer material. Is upper part of Monument Creek group of Hayden, which is here divided into *Castle cgl.* above and ***Monument Creek fm. restricted*** below. Named for typical development on Castle Rock butte [Douglas Co.].

G. B. Richardson, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 267–276). *Castle cgl. of Lee* [preoccupied] is here renamed *Castle Rock cgl.* It is of Olig. age, has max. thickness of 300 ft., and uncon. overlies Dawson arkose (Eocene and 2,000 ft. thick). The Castle Rock and Dawson comprise Monument Creek group of Hayden [and Dawson replaces Monument Creek fm. restricted of Lee].

G. B. Richardson, 1915 (U. S. G. S. Castle Rock folio, No. 198). *Castle Rock cgl.*—Outcrops in detached areas on divides btw. tributaries of South Platte River from vicinity of Elbert to vicinity of Sedalia, a distance of 40± mi. Greater part of fm. is in Castle Rock quad. Has max. present thickness of 300 ft.; original thickness unknown, because of erosion. Over large part of its area it is now less than 50 ft. thick, and in places represented only by residual pebbles. A complete section is not exposed. Composition very variable. Is essentially an indurated conglomeratic arkose. Includes a cliff-making basal cgl., usually well developed. Rest of fm. consists of coarse arkosic ss. streaked with lenses of cgl. Cross bedding and lenticular structure common. Lies on eroded surface of Dawson arkose. Vertebrate fossils prove its lower Oligocene age. Is youngest fm. in quad.

Castle Rock sandstone. (In Springer formation.)

Pennsylvanian: Central southern Oklahoma (Carter County).

R. Roth, 1928 (Econ. Geol., vol. 23, p. 45). [See under *Overbrook ss. memb.* Derivation of name not stated.]

Casto volcanics.

Permian (?): Southern central Idaho (Salmon Mountains region).

C. P. Ross, 1927 (Idaho Bur. Mines and Geol. Pam. 25). *Casto volcanics.*—Somewhat altered lava and pyroclastics, comprising lava flows, largely brecciated, and tuffs. At base, at several localities, a cgl. with tuffaceous matrix. Thickness probably 3,000+ ft. Of Perm. (?) age. Covers large area in Casto quad. and extends to NW. and E. beyond its limits.

Catadupa.

Eocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 58–61).

Catahoula sandstone (in southern Texas, **Catahoula tuff**).

Miocene? (lower Miocene?): Louisiana, Mississippi, southern Alabama, and eastern Texas.

A. C. Veatch, 1905 (La. Geol. Surv. Bull. 1, Rept. 1905, pp. 84, 85, 90). *Catahoula (Grand Gulf) ss.*—Name proposed from typical development of fm. in Catahoula Parish, La., and used for lower or typical Grand Gulf of Hilgard as exposed at Grand Gulf, Miss. Includes the ss.-bearing clays btw. Vicksburg and Fleming Olig. Thickness 1,000 ft.

G. C. Matson, 1916 (U. S. G. S. P. P. 98M). *Catahoula ss.*—Nonmarine ss., 0 to 750 ft. thick, representing all or portions of marine Chattahoochee and Vicksburg fms. in Miss. embayment. Underlies Hattiesburg clay. In Miss. and eastern La. overlies marine Vicksburg ls. In western La. and E. border of Tex. the lower part of this nonmarine ss. is contemp. with marine Vicksburg ls., which is absent there, and Catahoula rests on marine Fayette ss., of [Jackson] Eocene age.

Type Chattahoochee fm. is now known to be of lower Mio. age and same as Tampa ls., while Catahoula ss. may be of late Olig. age. According to C. W. Cooke (A. A. P. G. Bull., vol. 19, No. 8, 1935, p. 1162) it appears to be older than Tampa ls. In southern Tex. the Catahoula becomes a tuff, and uncon. underlies Oakville ss. (late middle and early upper Mio.) and uncon. overlies Frio clay, of Olig. (?) age. The Catahoula is unfossiliferous and may be either lower Mio. or late Olig. The U. S. Geol. Survey at present classifies it as Mio. (?).

Catahoula group.

Miocene (?) and Oligocene: Southeastern Mississippi.

B. W. Blanpied et al., 1934 (11th Ann. Field Trip Shreveport Geol. Soc., pp. 4+). *Catahoula group* as here defined uncon. underlies Citronelle fm. and uncon. overlies

Byram marl [restricted], and includes (descending): "Catahoula" of previous repts., Upper Chickasawhay memb., Lower Chickasawhay memb., and Bucatunna memb. [The Chickasawhay and Bucatunna members were included in original definition of Byram marl (top fm. of the Olig. Vicksburg group), and are still so included by U. S. Geol. Survey, which still uses *Catahoula ss.* as originally defined.]

Cataldo quartzite.

Pre-Cambrian (Belt series): Northern Idaho (Coeur d'Alene region) and central eastern Washington.

O. H. Hershey, 1912 (Geol. Soc. Am. Bull., vol. 23, p. 526; Am. Jour. Sci., 4th, vol. 34, pp. 264–267). *Cataldo qtzite.*—Name temporarily applied to a memb. of Belt series not recognized by Ransome and Calkins in their rept on Coeur d'Alene dist., as it is apparently poorly represented there. It consists chiefly of heavy beds, in part cross bedded, of lilac-colored, medium-grained qtzite, differing in appearance from any qtzite above the Prichard. With this are beds of greenish finer-grained sericitic rock. Thickness at least 1,000 ft. Evidently underlies Prichard sl. Beginning a little above mouth of Pine Creek, it is exposed over a great area, thence nearly to station of Rose Lake. It also occurs near town of Tekoa, Wash. It is apparently the basal memb. of Belt series. Outcrops are of light-gray color. That Calkins did not intend to include it in Prichard is proved by his mapping a small area of it as Burke. [Apparently named for town of Cataldo.]

Catalina facies of Franciscan series.

Jurassic (?): Southern California (Catalina Island).

A. O. Woodford, 1924 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 3). *Catalina metamorphic facies of Franciscan series.* [Mapped.] On Catalina Island, off coast of southern Calif., and in San Pedro Hill, on adjacent mainland, are areas of unusual metamorphic rocks similar to those forming part of Franciscan series farther N. These rocks are schistose, of variable grain, and made up largely of various combinations of the minerals quartz, albite, muscovite, chlorite, epidote, glaucophane, crossite, actinolite, and lawsonite. The Catalina facies is probably uncon. beneath the Chico, and it has a close lithologic resemblance to the schists of north Berkeley and the Tiburon Peninsula mapped by A. C. Lawson (1914) as *Franciscan.* These facts taken together suggest correlation with Franciscan series. The quartz schists would then be metamorphosed radiolarian cherts, the quartz-albite schists former arkoses derived from a region of quartz diorites, and the remaining types former basic igneous rocks. Soda basalts of type analyzed by Ransome from Point Bonita Franciscan (1893, p. 106, analysis I) may be represented. At this time, however, the correlation can be made only in most general sense, indicating merely that these rocks belong to a great and perhaps heterogeneous group now called *Franciscan series.* It may be that these metamorphic rocks belong to an ancient group which extends northward uncon. beneath typical Franciscan.

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, pp. 163, 172, 225). *Catalina facies of Franciscan series.*—Half of Catalina Island is a complex of albitic, amphibolic, chloritic schists, quartz schist, serpentine, etc., and there is a small area of similar rocks exposed in San Pedro Hill on the mainland. They are especially characterized by abundance of albite and by presence of the unusual minerals glaucophane, crossite, and lawsonite.

Catalina schist breccia.

Miocene (lower?): Southern California (southeast end of Catalina Island).

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, pp. 211–212). *Catalina schist breccia.*—At SE. end of Catalina Island small areas of schist and qtzite breccia with sandy matrix are involved in the volcanic rocks. As indicated by W. S. T. Smith it is difficult to determine whether these are contemp. with the volcanics or inclusions in them. The breccia blocks are sometimes exclusively subrounded qtzite and gray porphyry. Sometimes glaucophane and other schists are also present, making a rock very similar to San Onofre sandy breccia. [The above description is under center heading "Doubtful correlatives of the San Onofre facies" of Temblor fm. of Monterey series.]

Catamount schist.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Catamount schist.*—A sillimanite schist, included in Grenville series. Thickness 70–80 ft. Is older than Bear Pond schist and younger than Swede Pond qtzite. Type loc. is Catamount Mtn, W. of Pottersville, Warren Co., of which it forms the slopes.

Cataract formation.

Silurian (early): Ontario and western New York.

C. Schuchert, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 107). Fifty ft. of the Medina at Niagara Falls, N. Y., belongs to a new fm. named the *Cataract.* It has been traced from Niagara Falls to Manitoulin Islands, Lake Huron, where it is 110 ft. thick, the lower 45 ft. consisting of thin-bedded mag. ls. and the upper of red shales barren of fossils. At Cataract, Ont., it is well developed, 82 ft. thick, and replete with fossils. Assigned to Sil.

W. A. Parks, 1913 (Canada Geol. Surv. Guidebook 4, pp. 128–140), described *Cataract fm.* as overlying Queenston (Richmond) sh. and underlying Medina fm. [restricted to "grey band" (Thorold ss. memb.) and some underlying red sss. of uppermost part of original Medina ss.], and as consisting at Hamilton, Ont., of (descending): Red and gray shales, 70 ft.; blue ls., 10 ft.; and Whirlpool ss. of Grabau, 10 ft. He made the following statements: The Cataract fm. represents an invasion from the N. and W. at commencement of Sil. time. It was first officially defined by Prof. Charles Schuchert of Yale Univ. at 1912 meeting of Geol. Soc. Am. The reading of Professor Schuchert's paper evoked considerable discussion, Dr. E. O. Ulrich being strongly of opinion that the fm. should be included in the Medina or at least in the "Medinan." It is to be understood, therefore, that all American geologists are not prepared to accept the classification herein adopted.

The same year (Ottawa Nat., vol. 27, pp. 37–38) M. Y. Williams divided Cataract fm. of Georgian Bay region into Kagawong memb. above and Manitoulin memb. below, while A. W. Grabau (Geol. Soc. Am. Bull., vol. 24, pp. 438, 460, 1913) divided the same beds into Cabots Head beds above and Keppel dolomites below, the latter resting, with probable discon., on Queenston sh.

In 1914 (Sci., n. s., vol. 39, June 19, pp. 915–918) E. M. Kindle recommended the following names for subdivisions of *Medina fm.* (*restricted*), in descending order: Thorold ss., Grimsby ss., Cabot Head sh., Manitoulin beds, and Whirlpool ss.

In 1914 (Geol. Soc. Am. Bull., vol. 25, Sept. 1, pp. 277–320) C. Schuchert divided Cataract fm. of Ontario into (descending): (1) Cabots Head sh. memb. (20 to 75 ft. of greenish somewhat calc. shales with occasional thin beds of mag. ls.); (2) Manitoulin ls. memb. (9 to 60 ft. of heavy-bedded mag. lss., with local reefs of corals and bryozoans, and, to S., thin beds of ss.); and (3) Whirlpool ss. memb. (0 to 22 ft. of coarse, cross-bedded, white, red, or mottled ss., extending from Lockport, N. Y., to near Collingwood, Ont.). He stated that all of these members are present at Cataract, Ont., but he did not apply *Cabots Head* and *Manitoulin* in Niagara Gorge section, where he described Cataract fm. as consisting of (descending): (1) Dark green shales, 5 ft.; (2) thin-bedded green ss. underlain by yellowish mag. and argill. ls. with small black sh. pebbles, 5 ft.; (3) green shales, 10 ft.; (4) dark-green shales with very thin-bedded argill. mag. lss., 5 ft.; (5) dark green fissile shales, 7 ft.; and (6) Whirlpool ss. memb., 22 ft. The beds resting on Cataract fm. in Niagara Gorge he called *Medina fm.* [a greatly restricted use of Medina] and described them as consisting of (descending): (1) Thorold [ss.] memb., 8 ft. thick; (2) 15 ft. of red and greenish gray, much cross-bedded and channeled ss. with very little sh.; (3) thin-bedded red sss. with considerable red shales and two or more zones of localized storm-rolled mud balls, 35 to 40 ft.; (4) gray ss. with sh. partings, 5 ft. He stated that the Medina is of the Appalachian province, while the Cataract is of either the St. Lawrence or the Arctic realm; that the Cataract wedges in below Upper Medina in Niagara Gorge; that the Medina [restricted to uppermost 60 or 65 ft. of original Medina] thins out to NW., so that Cataract thickens in opposite direction; that the Medina [restricted], Brassfield, and Cataract "are correlates of one another," but that "they represent three physical provinces and marine basins," and that the 3 names "should be retained as names for independent marine faunas and formations." The same year (Canada Geol. Surv. Summ. Rept. for 1913, pp. 179–188, 1914) M. Y. Williams adopted Grabau's name *Cabot Head sh.* to replace *Kagawong* (preoccupied) and introduced *Grimsby ss.* for 0 to 50 ft. of beds underlying Thorold ss. and overlying Cabot Head sh., and also overlying Cataract fm. of Schuchert; he also used *Manitoulin memb.* and *Whirlpool ss.* for the rocks underlying Cabot Head sh. His 1919 classification (Canada Geol. Surv. Mem. 111, No. 91 of geol. ser.) employed the same names as his 1914 classification. He called the beds *Medina-Cataract;* stated that they are contemp. with Medina; that Schuchert restricted Medina to Grimsby and Thorold sss. and called the underlying beds *Cataract fm.;* that he (Williams) considered the Grimsby and Thorold are "only facies of the top of Cabot Head sh., although they represent another faunal invasion;" and that name *Cataract* is necessary as the phases of sedimentation are very different from most of the Medina. He also introduced two new names for dol. beds in Cabot Head sh. memb. of Bruce Peninsula and Manitoulin Island, the type loc., using *St. Edmund dol. lentille* for a bed near top of Cabot Head sh., and *Dyer Bay dol. lentille* for a bed in lower part of upper half of Cabot Head sh.

In 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 332, 364) G. H. Chadwick applied *Cataract fm.* to beds btw. Grimsby ss. above and Whirlpool ss. below.

In 1923 (Md. Geol. Surv. Sil. vol., pp. 334–336) E. O. Ulrich stated that fauna of Dyer Bay dol. is Niagaran (middle Clinton), and not Medinan, and he restricted (p. 267) *Cataract* to pre-Dyer beds of upper Medinan age, including Grimsby ss. in Medinan, and transferred Thorold ss. to Clinton.

In 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138) A. F. Foerste used Grabau's restricted *Medina* "to include the beds above the Queenston and below the Clinton," and stated that upper part of Cataract fm. in southern Ont. is formed by Thorold ss. memb. and Grimsby ss. memb., and that Whirlpool ss. memb. is base of Cataract fm. from Niagara River to vicinity of Duntroon, about 8 mi. S. of Collingwood, Ont.

Catarina formation.

Cretaceous: Lower California.

F. M. Anderson and G. D. Hanna, 1935 (Calif. Acad. Sci. Proc., 4th ser., vol. 23, No. 1, p. 8).

Catasauqua ls.

See *Cattasauqua ls.*

Catawissa reds.

Upper Devonian: Eastern New York (Catskill Mountains and to west) and northeastern Pennsylvania.

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7). The Cayuta or lower Chemung turns red as it crosses the Susquehanna, and on the S. outcrops at Catawissa [Columbia Co., Pa.?]; hence we may call its red phase the *Catawissa reds*. It is present in western Catskills along the Delaware, above the true Catskill (Portage) reds, but is not present in eastern Catskills.

Cat Creek sands.

Upper and Lower Cretaceous: Central Montana (Cat Creek oil field).

F. Reeves, March, 1921 (U. S. G. S. Press Bull. on Cat Creek anticline, in Twps 13, 14, 15, Rs. 28, 29, 30, 31 E, Fergus and Garfield Counties). *Cat Creek sand.*—An oil-bearing ss. forming basal bed of Colorado sh. in Cat Creek oil field, where it is principal producing horizon. It is usually spoken of as *first Kootenai sand*, and some oil men call it *Dakota sand*, but it is probably of age of Colorado sh., and is here so treated.

In subsequent repts this sand has been called *First Cat Creek sand*, and two older sss. (in Kootenai fm.) have been called *Second Cat Creek sand* and *Third Cat Creek sand*. In Cat Creek oil field the former lies 100 to 150 ft. higher than the latter, and from 300 to 350 ft. below top of Kootenai fm., and the First Cat Creek sand lies 0 to 5 ft. above top of Kootenai fm.

Cat Head limestone.

Upper Ordovician (Richmond): Manitoba.

D. B. Dowling, 1896 (Ottawa Field Nat. Club Trans. 1895–96, vol. 9, pp. 69–70). *Cat Head beds*, Cambro-Sil., Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 202). *Cat Head lss.*, Ord., Canada.

D. B. Dowling, 1901 (Canada Geol. Surv. Ann. Rept., n. s., vol. 11, p. 74F). *Cat Head ls.*, Ord., Canada.

Subsequent repts assign it to Ord. A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 211), correlated it with middle part of Bighorn dol. of Mont., which he assigned to the Richmond.

Cathedral granite.

Tertiary: Southern British Columbia and central northern Washington (Okanogan batholith).

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376).

Cathedral limestone.

Middle Cambrian: Alberta and British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 4). *Cathedral fm.*—Massive, aren. and dolomitic ls. Thickness, 1,595 ft. in Mount Bosworth section, B. C.; 987 ft. in Castle Mtn, Alberta; 1,600 to 1,800 ft. in Cathedral Mtn and Mount Stephen. Underlies Stephen fm. and [uncon., C. D. W., 1923] overlies Mount Whyte fm. Type loc. is Cathedral Mtn and Cathedral Crags, E. of Mount Stephen and SE. of Mount Bosworth. Contains Middle Camb. fossils.

L. D. Burling, 1916 (Am. Jour. Sci., 4th, vol. 42, pp. 469–472). *Cathedral fm.* of Mount Bosworth, B. C., consists of (1) 775 ft. of lss., underlain by (2) *Albertella sh. memb.* (7 ft. thick), which rests on (3) 375 ft. of lss. It is overlain by Stephen fm. and underlain by Mount Whyte fm., 250 ft. thick. Reference of *Albertella* fauna to Middle Camb. has been confirmed by discovery on Mount Bosworth of the parent ledge of the drift block which has been so often described. The inability of Mr. Walcott and myself to find this bed during the years in which search has been prosecuted is due to fact that its reference to Lower Camb. led us largely to confine our efforts to the series of thin beds underlying Cathedral fm. The fauna actually occurs in a 7-foot band of sh. which interrupts the sedimentation of the massive lss. of this Middle Camb. Cathedral fm. 375 ft. above its base. In 1914 I did not presume to question Walcott's reference of *Albertella* fauna to Mount Whyte fm. Indeed, writer's assignment of that fauna to Middle Camb. necessitates a change in systemic reference of Mount Whyte fm. I am now as thoroughly convinced that all but lowest beds of Mount Whyte fm. are Middle Camb., but discovery that *Albertella* fauna occurs in a sh. memb. embedded 375 ft. up in overlying massive aren. lss. of Cathedral fm., robs me of one of main arguments I used in 1914 for Middle Camb. age of Mount Whyte fm.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444, pp. 1–5). The name *Ptarmigan fm.* is proposed for a series of Middle Camb. lss. and interbedded shales that occur above Mount Whyte fm. (Lower Camb.) and beneath Cathedral fm. (Middle Camb.) in Alberta and British Columbia. At Ptarmigan Pass and Peak the Cathedral ls. is 2,100 ft. thick. The Ptarmigan fm. includes the Middle Camb. *Albertella* fauna about 100 ft. below its top.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 2, Pub. 2445). At Mount Bosworth the Cathedral lss. are 1,086 ft. thick, exclusive of a lower div. of 509 ft., which I have now included in a recently recognized fm. named *Ptarmigan.*

Cathedral Bluffs tongue (of Wasatch formation).

Eocene: Southwestern Wyoming (Sweetwater County) and northwestern Colorado (Moffat County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Cathedral Bluffs red beds memb. of Green River fm.*—Variegated clay, sh., and ss., in places slightly conglomeratic. Thickness 0 to 1,500 ft. Uncon. underlies Laney sh. memb. and overlies Tipton sh. memb. Produces the highly colored escarpment of Laney Rim and Cathedral Bluffs, Sweetwater Co., Wyo.

J. D. Sears, 1924 (U. S. G. S. Bull. 751G). In basin of Vermilion Creek, in NW. part of Moffat Co., Colo., and southern Sweetwater Co., Wyo., the upper part of Wasatch fm. consists of 600 to 1,200 ft. of clay sh. similar to that in E. part of field, except that here various shades of red are predominant. The upper and lower parts of Wasatch are separated by Tipton tongue of Green River fm. This tongue, which is characterized by gray fissile sh. and oil sh., wedges out southward, and main part of the Wasatch and the upper part (here called *Cathedral Bluffs tongue*) merge into a continuous fm. comparable to that E. of Godiva Ridge. According to Schultz the Cathedral Bluffs tongue (which he called *Cathedral Bluffs red beds memb. of Green River fm.*) passes northwestward by lateral variation into typical grayish Green River shales. To NW., beyond limits of the field in Moffat Co., the Cathedral Bluffs tongue of the Wasatch loses its identity and the older Tipton tongue merges with the overlying Green River shales. [Fig. 23 of this rept shows upper part of the red Wasatch fm. of certain areas in Colo. to be contemp. with and to interfinger in lower part of the grayish Green River fm. of vicinity of Green River, Wyo.]

†Cathedralian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289). *Cathedralian series.*—Dolomites, 1,600 ft. thick, underlying Stephensian series, and composing basal div. of Mid Cambric section in Alberta. [Apparently same as Cathedral ls.]

Cathedral Peak granite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, pp. 126–127, map). A coarsely porphyritic rock, in which biotite is more abundant than hornblende. The distinguishing feature of the granite is that it contains unusually large phenocrysts of feldspar. Included in Tuolumne intrusive series, in which it is next younger than Half Dome quartz monzonite and next older than Johnson granite porphyry.

Named for fact it composes Cathedral Peak and adjoining parts of Cathedral Range in Yosemite Nat. Park.

Catheys limestone.

Middle Ordovician: West-central Tennessee.

C. W. Hayes and E. O. Ulrich, 1903 (U. S. G. S. Columbia folio, No. 95, p. 2). *Catheys ls.*—Shales and knotty lss., usually underlain by heavy-bedded subcrystalline ls. and overlain by fine-grained, blue and earthy lss. separated by thin seams of sh.; all more or less highly fossiliferous. Basal part occasionally includes some granular phosphatic layers. Thickness 0 to 100 ft. Of Trenton age. Uncon. overlies Bigby ls. and uncon. underlies Leipers fm.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34), and C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, chart opp. p. 80), show Cannon ls. of Tenn. as underlying Catheys ls. and overlying Bigby ls. This is present accepted definition of Catheys ls.

Named for Catheys Creek, Lewis and Maury Counties.

Cat Hill gneissoid granite.

Pre-Cambrian: Southeastern New York (Putnam County).

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 52, 57). *Cat Hill gneissoid granite* is not essentially different from Storm King type as a physical unit. Its occurrence at a different point (Cat Hill), widely separated by other types from Storm King locality, and in rather large development, is worthy of separate note. Occurs in Garrison dist. [Putnam Co.].

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 20). *Cat Hill granite* is intrusive and of similar type to Storm King granite.

Catoctin schist.

Pre-Cambrian: Northeastern West Virginia, northern Virginia, and western Maryland.

A. Keith and H. R. Geiger, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 155–164). *Catoctin schist* underlies Shenandoah ls. No fossils found.

A. Keith, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, p. 306 and map). *Catoctin schist,* Algonkian, 1,000 ft. thick. Occupies three-fifths of area of Catoctin belt thus far mapped and a considerable portion of South Mtn belt in Pa. [According to map Catoctin Mtn, Va., is composed of this schist.]

A. Keith, 1894 (U. S. G. S. Harpers Ferry folio, No. 10, p. 2). *Catoctin schist.*—Altered diabase, with lenses of epidote and quartz, and associated with great masses of interbedded eruptive granite. Three varieties of schist are recognized: One of coarser texture, associated with the granite; one of fine grain, with large lenses of epidote and quartz; and one with quartz and epidote amygdules, occurring along the boundaries of the other two varieties. Light bluish green when fresh, dull grayish yellow when weathered. Thickness more than 1,000 ft. Oldest exposed fm. in region. Underlies Loudoun fm.

Also called *Catoctin greenstone.*

Named for Catoctin Mtn, Loudoun Co., Va., and Frederick Co., Md.

Catron formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 33, 41, 207, and pl. XLA). *Catron fm.*—Shales, sss., and coals, 300 to 460 ft. thick, overlying Mingo fm. and underlying Hignite fm. in Cumberland Gap coal field. In Log Mtns top of fm. is defined by bottom of Lower Hignite coal and base by bottom of Poplar Lick coal. In Black Mtns the Hignite coal is missing and top of fm. is defined by top of Jesse ss. memb. and base by base of Wallins Creek coal (may=Poplar Lick coal). Probably included in Lower Kanawha of New River.

Named for Catron Creek, Bell Co.

Catskill formation.

Upper and Middle Devonian and Carboniferous (?): New York, Pennsylvania, Maryland, and Virginia.

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 212, 213, 227–233). *Catskill Mtn series.*—White, gray, and red cgls.; with gray, red, olive, and black grits, slates, and shales. Overlies Helderberg [Onondaga] ls. series and underlies the coal-bearing rocks of Carbondale, Pa.

W. W. Mather, 1841 (N. Y. Geol. Surv. 5th Ann. Rept., pp. 75–85). *Catskill Mtn series* includes (in addition to younger cgls. and grits and red and gray grits and red shales mottled with green spots) Montrose ss., Chemung group, Ithaca group, Sherburne flags, Hamilton group and Marcellus shales.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 186–194). *Catskill group.*—Top div. of New York system. Overlies Chemung group. Includes Montrose and Oneonta sss. of repts. Consists of light-colored greenish gray ss., usually hard; fine-grained red ss., red sh. or sl.; dark-colored sl. and sh.; grindstone grit; and a peculiar accretionary and fragmentary mass appearing like fragments of hard sl. cemented by ls. Very few fossils. No line of demarkation observed btw. Catskill and Chemung groups in N. Y. or Pa. In ascending upwards from Chemung group the first signs of change which usually appeared was a diminution, then a disappearance of fossils of Chemung, a more solid or hard rock succeeding, often accompanied by red ss. or red sh., and the gray ss., sometimes accompanied by thin beds of cornstone; capping the whole was the complex structured ss. Is confined to Otsego, Chenango, Broome, and Tioga Counties, N. Y. [According to C. A. Hartnagel (1912 ed. Hdb. 19) and H. S. Williams (U. S. G. S. P. P. 79, 1913) the red Oneonta ss. is a nonmarine ss. of middle Portage age, separated from the red Catskill sediments by a considerable thickness of typical Chemung deposits. According to Hartnagel (1912 ed. Hdb. 19, p. 82) "Montrose" ss. is same as Oneonta ss.]

W. W. Mather, 1843 (Geol. N. Y., pt. 1, div. 4, pp. 2, 299–317). *Catskill div.*—Cgls., coarse grits, red shales, slates, and grits; gray and greenish gray slaty grits; chocolate-colored grits with red shales and slates. Underlies the Coal series. Includes upper part of Catskill Mtn series and Montrose and Oneonta sss. of repts; lower part of Catskill Mtn series is included in underlying Erie div. The Erie div. includes Chemung, Ithaca, Portage, Genesee, Tully, Hamilton, and Marcellus. The Helderberg div. [not Helderberg of present usage], which underlies Erie div., includes Onondaga ls. down to base of Onondaga salt group [Salina fm., Sil.]. The Montrose ss. of Vanuxem is below top of Catskill series in Catskill Mtns.

E. Emmons, 1846 (Agric. N. Y., vol. 1, pp. 187–197), assigned thickness of 1,800 to 2,000 ft. to Catskill "*group*" (which he defined as overlying Chemung group and underlying Coal series), and defined *Catskill "division"* as including (descending) Catskill group, Chemung group, Portage group, and Genesee sl., and as overlain by Coal series.

H. S. Williams, 1887 (U. S. G. S. Bull. 41, p. 27). There is reason to believe that in Sullivan Co., N. Y., the deposition of the red beds began as early as Hamilton time. This was shown to be a fact in Chenango and Otsego Counties by investigations in 1885.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 86). *Catskill beds,* named for Catskill Mtns, which have their greatest development in Greene Co., where the earliest sediments of this type began in early Portage time. This fm. includes the highest peaks of the Catskills and in point of elev. they are highest sedimentary rocks in State (Slide Mt, 4,204 ft. A. T.). To S. and W. the Catskill type of sedimentation began later and is contemp. with Chemung deposits, and perhaps in its later stages as developed in the Catskills, with the Postdevonic sediments in Allegany and Cattaraugus Counties.

During succeeding years the commonly accepted definition of Catskill fm. was the continental strata, chiefly red, in part contemp. and interfingering with the marine grayish and greenish Chemung and Portage strata and in part younger than Chemung.

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7) and 1933 (Sci., n. s., vol. 77, pp. 86–87, Jan. 20). The original Catskill of Catskill Mtns is all of Portage and Hamilton age, because it interfingers with marine sediments containing Portage and Hamilton fossils; and it is here divided into (descending): (1) *Catskill proper* (of Enfield or upper Portage age), which forms the peaks of all the true or eastern Catskills; (2) *true Oneonta,* of Ithaca or lower Portage age; (3) *Kiskatom red beds* (of Hamilton, Middle Dev., age), formerly erroneously called Oneonta. The Hamilton age of Kiskatom red beds is verified by recent work of G. A. Cooper. *In western Catskills,* along the Delaware, the Catskill proper (of upper Portage age) is overlain by *Catawissa reds* (the red equiv. of Cayuta, of *Chemung* age), which to W. is succeeded by true Montrose ss. (=upper Chemung or Wellsburg), Blossburg, and Cattaraugus (Bradfordian) fms. The name Catskill can no longer properly be used for the red beds farther W. in N. Y. and Pa. that are of Chemung and later age, though they happen to possess the same continental facies.

B. Willard, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 3, pp. 497–498), in order to avoid confusion, advocated the contined use of broad definition of Catskill that has been in general use many years (which is "synonymous with Dev. red beds, continental"), and suggested that the *Catskill-restricted* of Chadwick (the red beds btw. true Oneonta below the Catawissa above) be replaced by "an appropriate term, as *Kaaterskill (?)*."

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 480–484), agreed to abandon his proposed restriction of Catskill fm., but proposed that *Katsberg red beds* be used for the restricted unit. (See *Katsberg red beds.*) On p. 484 he stated: In place of Catskill, for present, we may best use the precision terms [upward succession]—Kiskatom (Hamilton reds); Onteora (Tully to Oneonta reds); Katsburg (Enfield reds); Catawissa (Cayuta reds); Montrose (Wellsburg reds); Blossburg (Girard-Chadakoin reds); and Cattaraugus (Venango reds).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 26). Chadwick's *Katsberg red beds* is more acceptable than Willard's *Kaaterskill* to replace Chadwick's restricted Catskill, inasmuch as type section of Willard's Kaaterskill, on Kaaterskill Cove, appears to be in an exposure of Chadwick's Onteora red beds, of Ithaca age. Nevertheless Willard's name has priority.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 857). Original Catskill fm. of Mather included all of Kiskatom fm. (about 2,500 ft. thick, including the Tully) and perhaps a little of overlying beds of Genesee age. But since later workers extended *Catskill* to the 5,000 ft. of still higher similar beds in these Catskill Mtns, and since *Catskill* has later come to be restricted to these higher beds, which are Upper Dev. (falsely supposed to be supra-Oneonta), it may be best to let the *Catskill* continue in the later significance (covering Genesee-Naples equivalents) excluding from it the Mid Dev. Kiskatom strata. [See also Chadwick's N. Y. State Mus. Bull. 307, 1936.]

The U. S. Geol. Survey applies the name *Catskill fm.* to the nonmarine red sediments contemp. and intertonguing with marine sediments ranging in age from Hamilton to Chemung, both inclusive, and in part later than the Chemung, extending from N. Y. to western Va.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 571). Writer now, as heretofore, uses *Catskill* as a phase or facies term to include all the continental Dev. beds.

G. H. Chadwick, Jan. 1936 (N. Y. State Mus. Bull. 307, pp. 1–101), discussed "history and value of the name 'Catskill' in geol.," and on p. 101 proposed to restrict *Catskill* to the beds exactly correlating with "what we now understand as the Senecan series of the Upper Dev.," and to exclude beds of Hamilton age.

Named for development in Catskill Mtns, Greene Co., N. Y.

Catskill division.
Catskill group.
See under *Catskill fm.*

†Catskill or Delthyris shaly limestone.
Lower Devonian: Eastern New York.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 120–122). *Catskill or Delthyris shaly ls.*—The upper part on Catskill Creek and the Helderberg is very light-gray coarse crystalline ls. which abounds in discoidal shaped fossils, about 2 inches in diameter, resembling a scutella. Lower part is usually a mixture of dark bluish gray sh. (which generally changes to drab) and fine-grained blue ls. Underlies Oriskany ss. and overlies Pentamerus ls. [Coeymans] that rests on water-lime group of Manlius. Named for occurrence on Catskill Creek, near Madison, Greene Co. [Apparently includes Becraft ls. at top and New Scotland ls. below. In later repts the term "Catskill shaly ls." was restricted to beds later named *New Scotland ls.*, because of conflict of name with *Catskill fm.*]

†Catskill Mountain series.
See first entries under *Catskill fm.*

Cattaraugus formation.
Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, pp. 524–528). Red and green shales interbedded with flaggy sands, to which it has been proposed to apply the term

Cattaraugus beds. Thickness 200 ft. Underlie Mount Herman or Salamanca cgl. and overlie Wolf Creek cgl. The validity and usefulness of the distinctive term for these strata, which represent those at times referred to Catskill fm. because of their red color and doubtless a western continuation of Catskill sedimentation, is very clearly indicated by the paleontologic evidence which they have furnished. [This definition was used in several repts.]

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 967–989). *Cattaraugus beds*.—Bright-red shales interbedded with green or bluish shales and fine-grained greenish gray, thin-bedded micaceous sss., with three cgl. lentils, named (descending): Kilbuck cgl. lentil, Salamanca cgl. lentil, and Wolf Creek cgl. lentil. Underlie, probably uncon., Oswayo beds, and rest on Chemung beds. Thickness 300–500 ft. Correlated with Catskill fm. to E., and assigned to Dev. [In same bull. (pp. 696–699) J. M. Clarke assigned *Cattaraugus beds* to Carbf. But in 1904 (Geol. Soc. Am. Bull., vol. 14, pp. 522–531) Glenn again assigned them provisionally to Dev. Clarke's 1903 Hdb. included Wolf Creek and Salamanca cgls. in the Cattaraugus, as did Glenn.]

Whether Cattaraugus fm. is late Dev. or early Carbf. is still an open question. (See under *Knapp fm.*) The 1903 definition was followed for many years, and the beds btw. Wolf Creek and Salamanca cgls., to which Clarke originally applied name *Cattaraugus beds*, were not renamed. In Warren Co., Pa., the lithology of Oswayo and Cattaraugus deposits changes, so that they can not be separated, as in N. Y., and in 1910 C. Butts named the combined unit *Conewango fm.*

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 455–464), divided beds *below* Riceville sh. in NW. Pa. into (descending): Woodcock horizon, Saegerstown sh., Millers horizon, Amity sh., and LeBoeuf horizon (all included in Venango group, which he described as resting on Chadakoin sh.).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203), divided Venango group of NW. Pa. into (descending): Riceville fm. restricted (Oswayo sh. memb.) and *Cattaraugus fm.*, the latter divided into (descending): Woodcock ss. memb., Saegerstown sh. memb., Millers ss. memb., North Warren sh. memb., Watson ss. memb., Amity sh., and Panama cgl. memb. (LeBoeuf, Wolf Creek). His Venango group rested on Chadakoin fm. of Chemung group.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61), excluded Riceville from his Venango stage, and assigned both Riceville and his Venango to Dev. On pp. 57–58 he stated: Cattaraugus fm. of Glenn is exact synonym of original "Venango group" of White. The only proper use of "Cattaraugus" is in a facies sense—*Cattaraugus parvafacies* of an unnamed magnafacies which is characterized by purple shales and cgls.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 570), applied *Cattaraugus red sh.* to the beds "mostly nonmarine," underlying Salamanca cgl. and overlying Panama cgl. This definition reverts to Clarke's original definition. Willard states (p. 580): The use of "Cattaraugus" in U. S. G. S. folio 93, 1903 (Elkland-Tioga), is erroneous, for it includes beds considerably older than Panama cgl., which makes base of Cattaraugus to W. If a term must be applied to these red beds, *Cherry Ridge* is logical, for they admit of no subdividing. What has been called *Oswayo fm.* in NE. Potter Co. and Tioga Co., Pa., appears to be green Coudersport memb. of Cattaraugus fm. Writer doubts presence of any true Oswayo in that area.

Named for development in Cattaraugus Co., N. Y.

Cattaraugus parvafacies.

See under *Smethport magnafacies* and under *Cattaraugus fm.*, 1934 entry.

Cattasauqua limestone.

Ordovician: Southeastern Pennsylvania (Northampton and Lehigh Counties).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, p. 153). The great ls. fm. of Easton and Allentown, No. II, 2,000 ft. thick, underlies Hudson River slates, and at its top are the *Cattasauqua ls. beds*.

Only recorded use of name. The name of the town is spelled *Catasauqua*.

Cattleman sand.

An oil-bearing subsurface ss. lying 50 to 75 ft. above the main shoestring sand horizon of Cherokee sh. in Wiggins field, 6 to 12 mi. N. of Eureka, Greenwood Co., Kans.

†Cauda-galli grit.

Lower Devonian: New York.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 127–130). *Cauda-galli grit.*—Fine-grained calc. and argill. ss., usually drab and brownish. Underlies Schoharie grit and overlies Oriskany ss.

Replaced by Esopus grit.

"Named for a fucoid having some resemblance in form to tail of a chicken cock."

†Caudagalli epoch.

Paleontologic term used by A. W. Grabau (see Buffalo Soc. Nat. Hist., vol. 6, p. xviii, 1898) to include time during which Schoharie grit and Esopus sh. were deposited. It has also been used to cover only the time of Esopus (†*Caudagalli*) grit.

Caulfeild formation.

Paleozoic (?) : British Columbia.

W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 12).

Causapscal formation.

Devonian: Quebec (Matapedia Valley).

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 368–385). *Causapscal fm.*—Shales and argill. lss., 3,000 ft. thick. Basal fm. of Dev. Conformably overlies St. Leon fm. (Sil.), and underlies Gaspe ss. (Dev.). Type section immediately S. of village of Causapscal in bluffs of Matapedia River. Also well exposed on Causapscal River below Causapscal Falls. Fossils (listed).

†Cavanal group.

†Cavaniol group.

Pennsylvanian: Central eastern Oklahoma and western Arkansas.

N. F. Drake, 1897 (Am. Phil. Soc. Proc., vol. 36, pp. 371, 388). *Cavaniol group.*—Shales, with sss., workable coals, and lss., 5,500 ft. thick, underlying Poteau group and extending down to base of Grady coal or top of Tobucksy [Hartshorne] ss.

According to J. A. Taff (U. S. G. S. 22d Ann. Rept., pt. 3, 1902) this name covers McAlester group and Savanna ss.

Named for Cavanal Mtns, N. part of Le Flore Co., Okla.

†Cave limestone.

Pennsylvanian: Eastern Kansas.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 7). *Cave ls.*—Hard, brittle, brown, gray, and drab ls., 20 to 30 ft. thick, forming bed No. 9 in Coal Measures of Miami Co. Occurs in beds of medium thickness, separated into fragments by vertical fractures. Overlain by 15 to 18 ft. of ss. and underlain by Einstine ss.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 118). Field work has shown that excepting at Lecompton (where the beds belong to a very much higher horizon) the †Cave ls. of Swallow is Wyandotte ls.

Apparently named for occurrence in it of many caves and crevices from which bold springs usually flow.

†Cave-rock series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., pp. 20–21). *Cave Rock series.*—Applies to beds No. 156 (Cave ls., 15 to 30 ft. thick) and No 157 (Einstein or

Einstine ss., 45 to 60 ft. thick) of geol. section of eastern Kans. Underlies Stanton ls. series and overlies Spring Rock series.

Not a geographic name. Includes Plattsburg ls. and underlying sh.

Cave Creek formation. (In Cimarron group.)

Permian: Central southern Kansas and northwestern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 27). *Cave Creek gypsums or fm.*—Gyp.-bearing fm., 50 ft. thick, consisting usually of either a single stratum of massive gyp. or two such strata separated by red clay sh. Includes (descending) Shimer gyp., Jenkins clay, and Medicine Lodge gyp. Overlies Flowerpot shales and underlies Dog Creek shales. Is top fm. of Salt Fork div. [In 1897 (Am. Geol., vol. 19, pp. 351–363) Cragin made Dog Creek shales top fm. of his Salt Fork div.]

C. N. Gould, 1927 (Obsolete Okla. names: Univ. Okla. Bull, Proc. Okla. Acad. Sci., vol. 6, pt. 2, p. 236). In Okla. a third gyp. memb., the Ferguson, occurs, and the 3 gypsums (Shimer, Medicine Lodge, and Ferguson) with associated dolomites and clays are now known as the *Blaine.*

Named for Cave Creek, Comanche Co., Kans.

Cavell formation.

Lower Cambrian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 292–293, 300). *Cavell fm.*—Lower Camb. qtzites well displayed on E. face of Mount Edith Cavell. Thickness at least 4,000+ ft. Rests on pre-Camb. Underlies Bosche ls. and sh.

Cavendish schist.

Upper Cambrian: Southeastern Vermont (Windsor County).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 210, 223). *Cavendish schist (Upper Camb.).*—Name is necessary because characteristics of the terrane will not permit it to be included in any group hitherto named. Cavendish is selected because this terrane is essentially the one in which the postglacial gorge so widely known as Cavendish Gorge [just E. of Cavendish village, Ludlow quad.] has been cut. Essential mineral composition is quartz and biotite. It is often hornblendic, and hornblende sometimes replaces nearly all of biotite. Is of dark gray color. Underlies all members of Upper Camb. Missisquoi group, of which Gassetts schist is oldest memb. Contact with Gassetts schist can be seen in the road cut a few rods N. of Gassetts station. Not determined that it either underlies or overlies Bethel schist, but writer has reached conclusion it is time equiv. of Bethel schist. [See also long description of this schist, by Richardson, in 17th Rept. Vt. State Geol., 1931, pp. 213–237.]

Cave Rock series.

See *Cave-rock series.*

Cave Springs sandstone.

Pennsylvanian: Southern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, p. 66). *Cave Springs ss.* suggested by G. I. Adams for ss. separating the two lss. composing Elk Falls ls. in vicinity of Cave Springs, Elk Co. In some areas the beds separating these lss. are shales.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 47). The sss. that occupy interval of Tecumseh sh. S. of Elk River were called *Cave Springs sss.* by Haworth (1898).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 178). [Refers to Adams' statement above, and abandons name, without explanation.]

†Caw Caw formation.

†Caw Caw sands.

Eocene (middle): Central South Carolina (Orangeburg County).

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 449, 454, 457–459). Warley Hill phase of earlier repts divided into *Upper or Warley Hill marl* and *Lower or Caw Caw shales and marls.* The Lower Warley Hill fm. lithologically represents a transition from Congaree shales [below] to later marls and comprises both shales and marls, often intergrading. Faunally they are distinctly characterized by first appearance of *Ostrea sellæformis* in S. C. and by abundant association of *Pteropsis lapidosa.* Succeeding a coarse glauconitic sand, a pea-green clay, now in the form of a slightly laminated sh., occupied the shoal areas, while pale yellow-green and gray marls formed in the deeper waters, and intergraded with the shales along their dividing zone. In some areas an irregular deposit of yellow to gray marls extended over the basal pea-green shales, but along the shoal areas renewed silting covered this broken bed of marl with a very fossiliferous pale yellow-green sh., in which casts of a large *Venericardia planicosta, Pteropsis lapidosa, Ostrea sellæformis* are found. At Kennedy's Scarp on Tinkers Creek this pea-green sh. incloses a matted mass of soft shells at base of the scarp. Some erosion, solution, or other degradation of the top shales of Lower Warley Hill phase occurred preliminary to deposition of Upper Warley Hill series. At some localities the Upper Warley Hill is represented by a bed of dark-gray, slightly glauconitic, fine-grained laminated sh.; it is coarser grained near its base and includes rounded gravel. Its greatest thickness is approx. 24 ft. The most extensive area of Upper Warley Hill phase exposes the characteristic Warley Hill glauconitic marl, which at Warley Hill may be seen resting on the slightly irregular surface of Lower Warley Hill series. It is exposed along Santee Valley as far down as Pinckney's Landing, and along Edisto River from Branchville to Sullivan's Bridge. Its greatest observed thickness does not exceed 25 ft. The Warley Hill marl is of a dirty gray-green color, compact, hard, and very harsh to the touch; the latter feature is accentuated by the large angular grains of glauconite. At one locality small semispherical crystals of wavellite appear to have been derived from the weathered glauconitic mass.

Is a local development of McBean fm., a marine deposit of Claiborne age. According to C. W. Cooke, 1936 (U. S. G. S. Bull. 867), it is lower part of McBean fm.

Named for exposures at Caw Caw Swamp, Orangeburg Co.

Cawker terrane.

Cretaceous: Kansas.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 255). *Cawker terrane*, shales, 50 ft. thick. Underlies Graneros and overlies Brookville (sss.). Included in Dakotan. [Derivation of name not stated, but probably Cawker City, Mitchell Co., north central Kans.]

Cawood sandstone member (of Hance formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U.S.G.S.P.P. 49, pp. 31, 33, 37, 120, 158). *Cawood ss. memb.*—Ss., 80 to 100 ft. thick, in Hance fm., lying 250 ft. below top of the Hance.

Named for Cawood, Bell Co., Ky.

Cayetano formation.

Cretaceous: Cuba.

E. L. De Golyer, 1918 (A.A.P.G. Bull., vol. 2, p. 140).

Same as *San Cayetano fm.*, Dickerson and Butt, 1935.

Cayuga group.

Silurian (late): New York, Pennsylvania, western Maryland and Virginia.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Cayugan period or group.*—Includes Manlius ls., Rondout waterline, and Salina beds, which are knit together by lithologic and faunal characters and are distinctly Ontaric [Silurian]. Outcrops are typically exposed about N. end of Cayuga Lake, N. Y.

In 1903 (Am. Geol.) C. Schuchert redefined Rondout, restricting name to upper part and introducing *Cobleskill ls.* for lower part of the beds formerly called *Rondout*. The Cayuga group (or Cayugan) has, therefore, for years been divided into these four fms.; but G. H. Chadwick in 1908 (Sci., n. s., vol. 28, p. 347, table and text) excluded Salina fm. from his *Cayugan*, while E. O. Ulrich in 1913 recommended the transfer of Rondout to Lower Dev. This is still an open question. (See further explanation under *Manlius ls.*) At present the U. S. Geol. Survey adheres to the old classification for N. Y. In Pa. and Md. the Cayuga group is divided into (descending) Tonoloway ls., Wills Creek sh., and McKenzie fm. In SW. Va. the Cayuga deposits are not differentiated and the rocks are called *Cayuga ls.*

†Cayuga dolomite.

Silurian: Canada.

See 1st entry under *Bertie ls. memb.*

Cayugan.

A time term covering the interval during which the rocks of the Cayuga group were deposited. Also used by N. Y. State Geol. Survey as a group name. (See under *Cayuga group.*)

Cayuta shale member (of Chemung formation).

Upper Devonian: West central New York.

H. S. Williams, 1906 (Sci., n. s., vol. 24, pp. 365–372). Chemung fm. of Ithaca region divided into (descending): Fall Creek cgl. lentil, 0 to 10 ft.; Wellsburg ss. memb., 600 to 650 ft.; *Cayuta sh. memb.*, 600 ft. The Cayuta memb. contains typical Chemung fauna. Exposed along Cayuta Creek from Cayuta Lake to its discharge into Susquehanna River. Rests on Enfield sh. memb. of Nunda fm.

H. S. Williams, 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169). *Cayuta sh. memb.*—Drab to bluish sh. and intercalated thin-bedded ss., 600 ft. thick. Underlies Wellsburg ss. memb. of Chemung and overlies Enfield sh. memb. of Portage fm.

This memb. is included in Chemung fm. in subsequent repts, including W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), and G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2).

Cazenovia group.

Middle Devonian: East-central New York (Madison County).

T. A. Conrad, 1841 (N. Y. Geol. Surv. 5th Rept., p. 31). [*Cazenovia group* appears in table as underlying Oneonta group and overlying Tully ls.]

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 150–160). Hamilton group includes *Cazenovia group.* Largest part of town of Cazenovia is covered by it. The hills around Cazenovia village are composed chiefly of coarse sh., which forms the Cazenovia shales of Conrad.

C. S. Prosser, 1893 (Am. Jour. Sci., 3d, vol. 46, pp. 212–230). *Cazenovia group* belongs below Tully ls., and not above it, as Conrad stated in 1841. [As Tully ls. is base of Upper Dev., these beds are a part of Hamilton group (Middle Dev.).]

Only recorded uses of name.

†Cedar limestone.

Upper and Middle Devonian: Eastern Iowa.

D. D. Owen, 1852 (Rept. Geol. Surv. Wis., Iowa and Minn., p. xix). SW. [of Upper Mag. ls. area] we come upon the Cedar lss., contemporary with the Dev. fm. of English geologists, separating the Mag. lss. of N. from the Carbf. lss. and the great coal field of Iowa and Mo. [On map accompanying this rept the rocks are described as "Formations of the Valley of Cedar River belonging to the Devonian period." As mapped by Owen the "Cedar lss." of his text include the Upper Dev. Lime Creek sh. and the Middle Dev. Cedar Valley and Wapsipinicon lss.]

Some later writers have used "Cedar ls." for Dev. ls. underlying Lime Creek sh., also for Dev. ls. underlying Grassy Creek sh. and Sweetland Creek sh., in which sense it is apparently a shortened term for *Cedar Valley ls.* Named for valley of Cedar River, eastern Iowa.

Cedar formation.

Upper Triassic: Northern California (Lassen Peak region).

J. S. Diller, 1892 (prel. proof-sheet edition of U.S.G.S. Lassen Peak folio) and 1895 (published Lassen Peak, folio, No. 15). Although there are slates and sss., with occasional traces of cgl., the principal stratum of *Cedar fm.* is ls., which forms conspicuous ledges on road a few mi. W. of Buzzard's Roost. This ls. is rich in Triassic fossils, which clearly show it is same horizon as Hosselkus ls. of Genesee Valley. Named for exposure on Cedar Creek, along toll road btw. Redding and Round Mtn, where it is overlain by Bend fm.

H. W. Turner, April 1894 (Am. Geol., vol. 13, pp. 229–249). The *Cedar fm.* includes Hosselkus ls. and underlying slates [meaning Swearinger sl., which is now known to overlie Hosselkus ls.].

Cedar volcanic series.

Oligocene: British Columbia.

C. Camsell, 1913 (Canada Geol. Surv. Mem. 26, p. 82).

Cedar Bay granite.

Mesozoic(?): Southeastern Alaska (Prince William Sound region).

U. S. Grant and D. F. Higgins, 1910 (U. S. G. S. Bull. 443, pp. 41–43, 46). *Cedar Bay granite.*—Light gray, even-grained. Surrounds two-thirds of Cedar Bay and forms core of neck of land btw. Wells Bay and passage NW. of Glacier Island. Cuts Valdez group.

Cedar Butte basalt.

Pleistocene: Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Cedar Butte basalt.*—Aphanitic blue pahoehoe basalt with fresh green olivine phenocrysts. Thickness exceeds 200 ft. where it dammed Snake River near Massacre Rocks. Behind this dam the American Falls lake beds accumulated. Rests, with local uncon., on thick series of early Pleist. blue and gray basalt flows which generally contain phenocrysts of olivine and feldspar. Type loc. Cedar Butte, T. 8 S., R. 29 E., Power Co.

Cedar Cliff limestone lens. (In Wills Creek shale.)

Silurian: Western Maryland and northern West Virginia.

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol., p. 41). *Cedar Cliff ls. lens.*—Hard blue or in places pink ls. Some of basal strata consist of nodules and resemble a cgl. Thickens westward and thins eastward. Can be traced from Keyser [W. Va.] to Hancock [Md.]. Occurs in midst of Bloomsburg red ss. memb. of Wills Creek fm. Well exposed at Cedar Cliff, Md., SW. of Cumberland.

†Cedar Creek beds.

Tertiary (middle Oligocene): Northeastern Colorado.

W. D. Matthew, 1901 (Am. Mus. Nat. Hist. Mem., vol. 1, pt. 7, pp. 355–374, 444). *Cedar Creek beds.* [See under †*Martin Canyon beds.*]

H. F. Osborn, 1909 (U.S.G.S. Bull. 361, pp. 65, 105). *"Cedar Creek beds"* = lower (or middle Olig.) part of Brule fm.

Named for Cedar Creek, Logan Co.

Cedar Creek limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 12, 21, 36). *Cedar Creek ls.*—Light-colored and massive except upper part, which is thin bedded. Thickness 1½ to 8 ft. Lies 13 to 30 ft. below top of Platte shales, and is separated from underlying Cullom ls. by 6 to 8 ft. of sh.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 48). *Cedar Creek ls.*, in middle of Tecumseh sh., is 2 to 9 ft. thick. Best developed at type loc. on Cedar Creek, 1½ mi. SW. of town of Cedar Creek [Cass Co., Nebr.]. Probably does not extend to Mo. and Kans. [The sh. in which this ls. occurs is now known not to be Tecumseh sh. (See R. C. Moore, Kans. Geol. Surv. Bull. 22, 1936, p. 178. Moore also abandoned the name.)]

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). *Cedar Creek ls.* is abandoned for another name, which has priority. The supposed Cedar Creek ls. of Bull. 1 is thought to be Iola ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Cedar Creek argillite.

Paleozoic(?): Northeastern Washington.

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 80; map). *Cedar Creek argillite.*—Medium to dark gray argillite that grades alternately into calc. argillite, carbonaceous argillite, and quartz mica schist. Usually fine-grained and finely laminated or bedded. Thickness 2,500± ft. Relations to other named units not determined. Extends to Int. Bdy and is part of Pend Oreille group of B. C. Exposed along wagon road up Cedar Creek to Frisco-Standard mine and on N. slopes of Red Top Mtn.

Cedar District formation.

Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 99).

Cedar Grove sandstones. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 169–178). *Upper Cedar Grove ss.*—Massive grayish brown, micaceous, medium grained, 10 to 40 ft. thick. Lies 5 to 20 ft. below Williamson coal and 20 to 50 ft. above Cedar Grove rider coal. Seth ls. not observed and evidently replaced by Upper Cedar Grove ss. Named for association with Cedar Grove coal. *Middle Cedar Grove ss.*—Massive, gray, fine grained, micaceous, sometimes containing a thin coal. Thickness 0 to 60 ft. Lies 0 to 10 ft. below Cedar Grove coal and overlies Lower Cedar Grove coal. *Lower Cedar Grove ss.*—Massive, persistent, similar in color and character to Middle Cedar Grove ss. Thickness 20 to 30 ft. Lies 1 to 10 ft. below Lower Cedar Grove coal and overlies Alma A coal.

Cedar Hills sandstone. (In Cimarron group.)

Permian: Central southern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 24). *Cedar Hills ss.*—Chiefly unevenly hard, in part massive, concretionary, fine-grained, bright red sss., 50 to 75 ft. thick, locally underlying Flower-pot shales and overlying Salt Plain measures in Barber Co., Kans. Included in Salt Fork div.

Named for Cedar Hills, Barber Co.

Cedar Hills anhydrite.

Permian: Central Kansas.

R. G. Moss, 1932 (Kans. Geol. Surv. Bull. 19), applied *Cedar Hills anhydrite* to a bed of gyp., 20 to 60 ft. thick, forming basal bed of Cimarron group in Ness and Hodgeman Counties, which he stated is "tentatively correlated with Cedar Hills fm."

Cedarian series.

A term applied by C. [R.] Keyes to approx. the same beds designated *Cedar Valley ls.* by other geologists.

Cedar Mesa sandstone member (of Cutler formation).

Permian: Southeastern Utah (San Juan County).

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1420, 1421, 1423, 1441, 1443, 1445, 1446). *Cedar Mesa ss. memb. of Cutler fm.*—

Massive white ss., 500 to 1,000± thick, underlying Organ Rock tongue (red) of Cutler fm., and overlying Halgaito tongue (red) of the Cutler. Well exposed on Cedar Mesa, Utah, on San Juan River, W. of Mexican Hat (Bluff P. O.). In earlier repts called Coconino ss.

†Cedar Mountain beds.

Miocene (upper): Central Nevada (Cedar Mountains).

A local term applied by some geologists to Esmeralda fm. (upper Mio.) in Cedar Mtns. See J. C. Merriam (Univ. Calif. Pub., Bull. Dept. Geol., vol. 8, No. 12, p. 277, 1914; vol. 9, pp. 163–172, 1916); J. P. Buwalda (Univ. Calif. Pub. Bull. Dept. Geol., vol. 8, No. 16, p. 305, No 19, pp. 335–363, 1914); and H. F. Osborn (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 21, 27, 1918), who assigned them to upper Mio. or lower Plio.

A. Knopf, 1921 (U. S. G. S. Bull. 725H: "Ore deposits of Cedar Mtn., Nev."). Buwalda has shown that the lake beds lying on both sides of Cedar Mtn are a part of Esmeralda fm., and they are here called Esmeralda.

Cedar Park member. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Eastern Texas (Williamson County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 331). South of Florence, Williamson Co., much of position of the Walnut [clay] is occupied by a ls. lentil here designated *Cedar Park memb.* Type loc. quarries about 2 mi. NW. of Cedar Park. It occurs over a considerable area in western Williamson Co. and grades out northward into Walnut of type facies. It consists typically (field work of H. C. Fountain) of about 58 ft. (in core tests) of ls. crystalline and porous above and more marly and nodular below. Upper 15 ft. is a solid, medium-grained, grayish ls. weathering yellow, with a few scattered fossils. This is underlain by a few ft. of porous ls. with fossils. The basal memb. is somewhat nodular and fossiliferous. The base is 5± ft. of typical Walnut marl with many *Exogyra texana* and other usual fossils. These 3 portions are exposed in a facies transitional to type Walnut on bluffs of the South San Gabriel at highway crossing N. of Leander, where they overlie the Glen Rose. In Cedar Park area the ls. lentil in basal Fredericksburg reaches 125 ft. in thickness and probably covers several sq. mi.

†Cedar Point shales and shaly limestones.

Permian: Central Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Cedar Point (Matfield) shales and shaly lss.,* about 92 ft. thick, overlie Wreford ls. and underlie Florence flints. Included in Florence beds.

According to its proposer is same as Matfield sh., older name. Probably named for Cedar Point, Chase Co.

Cedar Rapids phase (of Otis limestone).

Middle Devonian: Central eastern Iowa.

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, p. 378). *Cedar Rapids phase of Otis ls.*—This phase includes the wide variety of lithologic types, usually but slightly mag., seen in upper 30 ft. of Otis ls. in quarries at Cedar Rapids and at numerous other exposures.

Cedarton shale member (of Graford formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 391). *Cedarton bed.*—Sandy clay containing some usually gritty or conglomeratic ss. Prevailingly blue, but purple, red, and yellowish outcrops occur. Thickness 40 to 90 ft. Memb. of Canyon div. Overlies Adams Branch ls., and underlies Clear Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 35; Univ. Tex. Bull. 2132, pp. 109, 114). *Cedarton sh. and ss.*, 20 to 100 ft. thick, is basal memb. of Brad fm. in Colorado River Valley. Underlies Clear Creek ls. and overlies Adams Branch ls. memb. of Graford fm. Consists of blue sandy sh. (in places weathering red and purple) with ss. lentils and a few thin beds of cgl. Named for Cedarton, Brown Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 111), restricted Brad fm. to Placid sh. memb. of Plummer and Moore and Ranger ls. memb., and included Cedarton memb. in Graford fm.

Wallace Lee and C. O. Nickell have introduced (in a rept soon to be published by Tex. Geol. Survey) *Winchell memb.* for the beds overlying Cedarton sh. memb. and forming top memb. of Graford fm. in both Brazos River and Colorado River regions.

Cedartop gypsum member (of Blaine gypsum).

Permian: Southwestern Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 56). *Cedartop gypsum.*—Massive white gyp., 18 to 20 ft. thick, in midst of red clay sh. which separates Haystack gyp. below from Collingsworth gyp. above. Included in Greer div.

C. N. Gould, 1924 (A. A. P. G. Bull. vol. 8, No. 3, pp. 324–341). Cedartop gyp. memb. is provisionally considered=Medicine Lodge gyp. memb.

This gyp. is believed to be same as Medicine Lodge gyp. memb. of the Blaine, according to H. D. Miser.

Named for Cedartop Butte, Roger Mills Co.

Cedarvale shale. (In Scranton shale.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, p. 53). The Nebr. Geol. Surv. now restricts White Cloud sh. to that part of Scranton sh. below Happy Hollow ls. and applies *Cedar Vale sh.* to interval btw. Rulo ls. above and Happy Hollow ls. below. Type loc. is E. of Cedar Vale, Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 212). *Cedar Vale sh.* is bluish to yellowish brown, includes clayey and sandy beds, and, near top, the Elmo coal. Thickness averages 25± ft. Is traceable from southern Nebr. to northern Okla. Is exposed in E. bluff of Caney River, sec. 12, T. 34 S., R. 8 E., Chautauqua Co., Kans. Overlies Happy Hollow ls. and underlies Rulo ls. [Moore discarded Scranton sh. and treated this sh. as a fm. in his redefined Wabaunsee group.]

Cedar Valley limestone.

Upper Devonian: Eastern Iowa and southwestern Illinois (Calhoun and Jersey Counties).

W J McGee, 1891 (U. S. G. S. 11th Ann. Rept., pt. 1, p. 314). *Cedar Valley ls.*—Predominantly lss., ranging from pure to argill., dolomitic, or perhaps carbonaceous; sometimes regularly divided by smooth bedding planes, again massive, elsewhere finely laminated; usually brecciated in peculiar manner; some strata horizontal, others locally inclined at all angles. Thickness more than 60 ft. Overlaps underlying Independence sh. and underlies Hackberry sh. Extends from Minn. line to Muscatine Co., Iowa, in belt 50 mi. wide. [As thus defined includes upper part (Davenport beds of repts) of Wapsipinicon ls.]

See *Davenport beds.*

C. L. and M. A. Fenton, 1924 (Univ. Mich. Pub., Contr. Mus. Geol., vol. 1, frontispiece), divided Cedar Valley ls. of central northern Iowa into (descending) Nora ls., Shell Rock, and Lower Cedar Valley. [The Nora was originally included in Lime Creek sh.]

T. E. Savage, 1925 (Jour. Geol.), classified Cedar Valley ls. as Upper Dev. According to E. O. Ulrich, 1911 (Geol. Soc. Am. Bull. vol. 22, pl. 28), it is of Middle and Upper Dev. age and=upper Hamilton and Tully ls. of N. Y.

C. H. Belanski, 1927 (Am. Mid. Nat. vol. 10, No. 10), restricted Cedar Valley ls. to Middle Dev. beds uncon. below his Mason City substage. Subsequent repts of Iowa Geol. Surv., however, have continued to use Cedar Valley ls. for all beds below Lime Creek sh. and above Wapsipinicon ls.

C. H. Belanski (1928) included Upper Davenport beds (Middle Dev.) of Iowa Geol. Surv. in Cedar Valley ls. (See second entry under *Davenport beds*.)

The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, adopted Belanski's 1927 restricted definitions of *Cedar Valley ls.* and *Shellrock fm.* (see under *Shell Rock ls.*), gave thickness of Cedar Valley (restricted) as 90 to 150 ft., divided it into 3 members, named (descending) Coralville, Littleton, and Linwood (the latter two being new names), and assigned it to Upper Dev.

Named for exposures in valley of Cedar River.

Cedarville limestone.

Silurian (Niagaran): Southwestern Ohio.

E. Orton, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 271, 277–278, 297–8, 301, 304–6). *Cedarville, Guelph, or Pentamerus ls.*—Series of mag. lss., 10 to 90 ft. thick, characterized by abundance of large and noticeable fossils, most prominently *Pentamerus oblongus* and *Megalomus canadensis;* also includes series of very thin-bedded and fragile lss. in which *Pentamerus* rarely occurs but which are largely composed of fossil remains of other shells. Forms top fm. of Niagara group in Highland Co. and northward in SW. Ohio, except near Hillsboro and at a few other places, where it is overlain by Hillsboro ss. Underlain by Blue Cliff or Springfield ls. Best exposed at Cedarville, Greene Co.

A. F. Foerste gave further details in Denison Univ. Bull., Jour. Sci. Lab., vol. 30, 1935, pp. 154–158.

Cedarville sandstone. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia and western Maryland.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, p. 124). *Cedarville ss.*—Massive, greenish gray, medium coarse and hard, with flakes of mica and spots of iron peroxide. Thickness 32 to 41 ft. Lies 7 ft. below Sewickley ls. and overlies Redstone coal. Forms cliff at E. end of Cedarville, Gilmer Co.

Cedarville series.

Miocene: Northeastern California (Modoc County).

R. J. Russell, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, No. 11, pp. 402–416 and map). *Cedarville series.*—A series of andesitic rocks; at least 7,500 ft. thick, divided into: (1) Upper Cedarville (andesitic tuffs, aggls., intercalated flows, and about 5 per cent of non-volcanic sediments); (2) andesitic lava flows 150 to 500 ft. thick; and (3) Lower Cedarville (3,700+ ft. of andesitic aggls., tuffs, cgls., intercalated flows, and about 5 per cent of non-volcanic sediments. The Upper Cedarville contains fossil flora considered by Chaney to be of Mascall (Upper and Middle Mio.) age. [Mapped over large part of Warner Range, W. of Cedarville.]

R. S. LaMotte, 1936 (Carnegie Inst. Wash. Pub. 455). Upper Cedarville fm. (Plio.) of Modoc Co., Calif., is overlain by Alturas fm., but at Camp 49, Nev., the Alturas is absent, and Warner basalt rests on the Upper Cedarville.

Cedarville andesite.

Miocene: Northeastern California (Modoc lava-bed quadrangle).

H. A. Powers, 1932 (Am. Min., vol. 17, No. 7, pp. 253–282). *Cedarville andesite (Mio.).*—Oldest volcanic rocks in Modoc lava-bed quad.

Ceja Glorieta sandstone.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 64, No. 4, 1935, p. 263) to the Permian ss. of N. Mex. that has long been called "Glorieta ss." by other geologists.

†Cement series.

Descriptive term applied in a titular sense in some early N. Y. repts to Manlius, Rondout, and Cobleskill lss. and Salina fm., which comprise Cayuga group of present terminology.

†Cement shale.

Upper Devonian: Western Colorado (Gunnison County).

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 281, 289). *Cement shales.*—Shales, 100 ft. thick, composing top fm. of Yulean series and Ordoyicic system in Colo. Take title from [exposures on?] Cement Mtn, a few miles from Crested Butte, Gunnison Co.

E. Kirk, 1930 (Am. Jour. Sci., 5th, vol. 22, pp. 222–239), stated that this sh. is of Upper Dev. age, and therefore belongs to Chaffee fm.

Cement City limestone bed. (In Kansas City formation.)

Pennsylvanian: Northwestern Missouri and eastern Kansas.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13, 2d ser., pp. 7, 27–28, 118). *Cement City ls. bed.*—Thin but fairly persistent bed of gray, buff, or cream-colored ls., 5 to 10 ft. thick, lying 5 to 20 ft. above base of Chanute sh. memb. of Kansas City fm. Is believed to be Parkville ls. of Gallaher. At Kansas City it is known as "Gray ledge" or "Building ledge." Named for Cement City, Jackson Co., Mo.

R. C. Moore, 1932 (see under *Drum ls.*), divided Drum ls. into Corbin City ls. above and Cement City ls. below, and this definition of Cement City ls. was followed by Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.

G. E. Condra, 1933 (Nebr. Geol. Surv. Paper No. 4, p. 11). *Cement City ls.*, according to Moore, is true Drum ls. at type loc.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 43+). *Cement City ls.* is basal part of true Drum ls. This has been verified by R. C. Moore. The Chanute sh. of Hinds and Greene included true Chanute, true Drum, and underlying Quivira sh. of this rept. The Quivira is top part of Cherryvale sh. The Corbin City and Cement City ls. members of Drum ls. are uncon.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Cemetery limestone.

Upper Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22nd Ann. Rept., pt. 2, map, pp. 434, 437). *Cemetery ls.*—Great thickness of light-blue, thin to thick-bedded ls., mottled with dark-blue spots, overlain by 100 ft. of white or light gray granular ls. thin to thick bedded, varying to straw-yellow dolomitic marble. Lower part consists of 50 ft. of dark-blue granular ls. that weathers light gray, underlain by 70 ft. of blue lss. Total thickness 650 ft. Underlies Elkhorn sh. and overlies Hobo Gulch fm. Named for occurrence at Elkhorn cemetery.

Cenocene series.

A name proposed by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 22, 1915, p. 260) for latest Quat. deposits in N. Mex.

Cenozoic era.

A major time term, meaning recent life, employed to cover the Quaternary and Tertiary periods. For definition see U. S. G. S. Bull. 769, 1925, p. 8.

Centennial limestone.

Lower Ordovician and Upper and Middle Cambrian: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Centennial ls.*—Four relatively thick horizons of massive dark-blue ls. interspaced by as many relatively thin horizons of thinly bedded, light-gray ls. and one 6-ft. memb of thinly laminated light-green sh. Thickness 798 ft. Underlies 920 ft. of white lime sh. [Opohonga ls.] and overlies Golden Ray ls. [Evidently named for Centennial mine.]

These rocks were later subdivided into 4 fms., Ajax ls., Opex dol., Cole Canyon dol., and Bluebird dol.

Center iron sandstone. (In Clinton formation.)

Silurian (Niagaran): Central southern Pennsylvania (Perry County).

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 625, 628, 629, 634, 638). *Center iron ss.*—Massive red-brown iron ss. with interbedded sh. similar to that above. Thickness 36 ft. in vicinity of Center and 17 ft. at Harrisburg. Seen at Center village (4 mi. W. of Loysville) and vicinity. Base lies 96 ft. below top of Rose Hill fm. (lower or pre-Rochester Clinton). Lies higher in Rose Hill fm. than Swatara iron ss., which lies 511 to 631 ft. above base of the Rose Hill.

Centerfield limestone member (of Ludlowville shale).

Middle Devonian: Central and western New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 22). In Ontario Co. the succession of Hamilton beds from base up is: Shaffer sh. [=Skaneateles sh.]; *Centerfield ls.; Canandaigua sh.* [=Ludlowville sh. less Centerfield ls.]; Encrinal (=Menteth) ls.; Moscow sh. The Ludlowville shales do not maintain their integrity far from typical section on Cayuga Lake.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63), used *Canandaigua sh.* in Canandaigua and Naples quads., for beds beneath Tichenor ls. and above Skaneateles sh., which are "probably equiv. in part to the Ludlowville shales of Hall," because they were not certain the Encrinal ls. of Hall (the fm. overlying the Ludlowville sh.) is same as Tichenor (Encrinal) ls. The *Centerfield ls.* was treated as basal memb. of Canandaigua sh.

D. D. Luther, 1909 (N. Y. State Mus. Bull. 128), included *Centerfield ls.* in Ludlowville sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 67). In Ontario Co. the lower calc. beds of Ludlowville sh., which are characterized by their fossil contents, have been designated *Centerfield ls.* (1903 Clarke). The calc. beds at and near base of the Ludlowville extend as far W. as Erie Co. and also for some distance E. of Ontario Co. The strat. equivalence of *"Canandaigua"* and Ludlowville have now been established.

D. D. Luther, 1914 (N. Y. State Mus. Bull. 172, pp. 6–30), treated *Centerfield ls.* as top memb. of Skaneateles sh.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 223). *Centerfield ls.* is basal memb. of Ludlowville fm. Identified from Murder Creek, western N. Y., to E. of Skaneateles Lake. Is especially characterized by variety and perfection of preservation of its fossils, most notably its corals. Characterized by *Spirifer divaricatus*. In Livonia salt shaft it is 19 ft. thick; at Blossom, 4½ ft.; is probably 1½ ft. thick in cliff at Bayview, Lake Erie. Type section is on Schaffer Creek, 1 mi. N. of Centerfield.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included this ls. in Ludlowville sh., but B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 11, 39, 44), included it in Skaneateles sh., although stating that it is usually included in the Ludlowville.

The U. S. Geol. Survey treats *Centerfield ls. memb.* as basal bed of Ludlowville sh.

Center Hall formation.

Lower Ordovician: Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 404, 417–419, 422). *Center Hall fm.*—A zone of impure ls., 15 ft. thick, overlying Valentine fm. (pure quarry rock) and underlying Rodman ls. Thickens to E. Is not faunally or lithologically very different from Carlim ls., which underlies Valentine fm. The Valentine thins to E. and its beds are successively replaced by the upper beds of the Carlim, the younger of which appears to be synchronous with the Center Hall at Bellefonte. Included in Stones River group. Named for village of Center Hall [Center Co.].

Centerville limestone.

Silurian (Niagaran): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402, 407). *Centerville ls.*—Includes Baker (Clinton) ls., South Tunnel bed (Osgood shaly clay), and Whites Bend (Laurel) ls. At Centerville the Osgood bed is lithologically simply a softer phase in general Sil. section, although paleontologically it separates fauna of Clinton ls. below from that of Laurel ls. above. South of Harpeth River, where Clinton-Osgood-Laurel beds form practically a single lithological unit, the name *Centerville ls.* may prove convenient as a general name for this series.

Named for exposures at Centerville, Hickman Co.

Centerville formation.

Silurian (earliest): Southwestern Ohio (Montgomery, Clark, and Greene Counties), and southeastern Indiana.

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 173, 184–185). Until recently the Brassfield ls. was regarded as oldest Sil. fm. in area traversed by Cincinnati anticline. The Belfast is merely a local phase of base of the Brassfield. In Ind. and Ohio the base of the Brassfield is underlaid by a clay sh., all of which, until recently, was referred to Elkhorn memb. of the Richmond. Several years ago, however, a Sil. fauna was discovered locally in uppermost part of this clay. At quarry E. of Centerville [Montgomery Co., Ohio] the following distinctly Sil. fauna was collected [listed]. Such an association of fossils having a Sil. aspect with others having an Ord. aspect is known also in Edgewood fm. of SW. Ill. and adjacent parts of Mo. Hence the Ohio faunules here mentioned are correlated provisionally with the Edgewood, although no species known to be diagnostic of the Edgewood have been found. But presence of *Platymerella manniensis* at base of the Brassfield at Lawshe, Adams Co., Ohio, appears to confirm this correlation. Provisionally the term *Centerville fm.* is proposed for the supposed Ohio equiv. of the Edgewood.

Foerste gave further details in 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 145, 148), when he stated this fm. is exposed at large quarry ½ mi. NE. of Centerville, Ohio.

Centinela gravels.

Pleistocene: Southern California (Baldwin Hills, Los Angeles County).

A. J. Tieje, 1926 (A. A. P. G. Bull., vol. 10, No. 5, p. 510). The post-Palos Verdes alternating [fresh-water] blue-clay and gravel beds, however, of trench 10 may be correlated with a series of marine gravels which carry a fauna of still more warm-water aspect than that of Palos Verdes strata, and which may be tentatively styled *Centinela gravels,* since they were exposed S. of Centinela Creek, in trench 6. On other hand, these Centinela gravels may represent a new submergence of Baldwin Hills region.

†Central limestone and shale group.

Upper, Middle, and Lower Ordovician: Central and eastern Tennessee.

J. M. Safford, 1856 (Geol. Reconn. Tenn. 1st Rept., pp. 149, 154–156). *Central ls. and sh. group.*—Nearly horizontal blue lss., 800 to 900 ft. thick in Central Basin of Tenn., double or more than double that thickness in eastern valley of E. Tenn. Easily divisible into two nearly equal members. The Stones River or lower memb. is series of blue and dove-colored lss., more or less cherty, not generally as argill. as those of succeeding memb., and often remaining thick bedded when weathered; contains, however, several thin-bedded argill. divisions. Nashville or upper memb. is blue, argill., more or less sandy, compact, and highly fossiliferous ls., generally weathering into thin-bedded rough layers, often separated by shaly seams. Stones River and Nashville subgroups distinctly separated by fossil characters, the former being in general=Black River and lower Trenton, and latter=Hudson River, Utica sl., and Upper Trenton of N. Y. Underlies Clinch Mtn ss., and overlies Camb. (?) Magnesian ls. and sh. group or Calciferous ss.

Includes all Ordovician fms. in central and eastern Tenn..

Named for central basin of middle Tenn.

†Central limestone.

Lower Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 258–267). *Central ls.*—Thick-bedded, cherty, fossiliferous lss., of light-blue or dove color, 100 ft. thick. Basal fm. of Trenton or Lebanon [Stones River] group. Underlies Pierce ls. Bottom rock of Central Basin. Outcrops in approx. circular area around Murfreesboro.

Nongeographic name. Replaced by Murfreesboro ls.

Named for fact it outcrops in exact center of State.

Central marble bowlder member. (In Davis formation.)

Upper Cambrian: Southeastern Missouri.

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1, p. 33). *Central marble bowlder memb.*—Soft blue sh. and large ls. boulders, lying 63 ft. below top of Davis fm. Is persistent over large areas.

Nongeographic name.

†Central group.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 409, 436, 450, 455, 463, etc.). An abbreviation of *Central Mine group*.

Central City granite.

Pre-Cambrian (?): Central northern Colorado (Gilpin County).

J. Underhill, 1906 (Univ. Colo. Studies, vol. 3, No. 4, p. 272; also Colo. Sci. Soc. Proc., vol. 8, pp. 103–122). *Central City granite.*—A hypidiomorphic arrangement of quartz, feldspar, and biotite, no muscovite; classed with alkali granites or granitites. So far as known occurs only on each side and a little S. of head of Spring Gulch, just S. of Central City R. R. station. Intrudes the surrounding gneiss.

Centralia limestone. (In McLeansboro formation.)

Pennsylvanian: Southwestern Illinois (Marion County).

J. R. Ball, 1934 (Ill. Acad. Sci. Trans., vol. 26, No. 3, p. 97). *Centralia ls.*, lying 17± ft. above Shoal Creek ls. and 17± ft. below Macoupin ls., which it resembles, is very fossiliferous, and fauna differs from that of Macoupin ls. [Derivation of name not stated, but probably is Centralia, SW. corner of Marion Co.]

Centralian epoch (and series).

Term proposed by G. F. Kay (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 449–452, 1931) to include Sangamon (interglacial) and Illinoian (glacial) stages of Pleistocene epoch (and series), which Kay would elevate to Pleist. period (and system). Named for Centralia, Marion Co., Ill., where Illinoian till and Illinoian gumbotil are well developed over a large area surrounding the village.

Central Mine group.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 689). *Central Mine group.*—Mainly lavas of augitic ophite type, with infrequent sediments. At top is "Mesnard epidote" and just beneath the heaviest flow, over 1,000 ft. thick at times, known as the *Greenstone*. Includes "Greenstone group," "Phoenix Mine group," but only a part of Pumpelly's "Portage Lake series," and just about that part included and well exposed in workings of Central mine on a cross-fissure, exposing a good section (sections 24, 25, 36, T. 58 N., R. 31 W.). This is a new name we would introduce and define as extending from Bohemia cgl., Marvine's cgl. 3 or 8, to "St. Mary's epidote," a sediment, volcanic ash, just above the "Greenstone" and Marvine's cgl. No. 15. Characterized by very heavy flows of ophite, some of them hundreds of ft. thick, so that, for instance, the "Greenstone," the one at top of the series, extends beneath Lake Superior, from one side to the other; often proportionately coarse grained. On Black River there are possibly 25,000 ft. including flows. At Portage Lake say 8,000 ft.

Because of uncon. at base of †Mesnard epidote and closer relations of that fm. with overlying rocks, the †Mesnard epidote is now included in Ashbed group. Lane included it in that group in his 1911 publication.

†Central Mine conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

Local name for Houghton cgl. in Central mine.

Central Valley beds.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, p. 187). *Central Valley beds.*—Layers not well exposed, but evidently chiefly fine-grained diabases and amygdaloids, with a number of thin porphyry cgls., in all respects like underlying group. Thickness about 5,540 ft. Rests on Bohemian Range group and is overlain by the Sub-Greenstone group, 1,600 ft. thick.

Believed to extend from top of Bohemia cgl. up to top of Wolverine ss., thus covering lower part of Central Mine group.

Derivation of name not stated.

Centre Point division.

Pleistocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 29, 35–42, 188). *Plateau gravel or Centre Point gravel, phase, or div.*—Red gravels and red sandy clays, 0 to 200 ft. thick, forming uplands of N. half of interior margin of the region, becoming more and more conspicuous to W. toward Choctaw line, and attaining greatest development in central portions of Howard, Pike, and northern Hempstead Counties. In places overlies Arkadelphia shales, in other places rests on *Exogyra costata* clays and in other places rests on Camden series.

Named for exposures at Centre Point, Howard Co.

†Ceratops beds.

Upper Cretaceous (includes some Eocene in certain areas): Wyoming, northwestern Colorado, Montana, and North Dakota and South Dakota.

O. C. Marsh, 1889 (Am. Jour. Sci., 3d, vol. 38, p. 501). The geological horizon of these strange reptiles—the huge horned dinosaurs—is a distinct one in upper Cret., and has now been traced nearly 800 mi. along E. flank of Rocky Mtns. It is marked almost everywhere by remains of these reptiles, and hence the strata containing them may be called *Ceratops beds*. They are fresh-water or brackish-water deposits, which form part of the so-called Laramie, but are below the uppermost beds referred to that group. In some places at least they rest upon marine beds which contain invertebrate fossils characteristic of Fox Hills deposits. The fossils associated with the Ceratopsidae are mainly dinosaurs representing two or three orders and several families. Plesiosaurs, crocodiles, and turtles of Cret. types, and many smaller reptiles have left their remains in the same deposits. Numerous small mammals, also of ancient types, a few birds, and many fishes, are likewise entombed in this fm. Invertebrate fossils and plants are not uncommon in the same horizon.

Replaced by geographic name *Lance fm.*

Cercado formation.

Miocene: Santo Domingo.

C. J. Maury, 1919 (Sci., n. s., vol. 50, p. 591).

†Cerithium rock.

Paleontologic term formerly applied to a facies of Tampa ls. (lower Miocene) of Fla.

Cerro till.

Cerro glacial stage.

Pleistocene (pre-Wisconsin): Southwestern Colorado.

W. W. Atwood and K. F. Mather (U. S. G. S. P. P. 95, p. 14, pl. 1, 1915; Geol. Soc. Am. Bull., vol. 35, p. 122, 1924; U. S. G. S. P. P. 166, 1932). *Cerro till.*—Oldest Pleist. glacial drift in SW. Colo., the next younger Pleist. drift being named *Durango till*. The time covered by deposition of the till is called *Cerro glacial stage*. Replaces "San Juan glacial epoch" and "San Juan moraine," the name *San Juan* being preoccupied. Named for Cerro Summit [about 12 mi. E. of Montrose, Montrose Co.]. It is possible that some deposits referred to Cerro stage may be as old as Nebraskan, but we believe that most of these deposits are comparable to either Illinoian or Kansan.

Cerro Gordo clay.

Lower Cretaceous (Comanche series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 111, 188). *Cerro Gordo blue chloritic clays.*—Pale and yellowish green clay marls forming upper part of Washita div. in SW. Ark. Overlie massive semicrystalline lss. called Upper Little River ls. Underlie the poor lands from Cerro Gordo [Little River Co.] to within 6 mi. of Rocky Comfort, extending E. to Cane Creek.

According to C. H. Dane (personal communication, Dec. 1936), this name covered Kiamichi clay and may also include some of lower part of Woodbine fm.

Cerro Gordo substage.

Upper Devonian: Central northern Iowa.

C. L. Fenton, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 355–376). *Cerro Gordo substage.*—Upper part or *Spirifer* zone, 20 ft. thick at Hackberry Grove, consists of yellowish, very calc. shales, shaly clays, and occasional bands of shaly lss., very fossiliferous, containing three distinct faunules. Lower part or *Striatula* zone, 7 to 25 ft. thick, consists of calc. shales and shaly lss., slightly gritty; contains large amounts of iron pyrite and near base many calc. concretions; lower portion largely heavy ledges of strongly iron-stained and seemingly dolomitic ls. Basal part of Hackberry stage [restricted]. Underlies Owen substage of Hackberry stage and uncon. or discon. overlies Sheffield fm. [Juniper Hill fm. of Van Tuyl, 1925], which was referred to the Hamilton by Webster in 1889.

Named, apparently, for exposures in Cerro Gordo Co.

The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, treated *Cerro Gordo memb.* as middle part of Lime Creek sh.

Cerro Gordo moraine.

Pleistocene (Wisconsin stage): Central and northeastern Illinois. Described in U. S. G. S. Mon. 38, pp. 218–222. Belongs to Shelbyville morainic system. Named for Cerro Gordo, Platt Co.

Cerros de Sal formation.

Miocene (upper): Dominican Republic.

T. W. Vaughan et al., 1921 (Dominican Republic Geol. Surv., Mem. 1, p. 75).

Cevicos limestone.

Miocene (lower): Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Chaco marl.

Eocene: Northwestern New Mexico.

C. R. Keyes, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 725). *Chaco marls* (Eo.), 1,000 ft. thick, underlie Chama clays (Mio.) and are separated from underlying Torreon fm. [Torrejon] by Canyon Largo sss., 700 ft. thick. [Derivation of name not given.]

Appears to be upper part of Wasatch fm. of NW. N. Mex.

Chacra.

A name applied by C. [R.] Keyes to 150 ft. of sss. described as forming top memb. of Mesaverde fm. in Colo., N. Mex., and Ariz. Derivation of name not stated. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 6.)

Chacra sandstone member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Chacra Mesa region).

C. H. Dane, 1936 (U. S. G. S. Bull. 860C). *Chacra ss. memb.*—Buff, gray, and copper-colored ss., gray sh., some carbonaceous sh. and sub-bituminous coal. Thickness 0 to 360 ft. Top memb. of Mesaverde fm. in Chacra Mesa coal field. Replaces Cliff House ss. as used by M. Bauer and J. B. Reeside, Jr., in this region. Appears to be same as Chacra sss. of Keyes.

Chadakoin beds.

Upper Devonian: Western New York (Chautauqua County) and northwestern Pennsylvania.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). Upper Dev. of Chautauqua Co. divided into (descending): Knapp beds; Conewango fm. (with Panama cgl. at base); Chadakoin; Volusia sh. (=Girard sh. of Pa.).

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 154). *Chadakoin beds* succeed Volusia sh. in Chautauqua gulf section W. of Mayville, and on Chautauqua Lake they include some shales of distinctly reddish or chocolate color. Named for exceptional exposure in the shale-brick quarries at Dexterville (Jamestown) on Chadakoin River. Pass southward and eastward into upper "Chemung" of Warren folio and Olean region, which is characterized by such chocolate shales. In Elmira area they must lie wholly above true Chemung and in the Catskill, which there also is distinctly chocolate rather than red. Upper limit of Chadakoin fm. is presumably at base of Panama cgl. or of equiv. Le Boeuf ss. of Pa.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included *Chadakoin beds* in Chemung, and called underlying beds Cuba ss.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 62–70). *Chadakoin stage* (*Chadakoin monothem*) underlies Panama cgl. memb. and overlies Girard sh. Divided into (descending) Ellicott sh. memb. (which includes, near top, "Tanner's Hill red" band), Dexterville sh. memb., and Lillibridge ss. memb.

Chadron formation.

Oligocene (lower): Western Nebraska and South Dakota, eastern Wyoming, and northeastern Colorado.

N. H. Darton, 1899 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 736, 759, pl. 82). *Chadron fm.*—A thin sheet of light greenish sandy clay, underlying Brule clay and forming basal memb. of White River series. Formerly called "Titanotherium beds." Rests uncon. on Pierre clay. Thickness 30 to 60 ft. in outcrops along foot of Pine Ridge, but thickens considerably in vicinity of Adelia, where there are included some masses of dark gray and buff ss. of coarse texture. Appears not to extend far E. in southern Nebr., and is absent along Republican River. Underlies parts of Colo. and S. Dak.

Is lower fm. of White River group.

Mr. Darton stated (personal communication April 8, 1931) that he named this fm. for exposures at Chadron, Nebr.

Chaffee formation.

Upper Devonian: Colorado.

E. Kirk, 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 229–230). *Chaffee fm.*—A name applied to the Dev. deposits, of protean lithologic character, in areas to N. and E. of typical region of Ouray ls. and Elbert fm. of San Juan region, SW. Colo., of which it is considered the approx. equivalent. The area of Chaffee fm. extends from Salida to Crested Butte quad. and Glenwood Springs on W.; to N. at least as far as Alma dist., and to S. as far as Kerber Creek dist. The fm. consists of a variable series of sss., shales, dolomites, and relatively small amounts of ls., and is characterized throughout by Dev. invertebrate fauna so well known in Ouray ls. In Leadville and Alma districts the Parting qtzite is basal memb. of Chaffee fm. Thickness of fm. in a section near Salida 161± ft.; in Gold Brick dist. 204± ft.; in Crested Butte quad. 175 ft.; in Leadville dist. 102± ft.; at Gilman 70 ft. Named for Chaffee Co., in which it is well exposed S. of Arkansas River about 5 mi. SE. of Salida, and on W. slope of Monarch Mtn, at Monarch, 15± mi. SW. of Salida.

Chaffin limestone member (of Thrifty formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 410–412). *Chaffin bed.*—South of Home Creek, massive, hard, brittle, bluish white ls. of slightly nodular structure, in places replaced by massive ss.; N. of Home Creek, 2 to 3 ft. of massive, brown-weathering ls. above and 1 to 5 ft. of crumbling white ls. below, separated by 25 to 50 ft. of clay. Memb. of Cisco div. Underlies Waldrip bed and overlies Parks Mtn bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 24; Univ. Tex. Bull. 2132, p. 158). *Upper Chaffin bed* of Drake is Breckenridge ls. memb. of Thrifty fm. and Lower Chaffin bed of Drake is probably Blach Ranch ls. memb. of Thrifty fm. of Brazos River region.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, p. 233). The Breckenridge ls. (top memb. of Thrifty fm. of Colorado River area) was described by Drake as *Chaffin bed,* and was correlated with Breckenridge ls. of Brazos River area by Plummer and Moore. The bed lies directly on Chaffin coal.

The present definition of U. S. Geol. Survey treats Chaffin ls. as top memb. of Thrifty fm. in Colorado River region, its type area, and as overlying Parks Mtn ss. memb. of the Thrifty and underlying Harpersville fm.

Named for Chaffin coal mine, 2 mi. E. of Waldrip, McCulloch Co.

Chagres sandstone.

Pliocene: Panama Canal Zone.

D. F. MacDonald, 1919 (U. S. Nat. Mus. Bull. 103, p. 532).

Chagrin shale.

Upper Devonian: Northern Ohio.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, p. 521). *Chagrin sh.*—Grayish sh. and thin sss., underlying black Cleveland sh. and overlying black Huron sh. Replaces Erie sh. (preoccupied).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69); 1924 (N. Y. State Mus. Bull. 251, p. 157); 1933 (Pan-Am. Geol., vol. 60, pp. 195, 351). Upper Chagrin is of Bradfordian age and=Conewango fm. (Oswayo and Cattaraugus), and Lower Chagrin is of Chautauquan age and=Chadakoin and Girard. [On p. 195 of Pan-Am. Geol., vol. 60, he called the rocks *Chagrin group.*]

H. P. Cushing, 1931 (U. S. G. S. Bull. 818, on Cleveland, Berea, and Euclid quads., Ohio), defined *Chagrin sh.* as uncon. underlying Olmsted sh. memb. of Cleveland sh. and as resting on shales of Portage age. This is present accepted definition of Chagrin sh. Its relations to Huron sh. are now questioned. Named for exposures on Chagrin River, Cuyahoga Co. Assigned to Chemung epoch.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 4, pp. 280, 281), said *Chagrin sh.* is later than Chemung and of Conewango age, as did K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71). Also that the sh. called "of Portage age" in U. S. G. S. Bull. 818 is real Chemung and not of Portage age.

Chagrin magnafacies.

Upper Devonian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 28). The Big Bend magnafacies is transformed into an olivaceous, still fine-grained, sh. and ss. in the next seaward-adjoining province. For this magnafacies the name *Chagrin* is being used. The Chagrin "fm." of O. is in reality a terrane, and this usage of the term for this important magnafacies, which is almost if not quite as important as the Big Bend magnafacies, has decided advantage over any other available name. The parvafacies of Chagrin magnafacies within Venango stage is being termed *Irvineton parvafacies.* Venango stage included in Conewango series.

Chainman shale.

Mississippian: Eastern Nevada (Ely region).

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 24, 26, map). *Chainman sh.*—Essentially soft, fissile, clay sh. grading locally into fine-grained sandy sh. Contains much carbonaceous matter and beds are almost uniformly of very dark hue. In a few places they contain cobble-like segregations of iron carbonate, which becomes rusty on exposure. In NW. corner of Ely quad. a bed of qtzite 30± ft. thick lies in middle of fm., but elsewhere no sandy beds were seen. Locally there are intercalations of gray ls. in upper part of fm. Alternations of ls. and sh. in upper part show transition into overlying Ely ls. In mapping intention has been to draw upper bdy of fm. just above uppermost sh. bed of transition zone. Thickness 200 to 250 ft. Near Veteran the fm. has apparent thickness of 1,000 ft., but this is attributed to duplication by folding and crumpling. Is top fm. of Mississippian. Fossils listed. Overlies Joana ls. Named for Chainman mine, near Lane, Ely quad.

Chaleur series.

Silurian (Niagaran): Quebec (Gaspé Peninsula).

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 204).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 42).

W. A. Parks, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 787).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). The *Chaleur series* (middle Sil.) rests uncon. on Mictaw series (of late Trenton to early Eden age). Its 6 fms. are correlated by their faunas with Clinton, Lockport, and Guelph.

Chalk Bluff formation.

Permian: Southeastern New Mexico (Pecos Valley region).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Chalk Bluff fm.*—Comprises all sediments lying btw. San Andres ls. (below) and Salado halite (above). Consists of anhydrite, dolomitic anhydrite, sss., red beds, and dolomitic lss. Contains numerous beds of greenish bentonite, some 5 ft. or more thick. Is essentially a back-reef fm., but is contemp. with fms. of the reef zone. Thickness, 1,000± ft. Interfingers with upper (Azotea) tongue of Carlsbad ls., also with underlying part of the Carlsbad, and with the still older Dog Canyon ls. Exposed in Chalk Bluff, on E. bank of Pecos River SE. of Artesia.

Chalk Mountain nevadite.

Eocene: Tenmile district, Colorado.

W. Cross, 1886 (U. S. G. S. Mon. 12, pp. 345–349). Almost wholly quartz and feldspar.

Forms mass of Chalk Mtn, Eagle and Summit Counties.

Chalk Mountain dacite.

Recent (?): Northern California (Lake County).

C. A. Anderson, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pp. 656–657). *Chalk Mtn dacite* intrudes Cache fm. (upper Plio. or lower Pleist.), and may be of Recent age. It is brilliant white, and composes most of Chalk Mtn, a small conical hill rising 400 ft. E. of North Fork of Cache Creek.

Chalky Mount group.

Age (?): Barbados.

E. H. C. Craig, 1913 (Rept. on oil fields of Barbados, p. 3).

Challis volcanics.

Tertiary (late Oligocene or early Miocene): Southern central Idaho (Custer County).

C. P. Ross, 1930 (Idaho Bur. Mines and Geol. Pam. 33, March 1930). *Challis volcanics.*—Lava flows and associated pyroclastics of probable Mio. age in mtn region of south-central Idaho. Named for Challis National Forest and town of Challis, Custer Co.

C. P. Ross, 1932 (Idaho correlation chart, compiled by M. G. Wilmarth). *Challis volcanics* divided into (descending): (1) Tuffaceous beds present in places; (2) Yankee Fork rhyolite memb., 0 to 1,600± ft.; (3) Germer tuffaceous memb., 0 to 2,000+ ft.; (4) andesitic beds, 0 to 2,000 ft. Of Olig. (?) age. Uncon. underlies Mio. intrusives and uncon. overlies intrusives related to Idaho batholith.

More fully described by C. P. Ross in U. S. G. S. Bull. 854, 1934, on Casto quad.

Chama clay.

Miocene (?): Northwestern New Mexico.

C. R. Keyes, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 725). *Chama clays,* 300 ft. thick, underlie Santa Fe sands and overlie Eocene Chaco marls. [Derivation of name not given.]

Chaman series.

A term employed by C. R. Keyes (Iowa Acad. Sci. Proc., vol. 14, pp. 223–228, 1907) to cover his Chaco marls and Canyon Largo sss. of N. Mex., both Eocene, which correspond to Wasatch fm. of present terminology. Overlies Torrejon fm. Derivation of name not stated. He has also applied the name in Colo. and Ariz.

Chamberlain shale.

Pre-Cambrian (Belt series): Central southern Montana (Little Belt Mountains).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Chamberlain shales.*—Dark, siliceous, and in places aren. shales, 1,500 ft. thick, overlying Neihart qtzite and ss. and underlying Newland ls. Type localities are on ridges btw. Chamberlain and Sawmill Creeks, SE. of Neihart.

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 282). *Chamberlain shales.*—Dark gray, almost black, shales, frequently aren., occasional ripple marks; essentially slaty in fracture, but beds are jointed and form cliffs along stream courses. These beds form middle part of fm. At base the admixture of aren. and micaceous material indicates transition into underlying Neihart qtzite, while in upper part calc. beds appear alternating with the black sh., the latter becoming less and less prominent and the calc. sh. becoming true ls. It thus grades into overlying Newland ls. Estimated thickness in Little Belt Mtns 2,000 ft. Typically developed along Chamberlain and Sawmill Creeks, S. of Neihart. Estimated thickness on Sawmill Creek 2,078 ft.

Chamberlin's Brook formation.

Cambrian: Newfoundland.

B. F. Howell, 1925 (Bulls. Am. Pal., vol. 11, No. 43, p. 60).

Chambersburg limestone.

Middle Ordovician: Central southern Pennsylvania, western Maryland, and northwestern Virginia.

G. W. Stose, 1906 (Jour. Geol., vol. 14, p. 211). *Chambersburg ls.*—Crystalline and thin shaly lss., more than 1,000 ft. thick, containing in upper part fossils identified by E. O. Ulrich as of Black River and Chazy age. Top fm. of Shenandoah group. Underlies Utica sh. and overlies Stones River ls. Exposed along edge of sh. belt W. of Chambersburg, Franklin Co.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170). *Chambersburg ls.* contains fossils identified by E. O. Ulrich as of Chazy, Black River, and basal Trenton age. Thickness 100 to 750 ft.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), transferred to Martinsburg sh. the shaly beds [0 to 245 ft. thick] at top of Chambersburg ls., thus including in the Martinsburg all beds of Trenton age. This modified definition was adopted by U. S. Geol. Survey in 1927.

C. Butts and G. W. Stose, 1932 (16th Int. Geol. Cong. Guidebooks of Appalachian region), removed Lowville ls. memb. from Chambersburg ls. (because it is a distinct and mappable fm. over a large area) and restricted Chambersburg ls. to beds of post-Lowville Black River age. This is present approved definition of Chambersburg ls.

A. A. L. Mathews, 1934 (Va. Geol. Surv. Bull. 40), named the post-Lowville Black River beds of Giles Co., SW. Va., *Eggleston ls.* The U. S. Geol. Survey has not yet had occasion to consider this name for its publications.

Chambly member (of the Lorraine).

Upper Ordovician: Quebec.

A. F. Foerste, 1916 (Canada Geol. Surv. Mem. 83, p. 30).

Chamiso formation.

Upper Cretaceous: Southwestern New Mexico (Alamosa Creek Valley Socorro County).

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A). *Chamiso fm.*—Soft yellow sss. and sandy shales with intercalated carbonaceous beds and coal beds at 3 general horizons, the one 75 ft. above base being important. Wholly nonmarine. Abundant Mesaverde flora but no invertebrates. Probably includes rocks older than Mesaverde, hence local name. Thickness 1,850 ft. Rests on Bell Mtn ss. memb. of Miguel fm. and uncon. underlies Datil fm. (late Tert.). Named for Chamiso Creek, T. 2 N., R. 9 W., Socorro Co.

Champaign morainic system.

Pleistocene (Wisconsin stage): Western Indiana and eastern Illinois. Shown on moraine map in U. S. G. S. P. P. 106. Named for Champaign, Ill.

Champion shell bed. (In Kiowa shale.)

Lower Cretaceous (Comanche): Central southern Kans.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 358–371). *Champion shell bed.*—Gray shell cgl., 1 to 1½ ft. thick; zone of *Gryphaea hilli.* Overlies Cheyenne ss. and underlies Kiowa sh.

Included in Kiowa sh. as Kiowa was originally defined, but in later repts it has been both excluded from and included in Kiowa sh. The U. S. Geol. Survey includes it in Kiowa, as does Kans. Geol. Surv. (See W. H. Twenhofel, Kans. Geol. Surv. Bull. 9, 1924.)

Named for Champion Draw, an arroyo on Medicine Lodge River crossed by A. T. & S. F. Railway at Belvidere, Kiowa Co., a few rods W. of railway station.

†Champlain group.

Cambrian, Ordovician, and probably some Silurian: New York.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. 2d dist., pp. 99–126, 429). *Champlain group* includes all rocks btw. top of Gray ss. that underlies Medina ss. and base of Potsdam ss. Named for Lake Champlain.

†Champlain period (also †Champlain era).

Terms applied by J. D. Dana to part of Pleistocene epoch. See Am. Jour. Sci., 3d, vol. 5, pp. 198–211, 1873, wherein he stated: "The Champlain era, as the term has been used by me, includes all the time from near the beginning of the melting of the glacier, down to that in which these old alluvial or Champlain deposits became terraced in consequence of a general rising of the land, when what I have called the Terrace or Recent epoch began."

†Champlain clays.

A term applied in early geologic repts to the late Pleist. marine clays deposited in New England region after the ice front had retreated northward beyond St. Lawrence River. Has also been called "Lake Champlain clays," "Lawrentian clay," "St. Lawrencian terrane." Also see *Hochelagan fm.* *Champlain* was preoccupied (1842) in same general region when introduced for these clays (about 1867).

†Champlain division.

A term used in some early repts to include Lorraine sh. [Upper Ord.] to †Calciferous sandrock [Lower Ord. and Camb.?], both inclusive.

Champlain.

Name applied to a glacial lake, of Pleist. age, in Lake Champlain region. Also called *Vermont.*

†Champlainian system.

A term that has been applied to Ord. system and also to middle part only of the Ord., that is, to Mohawkian series plus the underlying Chazy.

†Champlainic system.

A term that has been applied by some geologists to Ord. system. For definition see U. S. G. S. Bull. 769, pp. 85, 88–89.

Chanac formation.

Pliocene: Southern California (Tejon Hills, Fresno County).

J. C. Merriam, J. P. Buwalda, and B. L. Clark, 1916 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 10, pp. 111–115). *Chanac fm.*—Mammal-bearing beds, 400 to 600 ft. thick, apparently of terrestrial origin. Consist of angular sands and coarser angular materials; the particles mainly rhyolitic, and display white, yellow, and striking reddish brown colors in exposures; not sharply bedded. Should be termed *fangls.* [Fossils described.] Of early Plio. or latest Mio. age. In southern part of Tejon Hills the Chanac fangls. rest on old crystalline rocks without observed discordance. Exposed along Chanac Creek.

H. W. Hoots, 1929 (U. S. G. S. Bull. 812, pp. 275, 291). *Chanac fm.* is=Tulare, Etchegoin, and Jacalitos fms, but is geographically separated from them.

Chancellor formation.

Cambrian: British Columbia.

C. D. Walcott, 1912 (Smithsonian Misc. Coll., vol. 57, No. 7, p. 230).

Chancellorian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). *Chancellorian series.*—Shales, 1,435 ft. thick, underlying Ottertailian series and overlying Sherbrookian series in Alberta. Of Late Cambric age. Includes Mons fm. [Probably same as Chancellor fm.]

Chanchelulla formation.

Devonian (?): Northwestern California (Klamath Mountains).

N. E. A. Hinds, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, p. 292). *Chanchelulla fm.*—Very thick. At base chiefly thinly and thickly bedded cherts, now recrystallized to qtzite, and subordinate graphitic and micaceous schists, cgl., qtzite, and crystalline ls. At top of fm. the proportion of chert is somewhat less. Is intruded by great numbers of sills and dikes of basic igneous rock now altered to greenstone and greenstone schist. Appears to underlie rocks correlated with Copley meta-andesite, which in turn is uncon. below the Middle Dev. Kennett fm. in Redding quad. Uncon. overlies Abrams and Salmon beds. Name is suggested because of wide exposure on and near Chanchelulla Peak, in NE. corner of Red Bluff quad.

N. E. A. Hinds, 1932 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 11, pp. 375–410) and 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2), described *Chanchelulla sediments*, 5,000± ft. thick, as uncon. overlying Siskiyou terrane (his group name for Salmon and Abrams fms.), as underlying Copley volcanics, and as intruded by *Chanchelulla greenstone* ("intrusive bodies of andesite and andesite porphyry cutting the *Chanchelulla sediments*"). He also called the intrusives *Chanchelulla meta-andesite.*

Chanchelulla greenstone.

Chanchelulla meta-andesite.

Devonian (?): Northwestern California (Klamath Mountains).

N. E. A. Hinds, 1932 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 11, pp. 375–410). [See 1932 entry under *Chanchelulla fm.*]

†Chandler formation.

Pennsylvanian: Central Oklahoma.

C. T. Kirk, 1904 (Okla. Dept. Geol. and Nat. Hist. 3d Bien. Rept., p. 9). The Red Beds interlap with both the Perm. and the Penn. The contact, then, extends through the Red Beds, leaving a large area of these in the Carbf. to E. This embayment of red shales and sss. in the Coal Measures forms an irregular segment reaching 250 mi. in length and 50 ft. in width. This group of rocks has been known provisionally as the *Chandler,* from a town of that name in its midst, but as the area has no independent place in geologic scale, probably the name will not be retained for it. [On pl. 1 of U. S. G. S. W. S. P. 148 certain areas are mapped as *Chandler fm.*, but the fm. is not mentioned in text. Only known description is that quoted above.]

Named for Chandler, Lincoln Co.

Chaney gypsum member (of Blaine gypsum).

Permian: Southwestern Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 41, 55). *Chaney gyp.*—Hard massive gyp., 3 to 5 ft. thick, usually white, but sometimes gray or bluish; often distinctly stratified or apparently cross bedded. Basal gyp. memb. of Greer div. Older than Kiser, Haystack, Cedartop, and Collingsworth gypsums and Mangum dol.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3), provisionally correlated Collingsworth gyp. with Shimer gyp.; Cedartop gyp. with Medicine Lodge gyp.; and Haystack gyp. with Ferguson gyp. members of Blaine fm., but did not assign the Kiser and Chaney gypsums to either the Greer (=Cloud Chief gyp.) or to the Blaine. They are now, however, classified as members of Blaine fm. by U. S. Geol. Survey.

Named for Chaney salt plain, on Elm Fork of Red River, Harmon Co.

Chaneysville sandstone member.

Middle Devonian (Hamilton): Central Pennsylvania (Bedford County).

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, June 1935, p. 361). [See this citation under *Mahantango fm.* Not defined.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, Aug. 31, pp. 1279, 1282, 1283). Near Chaneysville, Bedford Co., Pa., Mahantango fm. is divided into 3 intergrading members (descending): Frame sh. memb., 343 ft.; *Chaneysville ss. memb.*, 182 ft; and Gander Run sh. memb., 850 ft. The Chaneysville is hard, olive-gray, brown-weathering, platy to submassive, fossiliferous ss. Named for the village (which is also spelled Cheneysville). In northern Bedford Co. it is split by a sh. (10 ft. thick at Imler) in the NW., and by a thin ls. in the NE. Possibly represented in Blair Co.

Channahon limestone.

Silurian (early): Northeastern Illinois (Will County).

T. E. Savage, 1910 (Ill. Geol. Surv. Bull. 16, p. 334). *Channahon ls.*—Dark-gray argill. ls., 4 ft. thick, carrying interesting assemblage of fossils, which are more closely related to fauna of Edgewood fm. than to that of any other known fauna. Regarded as representing about same general period of deposition as Edgewood fm. Included in Alexandrian series.

T. E. Savage, 1912 (Ill. Acad. Sci. Trans., vol. 4, pp. 97–103). *Channahon ls.*, 0 to 10 ft. thick, outcrops in S. bank of Des Plaines River 1± mi. SE. of Channahon, Will Co. Small remnants or outliers occur only in Will and Kankakee Counties. Consists of (descending): (1) 1½ ft. of dark-gray to brown, rather fine-grained, impure, fossiliferous ls. in layers 3 to 6 in. thick; (2) 2½ ft. of dark ls., fine-grained matrix embedded with numerous simple corals and other fossils; (3) 5 ft. of fine-grained, yellowish gray, laminated, nonfossiliferous ss., markedly different from overlying ls. Rests on Maquoketa sh. and underlies Essex ls. Assigned to Alexandrian series, of pre-Clinton Sil. age.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 111–112, 351–376; Ill. State Geol. Surv. Bull. 23). Name *Channahon ls. memb.* will be retained for easy reference to the strata seen only along Desplaines River 1 mi. SE. of Channahon, Will Co. This ls. is considered=some part of Edgewood fm., but cannot yet be correlated with any particular part of that fm. because of complete isolation of area from other exposures of Edgewood ls. and slight difference in its fauna from that of typical Edgewood ls. of SE. Mo. and SW. Ill., although fauna is more closely related to that of Edgewood fm. than to any other known fauna. Included in Edgewood fm.

T. E. Savage, 1914 (Am. Jour. Sci., 4th, vol. 38, pp. 28–37). Cyrene ls. memb., basal memb. of Edgewood fm.="Channahon ls. memb." Sedimentation was continuous from bottom of Channahon memb. up to top of brown ls. corresponding to Bowling Green memb. (top memb. of Edgewood fm.).

In his later papers Savage continued to include this ls. in Edgewood fm.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 270–274). *Channahon ls. memb.*, 0 to 20 ft. thick, is probably near middle of Edgewood fm.

Chanute shale. (In Kansas City group, Kansas.)

Chanute shale member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 109). *Chanute shales.*—Shales and sss., with some coal, 100 to 150 ft. thick, underlying Iola ls. and overlying Erie ls.

As thus defined apparently overlies Drum ls., the top div. of †Erie ls. as defined. Subsequent repts defined Chanute as overlying Drum ls. and underlying Iola ls., which was definition later (1915) followed by H. Hinds and F. C. Greene (Mo. Bur. Geol. and Mines vol. 13), although, according to recent repts, the Iola and Drum lss. of Hinds and Greene are not true Iola and true Drum. Hinds and Greene treated Chanute fm. as a memb. of Kansas City fm. (In Kans. the Kansas City is treated as a group and the Chanute sh. as a fm.)

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 43, 51). True Chanute sh. underlies true Iola ls. and overlies Drum ls. The Chanute sh. of Mo. geologists included true Chanute sh., true Drum ls., and underlying Quivira sh., which is top part of Cherryvale sh. of SE. Kans. The Iola ls. of Hinds and Greene is Argentine-Frisbie ls. members of Wyandotte ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 109–111). Chanute sh. as here recognized underlies Iola ls. and overlies Drum ls. Early usage of *Chanute sh.* is somewhat confused because of miscorrelations of lss. above and below. It is clear, however, it was intended to designate the sh. and thin sss. that form plain extending E. from Chanute to the prominent escarpment made by the Bronson lss. The Iola ls. is well exposed in vicinity of Chanute and it can be traced without difficulty to Iola, about 20 mi. to N. †Thayer sh. is synonym of Chanute sh. There is discon. at base of Chanute sh. in part of SE. Kans. and northern Okla., also in vicinity of Chanute, where Drum ls. and underlying sh. are eroded, so that ss. of basal Chanute rests directly on different beds of upper part of Dennis ls., which is uppermost div. [?] of †Erie ls. Thickness of Chanute ranges from 10± ft. near Kansas City to 100± ft. in southern Kans.; av. in NE. Kans. is 25± ft. [On p. 45 Moore shows Chanute sh. of "old classification" as extending from top of Westerville ls. to base of Wyandotte ls.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for development in vicinity of Chanute, Neosho Co., Kans.

Chapala beds.

Pleistocene (?): Mexico.

R. H. Palmer, 1926 (Pan-Am. Geol., vol. 45, p. 127).

Chapapote formation.

Eocene (upper): Mexico (Tampico Embayment).

W. S. Cole, 1927 (Bulls. Am. Pal., vol. 14, No. 51, p. 9).

Chapelton formation.

Eocene (upper): Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 61–65).

Chapin beds. (In Kinderhook group.)

Mississippian: Central northern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 52, 91, 104, 108). *Chapin beds.*—Massive ls., lower part at some localities altered to dol., followed by fine-grained yellow ss. Thickness 20 to 30 ft. Fossiliferous. A fm. of Kinderhook group. Underlies Mayne Creek fm. and overlies Sheffield sh. Named for exposures in small abandoned quarry 1 mi. W. of Chapin, Franklin Co. [where, according to Laudon, 1931, only the upper oolitic beds are exposed].

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 388–396). *Chapin memb. of Hampton fm.* (basal memb. of the Hampton in north-central Iowa) consists (above) of 8 ft. of oolitic ls. grading into dark-brown sugary dol., very fossiliferous; and below of 24 ft. of thin-bedded hard gray ls. containing *Productus ovatus.* The fossiliferous brown dol. (7 ft. thick) that is found in upper part of Chapin memb. as described by Van Tuyl is here placed in base of *Maynes Creek memb.* of Hampton fm. for these reasons: Lithologically and faunally it is almost identical with overlying Maynes Creek memb.; it carries typical Wassonville fauna that marks base of Wassonville memb. of Hampton fm. in SE. Iowa province, which is also a dol. filled with fossiliferous chert; the oolitic ls. memb. that underlies it is faunally and lithologically like the oolitic ls. that caps top of North Hill memb. in SE. Iowa province; the gray ls. that forms base of the memb. corresponds to lower part of North Hill memb. of SE. province; it is a natural break btw. hard gray lss. beneath and brown chert-filled dol. above. This makes possible a correlation of memb. with memb. The oolitic ls. then is considered top of Chapin memb. It is locally dolomitized but is always easily separable from overlying cherty dol. The *Maynes Creek memb,* as here defined consists above of 37 ft. of brown, hard, slabby ls. and dol. interbedded with much very fossiliferous chert, and below of 7 ft. of very fossiliferous massive soft brown dol.

L. R. Laudon (1935) stated these beds should be removed from Hampton fm. See 1935 entry under *Hampton fm.*

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245), correlated Chapin ls. with Chouteau ls. of Kinderhook group.

Chapman dolomite.

Permian: Central Oklahoma (Blaine County).

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 353, 358). *Chapman dol.*—Large body of light-gray laminated dolomites composing upper memb. of Dog Creek fm. in central Okla., where lower part of the Dog Creek consists chiefly of dull red shales with laminae of dol. and one lamina-built amphitheater ledge of dol., called Amphitheater dol. Underlies Red Bluff fm. [Whitehorse ss.].

C. N. Gould, 1927 (Obsolete Okla. geol. names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, pp. 235–238). Chapman dol. of Cragin (1897) was never in common use.

Named for Chapman's amphitheater, at head of Salt Creek, Blaine Co.

Chapman sandstone.

Lower Devonian (Helderberg): Northeastern Maine (Aroostook County).

H. S. Williams, 1899 (Am. Jour. Sci., 4th, vol. 8, p. 360, footnote). The ss. at Edmund's Hill contains an Eodevonian fauna which corresponds closely with that of Gaspé ss. I have given it the name of *Chapman ss.* Is older than Mapleton ss.

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 78–88). *Chapman ss.*—Mainly thick-bedded sss., some shaly layers. Thickness 500+ ft. Fauna seems to correspond closely with Lower Oriskany of N. Y. as recognized at Becraft, and indicates the fm. is older than Mapleton and Moose River sss. and younger than Square Lake ls. Type loc. along E. bank of south branch of Presque Isle Brook, about 1 mi. from S. line of Chapman Twp, and about 1 mi. W. of Tweedy on road running SW. from Presque Isle.

H. S. Williams and C. L. Breger in 1916 (U. S. G. S. P. P. 89) assigned this fm. to late Helderbergian time.

†Chapman trachyte.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 109, 110, 162–163). *Chapman trachyte.*—Trachyte occurring in NW. corner of Chapman Twp, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the trachyte of this region is assigned to Dev.

Chapman Ranch formation.

Lower Ordovician: Central southern Oklahoma (Murray County).

See under *McKenzie Hill ls.*, also 1933 entry under *Arbuckle group*, Decker, 1933.

Chappel formation.

Mississippian: Central Texas (Llano region).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 91–92, 96). A thin ls. of Boone or Osage age here named *Chappell fm.* Known max. thickness in surface exposures only a few ft. Underground to N. and W. of Llano uplift it is absent or ranges in thickness up to 150 ft. Is hard, medium dark, abounds in crinoid fragments. Rests discon. on Ellenburger (Ord.) ls. and discon. underlies Barnett (Miss.) fm. Lowermost part contains, according to Goldman, as inclusions, small pelletts of Ellenburger ls. Type loc. is 3 mi. SE. of San Saba. [Geographic feature not mentioned, but there is a village called Chappel SE. of San Saba.]

Chaquaqua shale.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 3, 6). *Chaquaqua shales.*—Alternating red sss. and shales, 150 ft. thick, finely exposed in Chaquaqua Canyon, in NE. N. Mex. Uncon. underlie Comanchean and overlie Travester shales. Included in Morrisonian series [Upper Jurassic].

Chaquaqua member.

Triassic (?): Southeastern Colorado (Las Animas, Otero, and Bent Counties).

J. T. Duce, 1924 (Colo. Geol. Surv. Bull. 27, pt. 3, pp. 81–82). A series of brick red sandy shales and crinkled purplish limy sss., forming lower memb. of Lykins fm. in this area. Thickness exposed 122 ft., consisting of (descending): 2 ft. of maroon shales; 21 ft. of massive dark red ss.; 5 ft. of maroon sh.; 36 ft. of brick red sandy sh.; 18 ft. of purplish, limy, crinkled ss.; 30 ft. of brick red ss.; and 10 ft. of purplish limy ss. Underlies Red Canyon memb. of Lykins fm. and is oldest rock exposed in area.

Named for exposures in Chaquaqua Canyon, Las Animas Co.

Chardon sandstone.

Mississippian: Northeastern Ohio.

C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 219, 229). *Chardon ss.*—Thin-bedded shaly ss., 7′ 8″ to 9⅔ ft. thick, in middle part of Orangeville fm. in Lake and Geauga Counties. Underlies Brecksville sh. and separated from underlying Berea ss. by 29 ft. of sh. forming lower part of Orangeville fm. [This sh. is now called *Sunbury sh.*] Latter sh. interval is twice or three times as thick as sh. btw. Berea ss. and Aurora ss. of Cleveland region, hence correlation with Aurora is doubtful.

Named for Chardon Twp, Geauga Co.

Charette limestone.

See under *Charrette ls.*, the correct spelling.

Chariton conglomerate member (of Pleasanton formation).

Pennsylvanian: Southeastern Iowa and northern Missouri.

H. F. Bain, 1896 (Iowa Geol. Surv. vol. 5, pp. 394–398). *Chariton cgl.*—Coarse and fine cgl., 14 or more ft. thick, at top of Des Moines stage in Appanoose Co., Iowa. Overlies Appanoose beds and underlies glacial drift. Named for exposures along Chariton River near mouth of Snort Creek, Appanoose Co., Iowa, where it consists of (descending) coarse cgl., 2 ft.; fine cgl., 10 ft.; coarse cgl., 2 ft. The matrix is reddish ferruginous ss.

J. H. Lees, 1909 (Iowa Geol. Surv. vol. 19, pp. 598–604), stated that Chariton cgl. lies 30 to 118½ ft. below top of Appanoose fm. in Iowa. (See under *Appanoose fm.*)

†Charles limestone.

An abbreviated form of *St. Charles ls.* (of Utah) employed by C. [R.] Keyes.

Charleston sandstone.

Pennsylvanian: West Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 508). *Charleston ss.*—Coals and sediments, latter usually coarse, overlying Kanawha black flint, and extending upward to the red shales [*"Pittsburgh Reds"?*] are all exposed in bluffs back of Charleston. The sss. are usually feldspathic and friable; the beds are frequently conglomeratic, but the pebble-bearing horizons vary greatly in different parts of field. Thickness 320 to 420 ft. Overlies Kanawha fm.

Includes Allegheny fm. and lower part of Conemaugh fm.

Named for exposures at Charleston.

Charlestown moraine.

Pleistocene (Wisconsin stage): Rhode Island (Narragansett Bay region).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, table opp. p. 988).

Named for occurrence at Charlestown, Washington Co.

Charleton formation.

Ordovician: Anticosti Island.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 695, 697).

Charlevoix stage.

Middle Devonian: Northwestern Michigan (Traverse Bay region).

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14, pp. 2–25). *Traverse group* of northern counties (Traverse Bay region) of Lower Peninsula is here divided into (descending): (1) *Petoskey fm.*, 13 to 100 ft.; (2) uncon. and overlap; (3) *Charlevoix stage*, 13 to 28 ft.; (4) erosion uncon.; (5) *Gravel Point stage*, 35 to 120 ft.; and (6) *"Bell sh.,"* 40 to 100 ft. in wells. The physical evidence for separation of Gravel Point and Charlevoix beds has not been sufficiently studied to warrant establishment of formational rank of these faunally distinct stages. [Details of beds and faunal zones given.] The *Charlevoix stage* is characterized by fragmental deposition throughout, frequent occurrence of bituminously laminar beds, presence of a coarse calc. oolite near middle, and recurrence of fine-grained beds at top. [Appears to be named for Charlevoix Co., although he says Gravel Point stage is exposed 1½ mi. W. of town of Charlevoix.] The *Gravel Point stage* comprises oldest known Middle Dev. strata in W. part of Lower Peninsula. It is exposed in a series of undulating ledges and low bluffs at water level on and S. of Gravel Point, 1½ mi. W. of Charlevoix. Is basal div. of Traverse group in Mich. Consists of 0 to 11 ft. of blue sh. underlain by lss. with some thin shaly beds. [Pohl recognized "Bell sh." in wells beneath his Gravel Point stage.]

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 19–64), correlated the subdivisions of *Traverse group* as follows (descending): Thunder Bay series = Petoskey fm.; Alpena ls. = Charlevoix stage; Long Lake series and underlying "Bell sh." = Gravel Point stage.

Charlotte morainic system.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Charlotte, Eaton Co.

Charlton formation.

Tertiary? (Pliocene ?): Southeastern Georgia and extreme northeastern Florida.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 60, 392–400). *Charlton fm.*—Soft, white, argill. ls. and laminated, fossiliferous, greenish clay, exposed in banks and bluffs of St. Marys River, from Stokes Ferry, 11 mi. S. of St. George, Charlton Co., Ga., to Orange Bluff, near Kings Ferry, Fla. From studies of fossils Dr. Vaughan has classified the fm. as probably Plio. Older than Okefenokee and Satilla fms. (Pleist.). Thickness undet.; only 12 or 15 ft. seen in natural exposures. [The fm. as mapped in this rept and in U. S. G. S. W. S. P. 341, 1915, extends along St. Marys River from south-central part of Camden Co. to Fla. line in extreme SE. part of Charlton Co., Ga.]

Named for development in Charlton Co., Ga.

Charlton group.

Pre-Cambrian: Canada (Northwest Territories).

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 382).

Charrette limestone.

Middle Ordovician: Eastern Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Rept. 1855–71, pp. 49–50). *Charette ls.*—Upper part, 4 inches to 26 ft. of fossiliferous whitish or light-gray coarse ls. (the Receptaculite ls. of Shumard); lower part, 1 to 8 ft. of fossiliferous red or brownish gray to dark reddish brown ls. Underlies Upper Sil. Crinoidal ls. and overlies Middle Trenton ls. Included in Trenton ls. of Warren Co.

J. H. Bradley, Jr., 1925 (Jour. Geol. vol. 33, p. 49). While Ulrich was first to demonstrate unity of Kimmswick ls. on faunal and lithologic basis, and his term has been generally accepted, it should be mentioned Broadhead recognized lithological uniqueness of this pure, light-colored crystalline ls. and called it *Charette ls.*, from exposures in Warren Co., where it is 34 ft. thick and thins rapidly to W., being absent a short distance W. of E. bdy of Callaway Co. Faunal and strat. relations can best be studied at Ulrich's type loc., in Jefferson Co.

J. Bridge, 1930 (personal communication), stated that this ls. probably represents Kimmswick ls. as now restricted.

Named for *Charrette*, Warren Co.

Chartresan series.

A term proposed by C. [R.] Keyes to include the Mississippian rocks which he designates as (descending) Kaskaskia, Aux Vases, [Ste.] Genevieve, and [St.] Louis. He, however, would restrict Miss. to the pre-St. Louis and post-Kinderhook part of the Miss. of other geologists. The name is derived "from old French Fort Chartres, which once occupied a spot near mouth of Kaskaskia River just above the present hamlet of Chester," Ill. (See Pan-Am. Geol., vol. 60, No. 1, pp. 45, 49, 1933.)

Chase group.

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 771–786). *Chase fm.*—Massive lss. and flints separated by vari-colored shales; 265 ft. thick. Overlies Neosho fm. and underlies Marion fm.

Adopted as group term, to include the following fms. (descending): Winfield ls., Doyle sh., Fort Riley ls., Florence flint, Matfield sh., and Wreford ls. This definition has been followed for many years by both Kans. Geol. Surv. and U. S. Geol. Survey. In Sept. 1936, however, R. C. Moore (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12) shifted the upper bdy to top of Luta ls., which he treated as top memb. of Winfield ls. This change has not yet been considered by U. S. Geol. Survey for its publications.

Named for Chase Co., Kans.

Chase quartzite member. (In Shuswap series.)

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 123).

†Chatham series.

Upper Triassic: North Carolina (Chatham County).

E. Emmons, 1857 (American Geology, pp. iv, v, vi, 19), applied *Chatham series* to the rocks of Chatham Co., N. C., now known as *Newark group* (Redfield, 1856).

Chatham granite.

Late Devonian or late Carboniferous: Northern New Hampshire (North Conway quadrangle, White Mountains).

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, map, p. 82, etc.). *Chatham granite.*—Coarse nonporphyritic two-mica granite, which often intrudes Montalban group in lit-par-lit fashion. Covers many sq. mi. in Chatham Twp

[North Conway quad.]. Assigned to pre-Camb. (?); may be early Paleozoic. For a fine-grained and somewhat younger phase of Chatham granite, which intrudes the injection gneisses, I propose the term *Randolph granite.*

L. Kingsley, 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 139–167), assigned this granite to pre-Camb (?). "Is definitely older than extrusive and intrusive rocks of White Mtns batholith."

W. F. Jenks, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 321–340). *Chatham granite* completely surrounds Pleasant Mtn, Fryeburg quad., Maine. Is coarse-grained granite and granodiorite. Believed to be same as Billings's Chatham group of intrusives of N. H., which it may be said broadly are post-Dev. and probably pre-Mesozoic.

On 1933 geol. map of Maine, by A. Keith, the granites of Fryeburg region are mapped as Carbf. On 1932 geol. map of U. S. the granites in Chatham region are mapped as pre-Camb., but Billings (also Jenks) now regards them as late Paleozoic.

M. Billings, 1935 (letter dated Aug. 27). *Chatham granite* belongs to New Hampshire magma series [which he classifies as late Dev. or late Carbf.].

Chatooga zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C. advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 7, 12). The *Chatooga zone* (*Archean*) comprises narrow parallel belts of Carolina gneiss series and of Table Rock granite, and thick bands of Roan gneiss series. It includes the narrow belt btw. Chatooga River and a line extending southwesterly from a point on N. C. line about half way btw. Toxaway and Whitewater Rivers, to Tugaloo River slightly above its confluence with Brasstown Creek. The northwesterly belt of this zone exhibits a granite similar to Table Rock granite of Saluda zone, which is slightly schistose in structure, but granitic in texture, the color being a "pepper and salt" gray. The southeasterly belt, which sharply abuts the ls. series (Chauga zone), consists of highly schistose gneissoids, granites, mica schists, etc., of Carolina gneiss series; it includes pegmatites, peridotites, etc. Thin lines of Roan gneiss (hornblende series) are observed in this area. This zone is essentially Archean.

Named for exposures on Chatooga River, on NW. bdy of Oconee Co.

Chatsworth morainic system.

Pleistocene (Wisconsin stage): Northeastern Illinois. See F. Leverett, 1899 (U. S. G. S. Mon. 38, p. 259). Named for Chatsworth, Livingston Co. Now said to be same as Farm Ridge moraine.

†Chattahoochee.

Eocene (lower): Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, map of Ala.). [On this map the name *Chattahoochee* is listed in a table of geol. fms. of the State, without other definition than that it underlies Black Bluff [Sucarnoochee clay], overlies the Ripley, and includes *Midway and Fort Gaines.* As thus defined the name corresponds to Clayton fm., basal fm. of Eocene and of Midway group. Type loc. not stated and the geol. fms. are not mapped.]

†Chattahoochee formation.

Miocene (lower): Georgia (extreme southern part) and Florida.

D. W. Langdon, Jr., 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 322–324). *Chattahoochee group.*—Southward from Rock Island, 9 mi. by water, above Chattahoochee or River Junction, Fla., the white orbitoidal ls. disappears, and in lieu thereof there is a rock more argill. and siliceous in character resembling some phases of Eocene Buhrstone. This ls. is very well developed in a railroad cut about ½ mi. E. of Chattahoochee River, Ocheesee, 15 mi. below railroad bridge, and again at Rock Bluff, 2 mi. below Ocheesee section at Ocheesee, Fla.

1. Argill. ls., greenish yellow. No fossils seen. 10 ft.
2. A purer, more granular ls., creamy white and soft, resembling "chimney rock" phase [Marianna ls.] of Vicksburg group. Contains few obscure corals to water's edge, 5 ft.

Rock Bluff, about 30 ft. high, is made up of strata of ls. varying in purity, as at Ocheesee. For this older memb. of Miocene or newest memb. of Eocene White ls., writer suggests provisional name *Chattahoochee group*. Only fossils found were a large Pecten about 3 inches by 3½ inches and an oyster resembling very closely our *Ostrea virginica*. This group, estimated to be 250 ft. thick, differs materially in lithologic characteristics from any phase of White ls. yet observed in Ala. or Miss. On the rich black loam, derived from disintegration of these slightly phosphatic lss., the unique *Torreia taxifolia* or "Stinking Cedar" is found growing.

D. W. Langdon, Jr., 1891 (Ga. Geol. Surv. 1st Rept. Prog., p. 97). *Chattahoochee series*.—Argill. and sandy ls. alternating with strata of purer character. Contains a Pecten and an Ostrea very close to our recent Virginica. This may be termed *Chattahoochee group*, as it is well developed there and along E. river bank for next 10 mi. Thickness 25 [250] ft. Underlies Alum Bluff series and overlies White ls. series. [Same description is given by Langdon in Geol. Soc. Am. Bull., vol. 2, pp. 604, 605, 1891, except Chattahoochee *ls.* is used instead of *series* or *group*, and on p. 604 the thickness is stated to be 25 ft., but on p. 605 it is given as 250 ft.]

G. C. Matson and F. G. Clapp, 1913 (Fla. Geol. Surv. 2d Ann. Rept.). *Chattahoochee fm.*—Lss., marls, and some chert, 100 to 250 ft. thick, underlying Alum Bluff fm. [group] in western Fla. and uncon. overlying Vicksburg group. Considered contemp. with Tampa fm. of southern Fla.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *"Chattahoochee fm."* abandoned, because it seems to be of same age as Tampa ls., and in spite of fact that it contains more impurities than typical Tampa ls. and might by some people be regarded as a distinct facies worthy of a separate name. If future studies of faunas bring to light unsuspected differences in age, "Chattahoochee" can be restored to formational rank.

Named for exposures along Chattahoochee River, especially at Chattahoochee Landing, Gadsden Co., Fla.

†Chattahoochee bed proper.

Miocene (lower): Southwestern Georgia and adjacent parts of Florida.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 41–54). *Chattahoochee bed proper*.—Main element is peculiar gray or white ls. tinged with yellow; a soft friable rock well exposed at Old Chattahoochee Landing. Thickness 100 ft. The middle and major part of Chattahoochee series. Underlies Griffin bed.

According to C. W. Cooke this name as used by Foerste applied to Tampa ls. (†Chattahoochee fm.) of present usage.

Named for exposures at Old Chattahoochee Landing, Gadsden Co., Fla.

Chattanooga shale.

Devonian (also Devonian? and Devonian or Carboniferous; see explanation beyond): Tennessee; eastern Kentucky south of Somerset, Pulaski Co.; northwestern Georgia; northern Alabama; northeastern Mississippi; western Kentucky; Illinois; Missouri; Arkansas; and Oklahoma.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 143). *Chattanooga black sh.*, of Dev. age, 0 to 35 ft. thick. Equiv. to Black sh. of Smith and Safford. In NW. Ga. underlies Fort Payne chert (Carbf.) and overlies Rockwood fm. (Sil.).

Named for Chattanooga, Tenn., which is situated on the belt of sh. mapped by Safford as "Black sh.," a non-geographic term, which *Chattanooga* was intended to replace, and which, as defined by Safford, occupied interval btw. †Siliceous group [Fort Payne chert and Grainger sh.] and Helderberg ls.

The age of this black sh., which occurs at approx. the same horizon in several States, has been under discussion for a long time. For many years it was classified as Dev., and it is still so regarded by many geologists, but some geologists and paleontologists now consider it to be in part at least of Miss. age, while others regard its deposits, especially at type loc., where thickness is only 15 ft., as wholly Miss. In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29) E. O. Ulrich assigned the black Chattanooga sh. of Miss. Valley, Tenn., Allegheny Front, Appalachian Valley, and Ozark uplift to his post-Dev. Waverlyan system, although he stated (pl. 28) that Middle and Upper Dev. were partly represented in Chattanooga and Grainger fms. of NE. Tenn., but were absent in Ala. and western Tenn. Since that time a voluminous literature on the age of this black sh. has appeared, as a result of which the U. S. Geol. Survey at present classifies the Chattanooga sh. of different areas as follows:

Typical Chattanooga sh. of southern Tenn. and adjacent parts of Ala., Ga., and Ky.: *Dev. or Carbf.* In most of this region the sh. underlies Fort Payne chert (Miss.) and overlies Red Mtn fm. (Sil.), except locally in Ala. and Ga., where it rests uncon. on Frog Mtn ss. (Middle Dev).

Chattanooga sh. of western Tenn. and Ky., southern Ill., and Mo.: *Dev. or Carbf.*

Chattanooga sh. of Batesville dist., Ark., has yielded Genesee fossils near base and Portage (?) fossils, and is classified as *Upper Dev.* Elsewhere in northern Ark. and in Okla. the sh. has not yielded fossils and is classified as *Dev. (?)*.

In SW. Va. the sh. formerly called Chattanooga sh. is now divided into 3 fms. (descending): Big Stone Gap sh. (*Dev. and Carbf.*), Portage sh. (*Upper Dev.*), and Genesee sh. (*Upper Dev.*).

For the names by which this black sh. is now known in other States, see under †*Black sh.*

Chattanoogan series.

A time term employed by some geologists to cover the epoch during which Chattanooga sh. and its assumed equivalents were deposited. See E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29); C. Schuchert, 1924 (Textbook geol., p. 335).

Chatte River limestones.

Silurian: Canada.

H. M. Ami, 1900 (Roy Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 204).

Chauga zone.

Cambrian (?): Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 6, 10, 12). *Chauga zone (Cambrian?)*.—Comprises a narrow band bounded on NW. by Chatooga zone; and on SE. by a line extending from near point where Toxaway River enters S. C. to Tugaloo River, slightly below its confluence with Brasstown Creek. Fine-grained dark shimmering quartz schist, mica schists, graphite slates, ls., etc. This group probably corresponds to Keith's "Brevard Schist," assigned to Camb.

Named for exposures along upper half of Chauga River, Oconee Co.

Chaumont formation. (In Black River group.)

Middle Ordovician: New York.

G. M. Kay, 1929 (Jour. Geol., vol. 37, No. 7, pp. 664–671; and A. A. P. G. Bull., vol. 13, No. 9, p. 1214). *Chaumont fm.*—Includes (descending) Watertown ls., Glenburnie ls. (in Ontario), and Leray ls. Overlies Lowville [excluding Leray memb.] and underlies Trenton group. Named for Chaumont Bay, Lake Ontario [Jefferson Co., N. Y.], in vicinity of which the members are well exposed.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), apparently does not mention this name, as it is not listed in index or tables.

†Chautauqua sandstone.

Pennsylvanian: Southeastern Kansas.

G. I. Adams and E. Haworth, 1898 (Univ. Geol. Surv. Kans., vol. 3, pp. 57–60). The wide zone through which Lawrence shales are exposed, being from 15 to 25 mi. wide S. of Neosho River, is an exceedingly sandy and hilly country. The sss. alternating with the softer shales have produced by erosion an irregular topography difficult to describe and unequaled in general irregularity anywhere in state. From Burlington and Neosho Falls to SW. by way of Yates Center, Benedict, New Albany, Buxton, Colfax, Sedan, Peru, and Chautauqua, this ss. and the corresponding irregular surface occupy the whole country. Doctor Adams has suggested that the ss. here is sufficiently prominent to merit a distinct local designation, and has proposed for it the name *Chautauqua ss.* The following description of the area is taken from his notebook: Passing S. from Neosho River the shales grade into sss., so that at Yates Center they become conspicuous, producing the hill on which town is built. The area broadens to S., its eastern border passing W. of Buffalo, Fredonia, and Tyro, while its western border runs approx. from Yates Center to Toronto, Fall River, Elk Falls, Sedan and Elgin. To this region the name *Chautauqua Sandstone Hills* may be here given. The name is already employed somewhat in common usage. These ss. hills are as characteristic a feature of SE. Kans. as are the Flint Hills.

Is a sandy development of Lawrence sh.

Named for Chautauqua Sandstone Hills, which extend through parts of Chautauqua, Woodson, Wilson, Montgomery, Greenwood and Elk Counties.

†Chautauqua conglomerate.

A name applied in some early repts to Olean cgl. of Chautauqua Co., N. Y. (See first entry under *Olean cgl.*)

Chautauquan group.

Upper Devonian: New York.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Chautauquan period or group* includes Chemung beds and Catskill ss., local facies. Named for exposures in Chautauqua Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), followed above definition.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), included in *Chautauquan* at top the lower part only of the Catskill, and at base certain beds (Dunkirk sh., Gowanda sh., Laona ss., etc.) that had previously been included in the Senecan and in Portage group of western N. Y. In 1924 (N. Y. State Mus. Bull. 251, pp. 149–157) Chadwick again employed his modified definitions of Senecan and of Portage group. His charts show that the beds he transferred to Chautauquan (and to the Chemung) he correlates with Cayuta sh. and Wellsburg ss. members of Chemung of central N. Y.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Chautauquan* of western N. Y. includes Chadakoin beds at top and Dunkirk sh. at base.

Chaves shale.

Permian: Southeastern New Mexico (Guadalupe Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 258; Conspectus of geol. fms. of N. Mex., pp. 3, 6). *Chaves shales.*—Lowermost section of red shales, 425 ft. thick, which rest on the great Capitan lss. in Guadalupe Mtns, N. Mex. [Derivation of name not given. See also Pan-Am. Geol., vol. 65, No. 1, Feb. 1936, pp. 42, 46, 49.]

Chazy group (**limestone** where not divided).

Lower Ordovician: Eastern New York (Champlain Valley).

E. Emmons, 1842 (Geol. N. Y. pt. 2, div. 4, geol. 2d dist., pp. 107, 315, 429). *Chazy ls.*—Dark, irregular, thick-bedded ls., 130 ft. thick in second dist. of N. Y. [On another page he gives thickness of 150 ft. for Clinton Co.] At Chazy [Clinton Co.] it contains many rough, irregular flinty or cherty masses. Underlies Birdseye [Lowville] ls. and overlies Calciferous sandrock [Beekmantown group].

In 1888 (Am. Geol., vol. 2, pp. 323–330) E. Brainerd and H. M. Seely divided typical Chazy into 3 divisions (descending): Group C, 157 ft., characterized by *Rhynchonella;* group B, 265 ft., characterized by *Maclurea magna;* and group A, 310 ft., which was included in "Calciferous" [Beekmantown] by Emmons. In 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, pp. 503–574) H. P. Cushing stated that *Chazy ls.* is 740 ft. thick at Chazy, where lower 100 ft. is lacking, and 890 ft. thick on Valcour Island, which affords most complete section. In 1905 (N. Y. State Mus. Bull. 95) Cushing applied *Valcour ls.* to group C of Brainerd and Seely, *Crown Point ls.* to group B, and *Day Point ls.* to group A. In 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 155 +) Cushing applied *Pamelia ls.* to beds of Chazy age in Theresa and Alexandria Bay quads., Jefferson Co., 40 to 140 ft. thick, which he stated appear to occupy strat. position btw. Valcour ls. and Crown Point ls., but which rest uncon. on Camb. Theresa fm. and are uncon. overlain by Lowville ls. Later (N. Y. State Mus. Bull. 145, 1910) Cushing applied *Pamelia* (*Stones River*) *ls.* to these beds, and stated that the Stones River is of Chazy age but laid down in separate basin.

The Chazy group of N. Y. has for many years been divided into (descending) Valcour ls., Pamelia ls., Crown Point ls., and Day Point ls. The Pamelia does not occur in same section with the other lss., but is overlain by Lowville ls. and rests on Theresa fm. or on Tribes Hill ls., and there has, in recent years, arisen doubt in minds of some geologists whether it may not be of Middle Ord. (Black River) age. (See under *Pamelia ls.*). At present the U. S. Geol. Survey classifies Pamelia as Lower Ord.

Chazyan.

A time term proposed by A. W. Grabau, 1909 (Jour. Geol., vol. 17, pp. 209–252), to include Chazy ls. (Lower Ord.) and Black River group (Middle Ord.). E. O. Ulrich, 1911 (Geol. Soc. Am. Bull. vol. 22), included in his Chazyan only the rocks btw. base of Lowville ls. and top of Beekmantown group, which is commonly accepted usage of the term.

Cheaha sandstone member (of Talladega slate).

Probably Paleozoic: Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 54, 58). *Cheaha ss. memb. of Talladega sl.*—Chiefly thin-bedded rather soft ss., with occasional layers of purplish phyllite; basal 200 ft. is coarse quartz cgl. Lies in middle of Talladega sl. and higher than Brewer phyllite memb. No fossils. Is probably Paleozoic and pre-Dev.

Named from fact that Cheaha Mtn, Clay Co., is formed by the ss.

Cheboygan moraine.

Pleistocene (Wisconsin stage): Northern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Belongs to Port Huron morainic system. Named for Cheboygan.

Checkerboard limestone member (of Coffeyville formation).

Pennsylvanian: Northeastern and central Oklahoma.

L. L. Hutchison, 1911 (Okla. Geol. Surv. Bull. 2, pp. 151–164). Lenapah ls. is same fm. that is known as "Checkerboard ls." in region of Glenn pool.

L. C. Snider, 1913 (Petroleum and nat. gas in Okla., pp. 44–49). *Checkerboard ls.* is probably 100 ft. above Lenapah ls.

A. E. Fath, 1917 (Okla. Geol. Surv. Bull. 19, pt. 2, pp. 369–372). The ls., 2 ft. thick, locally known as *Checkerboard lime,* outcrops in creek bed at old "Checkerboard Crossing" near E-W.¼ line of sec. 22, T. 15 N., R. 11 E.

D. W. Ohern, 1918 (A. A. P. G. Bull., vol. 2, p. 122). *Checkerboard ls.* lies about 70 ft. above Lenapah ls.

R. W. Clark and C. M. Bauer, 1921 (A. A. P. G. Bull., vol. 5, pp. 282–292). *Checkerboard lime* is a hard blue ls., 4 ft. in average thickness, which contains peculiar semicircular markings caused by presence of fossil brachiopods. Weathered surface usually of light cream or very light yellow color. Breaks into blocks, nearly cubical and 4± ft. on each side. Remarkable for persistent character, such as thickness, color, resistance to weathering, peculiar fossil markings, jointing, etc. Has been mapped for a distance of 20 mi. Can be traced from Deep Fork in sec. 19, T. 14 N., R. 11 E., through Mounds and Jenks, over Turkey Mtn and into Tulsa, but can not be followed continuously SW. from Deep Fork. Lies 100 to 120 ft. above Seminole cgl.

A. W. McCoy, 1921 (A. A. P. G. Bull., vol. 5, No. 5, pp. 541–550). According to general strat. relation of *Checkerboard ls.* to Lenapah ls. of Okla., as described by Ohern, the Checkerboard ls. has been tentatively regarded as = base of Kansas City fm. or the Hertha ls.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 72). *Checkerboard ls. memb. of Coffeyville fm.* lies near base of that fm. It is 2½ to 3 ft. thick, fine-grained, fossiliferous, bluish white on fresh surfaces but weathers yellowish white. In bare areas it presents a "checkerboard" appearance, due to solution channels along joints, which occur in two sets, the one crossing the other. From this feature the ls. was for years known as "Checkerboard lime," but the geographic loc. which is here designated as its type loc. is the exposures on Checkerboard Creek in T. 15 N., R. 11 E. A good exposure may be seen at "Checkerboard Crossing" of the creek, near E.-W. quarter line of sec. 22, T. 15 N., R. 11 E.

Chediski white sandstone member (of Troy quartzite).

Cambrian(?): Central eastern Arizona (Fort Apache Indian Reservation).

E. F. Burchard, 1931 (U. S. G. S. Bull. 821C). *Chediski white ss. memb. of Troy qtzite.*—White ss., fine to medium grain, with white sericitic interstitial cement. Thickness 50 to 100 ft. Basal memb. of Troy qtzite. Rests on banded chert, ferruginous in places, which forms top memb. of Mescal ls. Forms cliff on NE. face of Chediski Mtn, and is conspicuous for many miles.

Chegoggin Point formation.

Age (?): Nova Scotia.

E. R. Faribault, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. F, p. 15).

Chehalis sandstone.

Eocene: Southwestern Washington.

A. C. Lawson, 1894 (Am. Geol., vol. 13, pp. 436–437). *Chehalis ss.*—Soft, friable sss., generally clayey, bluish gray to yellowish, with thick beds of lignite associated with them in vicinity of Chehalis. It is very probable that the sss. in which the fossils occur and those in which the lignites occur are part of same geological series. Marine fossils in a portion of the sss. at Chehalis, which T. W. Stanton says are either Eocene or Mio. and correlatable with nonmarine Puget group.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 566, 567). *Chehalis fm.*—Ss. and shaly ss. Upper beds marine; lowest beds probably fresh water. Redefinition of Lawson's name Chehalis ss. Underlies Olequa fm. The Chehalis and Olequa are of Tejon Eocene age and belong to zone of *Venericardia horni* Gabb. The Chehalis fm. of Weaver 1912 is Mio. Broadly speaking Puget group is=Tejon.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 225–242). Chehalis may be younger than Olequa fm. [See 1925 entry under *Olequa fm.*]

Chehalis formation.

Miocene (lower): Southwestern Washington.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). *Chehalis fm.*—Sandy shales and shaly sss., the former predominating. Gray to brownish. Thickness 7,000 ft. Uncon. underlies Montesano fm. (Upper Mio.) and rests uncon. on Blakeley fm. (Lower Mio.). Part of fauna ranges down into Blakeley and part ranges up into Upper Mio. Named for Chehalis River, in Chehalis [Grays Harbor Co.].

Chelan physiographic stage.

Pleistocene: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. P. 19). Type loc., gorge of Lake Chelan and terraces of Columbia River. Latest glacial epoch.

Chelan granodiorite.

Late Jurassic(?): Central Washington (Entiat Mountains).

A. C. Waters, 1932 (Jour. Geol., vol. 40, No. 7, p. 605). Presumably in late Jurassic the Entiat Mtns were invaded by an enormous batholith of basic granodiorite. The confines of batholith have never been mapped but it is known to extend over an area of more than 800 sq. mi. It is here called *Chelan granodiorite,* from Chelan Mtns, where it is typically exposed. Assigned to late Jurassic (?).

†Chelly sandstones.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, p. 250). Sss., 125 ft. thick, uncon. underlying Shinarump cgls. and overlying Adamana shales. Topmost fm. of Moenkopian series and Carbonic system in Ariz.

Probably an abbreviated form of *De Chelly ss.*

Chelmsford sandstone.

Pre-Cambrian (upper Huronian): Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept., vol. 14, pt. 3).

Chelsea sandstone lentil (of Cherokee formation).

Pennsylvanian: Northeastern Oklahoma (Rogers County).

This name was first used by D. W. Ohern in unpublished ms. on Nowata and Vinita quads.

G. C. Clark and C. L. Cooper, 1927 (Okla. Geol. Surv. Bull. 40H, fig. 3). [Show Welch coal as in interval btw. Fort Scott coal and *Chelsea ss. lentil,* and as lying 60± ft. below Fort Scott coal, and show Cherokee coal as in interval btw. Chelsea ss. and Bluejacket ss., and as lying 100± ft. below Chelsea ss. The Chelsea ss. is shown as 250± ft. below Fort Scott coal (top of Cherokee sh.) and as 200± ft. above Bluejacket ss.]

C. D. Smith, 1928 (Okla. Geol. Surv. Bull. 40U, map). [*Chelsea ss.* mapped in upper part of Cherokee fm. Lies lower than Verdigris ls. and higher than Bluejacket ss.]

C. L. Cooper, 1928 (Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 7, p. 161). The *Chelsea ss.* lies 200± ft. above Bluejacket ss. It forms a prominent escarpment from upper branches of Whiteoak Creek, thence S. and W. to Chelsea.

Cheltenham fire clay.

Economic term for a persistent bed of fire clay in basal part of Penn. deposits in St. Louis Co., Mo. Named for development at Cheltenham, St. Louis Co. The name has also been applied to a clay in basal part of Pottsville fm. of SW. and central western Ill., that is supposed to be the same as Cheltenham clay of Mo. (See E. F. Lines, Ill. Geol. Surv. Bull. 30, 1917, pp. 62, 64, etc.)

Chemehuevi gravel.

Pleistocene: Western Arizona.

W. T. Lee, 1908 (U. S. G. S. Bull. 352, p. 18). *Chemehuevis gravel.*—A series of unconsolidated gravels that lie uncon. on Temple Bar cgl. in terraced bluffs along

Colorado River from Grand Canyon to the Gulf. Thickness 700± ft. max. Occupy a measurably narrow belt along the river, having been deposited as valley filling during an aggrading stage of Colorado River. Named for Chemehuevis [now spelled without the final *s*] Valley, S. of The Needles.

Chemung formation.

Upper Devonian: New York (western, central, and eastern), Pennsylvania, and western Maryland and Virginia.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 322–326). *Chemung group.*—Rocks and fossils very distinct from underlying Ithaca group. Essential difference is lithological characters of the ss. of this group, absence of argill. matter in most layers, these being a nearly pure siliceous rock, harsh to touch, and generally porous, while a large proportion of mass consists of compact shales and argill. sss. softer than those below. Occurs in valley of Chemung River and well defined in town of Chemung, Chemung Co., N. Y., but nowhere in county is it so well exposed as at Chemung upper narrows, about 11 mi. below Elmira. A group so well defined in the valley, and particularly in town of Chemung, merits appellation of *Chemung group.*

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 381). A series of thin ss. flags with fucoides resembling those below the Ithaca separates *Chemung group* from Ithaca group.

J. Hall, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 389–395, 402–409, 452–455). *Chemung group.*—Underlies red ss. equiv. to Old Red ss. of Europe, and overlies Portage or Upper Fucoidal group. Consists of (descending): (1) Green shales with thin beds of ss.; (2) dark, nearly black, sandy, highly micaceous sh. with septaria, iron pyrites, and thin interstratified masses of gray ss. containing Chemung fossils; (3) greenish-olive sandy sh. or very shaly ss., never slaty.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 179–185). *Chemung group.*—Underlies Catskill group or Old Red ss. and overlies Ithaca group (which rests on Portage or Nunda group). No precise line of division observed btw. Ithaca and Chemung group. A high ridge was seen rising above the inclined plane at Ithaca; the rocks to S. contained none of brownish ss. of Ithaca group and there were different fossils noticed in the two; upon these differences the Chemung group was founded. Best section for examining the two groups is from head of Cayuga Lake to Factoryville. At Chemung Narrows the evidence of difference appeared to be conclusive; so also in Tioga and Broome Counties, where, probably with one exception in Broome Co., no lower rocks than Chemung group exist.

E. Emmons, 1846 (Agric. N. Y., vol. 1, pp. 190–193). *Chemung group.*—Underlies Catskill group and overlies Portage group. Includes Ithaca group, because there is no necessity for separating the Ithaca from the Chemung group. Consists of flags and slates in thinner beds than those of Portage group; flags are gray, olive, and brown, with impure calc. bands of fossils; the shales are green and olive but sometimes black.

In 1857 and in several editions of his Textbook of geol. J. D. Dana used the term *Chemung period* to include the Chemung and Portage of later nomenclature. *Chemung group* has also been used to include Portage, Chemung, and Genesee.

In 1905 (N. Y. State Mus. Bull. 81) J. M. Clarke and D. D. Luther restricted *Chemung* (as *Chemung ss. and sh.*) to what they stated to be the beds included in it by Hall in his 1839 definition, which they described as 800 ft. of light and dark shales and light blue-gray siliceous sss., with a basal bed of crumpled black sh., overlying Prattsburg sh. (In 1904 (N. Y. State Mus. Bull. 63) they had included the Prattsburg and underlying High Point ss. in the Chemung.)

In 1906 (Sci., n. s., vol. 24, pp. 356–372) and 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169) H. S. Williams divided *Chemung fm.* of its typical region into (descending): (1) Thin cgl. that is supposed to be same as Fall Creek cgl. memb. of Bradford, Pa.; (2) Wellsburg ss. memb.; and (3) Cayuta sh. memb.; and he defined it as resting on Enfield sh. memb. of Portage fm.

C. A. Hartnagel's 1912 Hdb. 19 of N. Y. State Mus. followed Williams' subdivisions of Chemung fm., and divided the underlying Portage of western N. Y. into (descending): Wiscoy sh., Nunda ss. (including Laona ss. at base), Gardeau flags, Dunkirk sh., Grimes ss., Hatch sh. (= Hanover sh., and Angola sh.), Rhinestreet sh., Cashaqua sh., and Middlesex sh., all of which were said to carry the Naples fauna.

In 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157), 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), and 1924 (N. Y. State Mus. Bull. 251, pp. 149–157) G. H. Chadwick made the following changes in correlations of Chemung and Portage strata: (1) Fall Creek cgl.=Cuba ss.; (2) Wellsburg ss.=Northeast sh., Shumla ss., Westfield sh., and Laona ss.; (3) Cayuta sh.=Gowanda and underlying Dunkirk sh.; (4) the underlying beds he called *Portage group* and the overlying beds *Girard and Chadakoin fms.*

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), divided Chemung of western N. Y. into (descending): Chadakoin beds, Cuba ss., Northeast sh., Shumla ss., Westfield sh., Laona ss., Gowanda sh., and Dunkirk sh., and divided Chemung of central N. Y. (type area) into (descending) Fall Creek cgl., Wellsburg ss., and Cayuta sh. "The Chemung fauna is a modified Ithaca-Hamilton fauna and is characterized by *Spirifer disjunctus*."

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, pp. 202–203). *Chemung group* (of which Chadakoin is top memb. in NW. Pa.) underlies Panama cgl. (basal memb. of Cattaraugus fm.) and is top group of Chautauquan series. Panama cgl = Wolf Creek cgl., Le Boeuf ss., and Venango 3d oil sand.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 200). Chemung of Olean to Genesee River, N. Y., region includes (descending) Northeast sh., Shumla, Westfield, Laona, Gowanda, and Dunkirk, and is older than Girard and Chadakoin, which underlie Wolf Creek (Panama) cgl.

K. E. Caster, 1934 (Bulls. Am. Pal. vol. 21, No. 71, table opp. p. 61), dropped Chemung from classification of rocks of NW. Pa., and divided his Chautauquan series into Chadakoin stage and Girard stage, with Cuba ss. at base.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 313–326, 338–351, 352). *Canadaway group* (pseudo Chemung) includes (descending) Northeast sh., Shumla ss., Westfield sh., Laona ss., Gowanda beds, and Dunkirk black sh., and is younger than true Chemung. Type Chemung has proved itself to be only the brachiopodiferous facies of "Portage" (Nunda) group, and therefore must be classified as top part of Senecan. Senecan series is divided into:

Chemung group	Wellsburg memb.	Hanover unit.
		Pipe Creek unit.
		Portage unit.
	Cayuta memb.	Letchworth (sh.) unit.
		Gardeau unit.
		Grimes unit.
Naples group	Enfield or Attica memb.	Hatch unit.
		Rhinestreet unit.
	Ithaca or Sonyea [new] memb.	Cashaqua unit.
		Middlesex unit.
Genesee group	Sherburne memb.	Standish unit.
		West River unit.
		Genundewa unit.
	Gorham memb. (Clarke).	Geneseo unit.

Dunkirk sh. (basal fm. of Canadaway group of overlying Chautauquan series) includes Fall Creek cgl. [p. 323.] Type Chemung exposure at Chemung Narrows is plainly below Wellsburg memb. [See also under *Portage group.*]

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 858). *Chemung group* of Genesee River region is divided into (descending): (1) Hanover olive shales; (2) Pipe Creek black sh.; (3) Portage (incorrectly "Nunda") ss. or bluestone; (4) *Letchworth sh.* (Hall's Portage and most of Clarke's "Gardeau"); (5) *Table Rock ss.;* (6) "Gardeau" sh. as finally restricted; and (7) Grimes ss. The Pipe Creek and Hanover on Genesee River combine into Wiscoy sh.

For many years *Chemung fm.* has been employed in Pa., Md., and northern Va. as the name of a series of marine sss. and shales, of gray, green, and brown colors and Upper Dev. age, which are in part older and in part grade laterally into the continental red beds long known as *Catskill fm.*, and which overlie sss. and shales containing what has been known as the *Portage fauna* and commonly designated as *Portage fm.* In western N. Y. and NW. Pa. the beds that have for many years been called *Chemung fm.* are overlain by a series of Dev. or Carbf. beds commonly called *Conewango fm.* (in places divisible into Oswayo and Cattaraugus fms.), which is in turn overlain by Knapp fm.

†Chemung conglomerate.

A term applied in some early repts to upper cgl. of Chemung fm. in western N. Y. See also *Jamestown cgl.*

Cheneysville sandstone member.

See *Chaneysville ss. memb.* The U. S. Postal Guide spells the town *Chaneysville.*

Chengwatana series.

Pre-Cambrian (Keweenawan): Eastern Minnesota (Kanabec and Pine Counties).

C. W. Hall, 1900 (Am. Ass. Adv. Sci. Proc., vol. 49, p. 191). *Chengwatona series.*—Volcanic rocks first identified by [T. C.] Chamberlin as belonging to Lake Superior copper-bearing fm. Consists of basic eruptions (lava flows of typical structure), with 5 intercalated cgl. beds varying in thickness from 5 to 104 ft. Not less than 45 lava flows were counted and neither top nor bottom flow was seen. Thickness actually exposed 10,000 ft. Exposed along Snake River almost continuously for 2 mi.

C. W. Hall, 1901 (Geol. Soc. Am. Bull., vol. 12, p. 327). *Chengwatana series.*—A series of eruptive and clastic rocks of unusual extent. Consists of 65 lava flows containing not less than 6 cgl. beds. Thickness 4,000 to 10,940 ft. Belongs to Keweenawan series. Outcrops on Snake River at Chengwatana [the approved spelling].

Chepultepec dolomite.

Lower Ordovician (Beekmantown): Northern Alabama, eastern Tennessee, and western Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 549, 638–640, pl. 27). In Ala. (Murphrees, Birmingham, and Cahaba Valleys) another fm., about 1,000 ft. thick, characterized by abundant soft mealy chert, for which *Chepultepec* is proposed, is intercalated btw. top of typical Knox and overlying Canadian [Beekmantown] ls. and dol. At Chepultepec the Canadian ls. and dol. are absent and the Chepultepec is uncon. overlain by the Stones River. The Chepultepec is a highly cherty mag. ls., the chert always soft and more or less mealy. Fossils common in upper 300 ft. Not recognized in Tenn. Rests on beds younger than Copper Ridge chert, which are supposed to represent "Upper Knox" of Tenn. Represents last of Ozarkian deposits in this province. Correlates with Gasconade of Mo. Basal part is = upper part of Little Falls dol. of N. Y., and rest of fm. is younger than Little Falls dol. and is not present in either east-central N. Y. [typical Little Falls region] or in Champlain Valley. Correlates with part of Oneota dol. of upper Miss. Valley.

In 1915 (U. S. Nat. Mus. Bull. 92, vol. 1, p. vii, and vol. 2, pls. 1 and 2) R. S. Bassler, who collaborated with Ulrich, redefined the Chepultepec as=so-called †Upper Knox in Tenn., and as resting conformably on Copper Ridge chert in both Tenn. and Ala. He correlated it with *top bed* only of Little Falls dol. of Champlain Valley, N. Y. and with Gasconade of Mo., and showed typical Little Falls dol. of N. Y. as much older than Copper Ridge. Bassler repeated this definition and correlation in 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51). In both of these repts Bassler placed Chepultepec and Little Falls dol. as older than Beekmantown, included them in *Ozarkian*, and included "Ozarkian" in Camb.

In 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34, and Bull. 31, p. 16) Ulrich placed *Chepultepec* uncon. below Tribes Hill, included former in his Ozarkian system, included latter in his Canadian system, and recognized Chepultepec in eastern Tenn. uncon. beneath Longview dol. and conformably above Copper Ridge dol.

In 1926 C. Butts (Ala. Geol. Surv. Spec. Rept. No. 14) defined the Chepultepec as resting conformably on Copper Ridge dol. and in Ala. uncon. overlain by Longview ls., of Beekmantown age. Butts has since discriminated the fm. as far N. as Strasburg, Shenandoah Co., Va.

Named for exposures near Chepultepec, Blount Co., Ala., 30 mi. NE. of Birmingham.

Originally the U. S. Geol. Survey classified Chepultepec dol. as *Camb. or Ord.*, and later as *Upper Camb.* In Jan. 1936, however, the age designation *Lower Ord.* (*Beekmantown*) was adopted, as explained under *Beekmantown group.*

Chequamegon sandstone.

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield and eastern Douglas Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 33). *Chequamegon ss.*—Red and white ss., predominantly of quartz grains, with thin lenticular beds of red sandy sh. Thickness 1,000 ft. Top fm. of Bayfield ss. group. Overlies Devils Island ss. Named for exposures on Chequamegon Bay.

†Cheraw cobbles.

Pleistocene and Pliocene(?): Northeastern South Carolina (Chesterfield County)..

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 20). *Cheraw* (*Lafayette*) *phase.*—A fresh-water deposit. The fm. designated *Cheraw Cobbles*, the equiv. of the Lafayette, has been variously assigned to Plio. and to Pleist. It has apparently resulted from vast fresh-water floods which extended over a great flat, constituted by the median three-fifths of the Coastal Plain, the character of whose waters excluded life forms from its deposits. These waters also extended up the greater valleys to foot of Blue Ridge Mtns. The inauguration of the great floods is marked in favored places by the survival of enormous deposits of more or less stratified sands, which followed the shore line as it retreated inland; then appear the cobbles and pebbles, which were deposited high on the scarps of the inclosing ridges of the Savannah, Congaree, Wateree, and Great Pee Dee Rivers, along their courses from the mtns to and beyond the fall line. But let it be carefully observed that there are no marginal beds of cobbles along either the Edisto or Black Rivers, whose waters originated in the Coastal Plain.

E. Sloan, 1907 (Hdb. of S. C., p. 92). *Cheraw cobbles.*—Freshwater deposit equiv. to Lafayette. Apparently resulted from vast fresh-water floods which extended over a great flat. Has been variously assigned to Plio. and to Pleist.

C. W. Cooke, 1935 (personal communication). The †Cheraw cobbles of Sloan is in part probably Plio. and in part Pleist.

Named for development around Cheraw, Chesterfield Co.

†Cherokee slates.

Lower Cambrian: Western North Carolina.

W. C. Kerr, 1869 (N. C. Geol. Surv. Rept. 2, pp. 13–35). *Cherokee slates.*—Semimetamorphic clay slates and shales, sss., grits, qtzites, cgls., and ls. Occupy in direct cross section a space of more than 10 mi. Occur along Smoky Mtns, on NW. border of N. C. Believed to be = Linville slates. Conspicuous on Valley River and therefore called *Cherokee slates*. They pass in NE. course up Laurel Valley and through Smoky or Unakee Mtns into Tenn.

The rocks described are now divided into several fms. (See North Carolina chart.)

Named for development in Cherokee Co., N. C., along Valley River.

†Cherokee limestone.

Mississippian: Southwestern Missouri and southeastern Kansas.

W. P. Jenney, 1893 (Am. Inst. Min. Engrs. Trans., vol. 22 (author's edition August 1893), pp. 178, 186, 191–202). *Cherokee ls.*—Ls., irregularly interstratified with layers of chert, 185 to 220 ft. thick. Probably representative of Warsaw or St. Louis epoch. Forms top div. of Subcarboniferous in SW. Mo., SE Kans., and northern Okla. except where locally Subcarboniferous shales overlie it.

Practically same as Boone ls.; older name, and conflicts with Cherokee sh.

Named for Cherokee Co., Kans.

Cherokee shale.

Pennsylvanian (early): Eastern Kansas, southeastern Nebraska, northwestern Missouri, and northeastern Oklahoma.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 105–106). *Cherokee sh.*—Ashy white to black shales, 500 ft. thick, containing many beds of coal, ss., and ls. Suggest that term be applied to all shales above Galena ls. and below Oswego ls., unless Swallow ls. should prove to be more extensive in Cherokee Co., Kans., than now seems probable. Should such be the case the term should apply only to shales below Swallow ls. [The underlying ls. was years ago proved not to be Galena ls., but to be of Miss. age.]

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13). *Cherokee sh.* underlies Fort Scott ls. memb. of Henrietta fm. and uncon. overlies Miss. in NW. Mo. Is basal fm. of Des Moines group and of Penn. Includes, near top, Lexington coal (=Mystic coal), and lower down, at different (descending) horizons, Summit coal, Mulky (Macon City) coal, Bevier coal, and Tebo (Lower Ardmore) coal.

F. C. Greene, 1933 (Mo. Bur. Geol. and Mines 57th Bien. Rept., App. II). Lexington or Butler coal occurs in lower part of Labette sh.; the upper Fort Scott or Summit coal occurs in Fort Scott ls., 0 to 15 ft. above its base; the lower Fort Scott or Mulky coal lies in upper 10 ft. of Cherokee fm. in west-central Mo.; the Bevier or Williams coal lies in upper part of Cherokee sh., 60 to 100 ft. below Mulky coal.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 42, 61). Lexington coal (=Mystic coal of Iowa) occurs in lower part of Labette sh.; Summit coal occurs in lower part of Fort Scott ls.; Mulky and Bevier coals lie in upper part of Cherokee sh.

In NE. Okla. Cherokee sh. uncon. overlies Morrow fm. (of Penn. age), and contains so much ss. and ls. that it is called *Cherokee fm.*

Named for prominent exposures in Cherokee Co., Kans.

Cherokee zone.

Cambrian (?): Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C. advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2) and 1907 (Summary of mineral resources of S. C., pp. 6, 11, 12). *Cherokee zone* (*Cambrian ?*).—This zone comprises a small area bounded on SE. by a line which extends SW. from point where King's Creek crosses the N. C. line, by Silver Mtn across Broad River, and thence across Thicketty Creek below mouth of Limestone Creek to a point W. of their confluence, where it encounters Anderson-Spartanburg zone; which zone thence bounds it on W. and NW. to N. C. line; the State line constitutes the bdy on N. Some corresponding fms. of probable equivalence are interruptedly exposed in a narrow, much obscured band, which extends towards Saluda River, along the line which separates Anderson-Spartanburg zone from Abbeville-York zone, across Laurens Co.; exhibited at Frenchman's Creek, at Mahaffey Kiln, at Masters Kiln and at Raysors Kiln. Siliceous slates (slightly carbonic), qtzite, hornblende slates variously merging to ls. and marble; ottrelite schists; itacolumite; slates interbedded with hematite; lithia granite; gneiss; black slates; mica slates; metamorphosed igneous mag. rocks with lenticles of magnetite and bodies of asbestos; siliceous and mag. hematite, and specular iron ores intercalated with slates; massive fine grained gray mica slates; intrusive diabase (distinctly foliated).

Probably named for exposures in Cherokee Co.

†Cherokee limestone.

Cambrian (probably Lower): Northwestern South Carolina.

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, p. 432), under heading "Cherokee zone," referred to, but did not define, *Cherokee ls.* and *upper Cherokee ls.*

A. I. Jonas, 1932 (Am. Jour. Sci., 5th, vol. 24, p. 237). "Cherokee ls." of Sloan was called *Gaffney marble* by Keith [which Miss Jonas assigns to pre-Camb.].

Cherric period.

Pre-Cambrian: Montana.

See under *Bitterroot period.*

Cherry limestone.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, p. 136), in quoting Drake's section along Colorado River, used *Cherry* for the ls. called *cherty* by Drake. E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), used "Cherry ls., Plummer, 1919," for this ls. The name appears to be a typographic error.

Cherry shale.

Lower Ordovician: Eastern Nevada (Ely region).

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 78). *Cherry shales*, 200 ft. thick, underlie Willow lss. and overlie Egan lss. [On p. 78 of book cited the *Cherry shales* are defined as the thick argill. beds forming upper part of *Mid* Ordovicic section in Egan Range.] Fully exposed on Cherry Creek, N. of Ely.

A part of Pogonip ls.

Cherry Creek group.

Pre-Cambrian: Central southern Montana (Three Forks quadrangle) and southwestern Montana.

A. C. Peale, 1896 (U. S. G. S. Three Forks folio, No. 24). *Cherry Creek fm.*—Interlaminated gneiss, mica schist, marbles, crystalline ls. and qtzite, all highly inclined and perfectly conformable with one another. Thickness 7,000+ft. Uncon. underlies Belt fm. and rests on Archean gneiss and schist. Occupies area of 30 to 40 sq. mi. in foothills W. of Madison River. A limited area of these beds occurs on E. side of Madison Valley at W. edge of Madison Range. Between Cherry Creek [SW. corner of Three Forks quad.] and Wigwam Creek, on W. side of Madison Valley the upturned edges of this group are overlain by unchanged Camb. beds.

According to J. T. Pardee (personal communication) the rocks named *Cherry Creek* by Peale do not resemble the Belt series but do very closely resemble the rocks mapped by Peale as "Archean."

Cherry Grove sand.

Subsurface sand, western Pa., of Chemung age. Supposed=Gartland oil sand, Garfield sand, and Balltown sand. Named for Cherry Grove, Warren Co., Pa.

Cherry Ridge group.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 64). *Cherry Ridge group.*—Consists of an upper div., divided into (descending): (1) Cherry Ridge cgl., 20 to 25 ft.; (2) Cherry Ridge shales, 20 to 25 ft.; (3) Cherry Ridge ls., 5 ft.; and a lower div. consisting of Cherry Ridge red sh., 110 ft. thick. Well exposed near Cherry Ridge P. O., Wayne Co. Overlain by Elk Mtn lower sands and underlain by Honesdale ss. group, all included in Catskill fm.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, p. 78). *Cherry Ridge group* of section extending from N. line of Monroe Co. SE. to Kittatinny (Blue) Mtn, consists of (descending): Cgl., 30 ft.; sh., 20 ft.; cgl., 25 ft.; red sh. and ss., 500 ft.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 577). *Cherry Ridge* is another of I. C. White's names, but it was rather ill chosen, for Cherry in Wayne Co. gives an indifferent exposure of these beds, but good exposures are rare, and a complete section of the fm. is unknown. White treated Cherry Ridge as a group of 5 lithologically unlike members, to each of which he applied name *Cherry Ridge* with an appropriate lithologic designation. Most of these are so local that they can be disregarded, and the situation be clarified by using *Cherry Ridge red beds* for the dominantly red succession of somewhat varied lithology which separates Elk Mtn ss. (above) from Honesdale ss. (below). Such subdivisions as are useful will be renamed. Thickness 170 ft. (in Wayne Co., as reported by White) to 275 to 300 ft. on Pocono Plateau, btw. 300 and 400 ft. along Lehigh River (where, however, its upper bdy is vague), 600 ft. in Susquehanna Valley, and 1,000± in parts of Bradford and Tioga Counties. It continues W. to Susquehanna and Juniata Valley in Perry Co. In western Potter and McKean Counties it becomes the red Cattaraugus fm. [which U. S. G. S. classifies as Dev. or Carbf.]. At least 2 units of the Cherry Ridge deserve attention. White reported a cgl., distinguished by red quartz pebbles, in upper part of fm. This is persistent bed across Pocono Plateau, where it forms small ridges and hills concentric to E. escarpment. Because of its occurrence so far E. on the Plateau there seems no reason for placing it in the Mount Pleasant rather than in the Cherry Ridge beds. It is here named *Pimple Hill cgl.*, for one of the knobs which it supports—Pimple Hill, Monroe Co. It is exposed along Lehigh River, where, however, other cgls. of similar nature, particularly in lower part of the Cherry Ridge, help support Bear Mtn, SE. of Mauch Chunk, and the corresponding ridge across the River N. of Packerton. Possibly more than 1 cgl. is present on the Plateau, but the Pimple Hill is thought to be the most persistent. West of Lehigh River the Cherry Ridge carries 1 or more cgls., probably the lower ones, all the way to Susquehanna Valley. [The other important unit in his Cherry Ridge red beds is his *Dyberry glomerate*, q. v.]

Cherry Ridge sandstone.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 64). *Cherry Ridge ss.*—Gray, current bedded, pebbly ss., 15 ft. thick. With underlying Cherry Ridge ls. it forms a conspicuous rock ledge at hundreds of places in all parts of Wayne Co. Followed S. it becomes coarser and finally well supplied with reddish white quartz pebbles. Overlain by Cherry Ridge shales. All included in Cherry Ridge group.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 577), discarded this name, as explained in 1936 entry under *Cherry Ridge group*.

Cherry Ridge shales.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 64). *Cherry Ridge shales.*—Usually of greenish or olive color. Thickness 20 to 25 ft. A part of Cherry Ridge group. Underlies Cherry Ridge cgl. and overlies Cherry Ridge ss.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 577), discarded this name, as explained in 1936 entry under *Cherry Ridge group*.

Cherry Ridge conglomerate.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 64). *Cherry Ridge cgl.*—Grayish white, very hard rock, filled with reddish quartz pebbles through S. half of Wayne Co., but in N. half of that county the pebbles are scattered through it only at some localities. Thickness 20 to 25 ft. A calc. breccia often occurs at base; in eastern Susquehanna Co. this breccia is a black stratum 5 ft. thick. The cgl. caps Collins high knob just W. of Cherry Ridge P. O., Wayne Co. Is top memb. of Cherry Ridge group. Overlain by Elk Mtn lower sands and underlain by Cherry Ridge shales.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 578), replaced this name with *Pimple Hill cgl.*, and retained *Cherry Ridge* in broad sense in which White used the name.

Cherry Ridge red shale.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_6, p. 66). *Cherry Ridge red sh.*—Red sh. 110 ft. thick. Often subdivided by a middle bed of 15 to 20 ft. of gray current-bedded ss. and in some places including 2 or 3 additional thinner sss. Persistently underlies Cherry Ridge ls. throughout the region. Is basal div. of Cherry Ridge group.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 577), discarded this memb. name and applied *Cherry Ridge red beds* to all of *Cherry Ridge group* of White, q. v.

Cherry Ridge limestone.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 65–66). *Cherry Ridge ls.*—An aggl. of chips of sl. or sh., fish-bone fragments, pieces of fossilized wood, and often a large quantity of sand, all cemented together by lime. In respect of amount of carbonate of lime in the rock it cannot be said to deserve the name of ls. Is one of most remarkable and persistent of Catskill strata. Extends over large part of Wayne Co. Included in Cherry Ridge group. It always immediately underlies Cherry Ridge ss., and in fact is a part of it, for while the average thickness of the calc. part of the rock may be called 5 ft., it varies greatly, rising here and there into the ss. beds, and the sand descending elsewhere into the ls. bed. In N. Y. State repts for 1844 this rock is properly referred to as *Catskill ls.*

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571–578), replaced this name with *Dyberry glomerate,* as explained under that name.

Cherryvale shale. (In Kansas City group, Kansas.)

Cherryvale shale member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

E. Haworth, 1898 (Kans. Univ. Geol. Surv., vol. 3, pp. 47–48, 102). *Cherryvale shales.*—Shales, 120 ft. thick, prominent from Coffeyville almost to Neosho River. Overlie Mound Valley ls. and underlie Independence ls.

G. I. Adams, 1903 (U. S. G. S. Bull. 211). *Cherryvale sh.* of SE. Kans. underlies Drum ls. (=Independence ls., preoccupied) and overlies Dennis ls. (=Mound Valley ls.).

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1). *Cherryvale sh.* underlies Drum ls. and overlies Dennis ls. But Adams confused the Dennis with the older Mound Valley ls., which underlies Galesburg sh. We retain *Dennis* for the upper ls.

In 1912 the equivalency of Independence ls. with Drum ls. was considered established, and *Independence ls.* was discarded for *Drum* by the U. S. Geol. Survey, and *Winterset ls.* was adopted (priority) for the ls. underlying the Cherryvale, its correlation with Dennis ls. being regarded as established. (See H. Hinds and F. C. Greene, Mo. Bur. Geol. and Mines vol. 13, 1915.) This definition of Cherryvale sh. (as underlying Drum ls. and overlying Winterset ls.) was continued by Kans. Geol. Survey until 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), when R. C. Moore stated that the true Drum ls. is a higher ls. than the Drum of Hinds and Greene (=De Kalb ls.), and he included the De Kalb ls. in the Cherryvale sh. This definition of Cherryvale was adopted by Moore and G. E. Condra in their Oct 1932 revised classification chart of the Penn. rocks of Kans. and Nebr.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 34+). *Cherryvale sh.* of SE. Kans. underlies true Drum ls. and overlies Winterset ls. memb. of Dennis ls. It corresponds to beds here named (descending) Quivira sh., Westerville ls., Wea sh., Block ls., and Fontana sh. The Drum ls. of Hinds and Greene at Kansas City is the true Westerville, and their Cherryvale sh. includes only Wea sh., Block ls., and Fontana sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 98). Type Cherryvale sh. overlies Winterset ls. and underlies Drum ls. It is 60 ft. thick about 2 mi. S. of Cherryvale. It appears that Cherryvale sh. of type region is very lenticular and that it is lower than other fairly thick sh. and ss. locally occurring above flaggy lss. and below Drum ls. Correlation of Cherryvale sh. with Fontana and other fms. btw. Winterset and Drum lss. of Kansas City area is very uncertain. It is not advisable at present to use *Cherryvale* except in vicinity of Cherryvale. [On p. 45 Moore placed Cherryvale sh. of "old classification" opposite Wea sh., Block ls., and Fontana sh. of "revised classification."]

Named for exposures in vicinity of Cherryvale, Montgomery Co., Kans.

Cherry Valley limestone. (In Marcellus shale.)

Middle Devonian: Central and east-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, chart). [In central and east-central N. Y. columns there appears: *Marcellus sh. incl. Cherry Valley ls.*]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 64–65 and chart). Marcellus black sh. includes near its base at Cherry Valley a ls. with *Anarcestes plebeiformis* and the *Agoniatites* ls. The latter ls. extends in force from Schoharie to Ontario Co. West from there the basal sh. becomes more calc., and in Erie Co. the Agoniatite layer and the strata below it have become so far assimilated with Onondaga ls. as not to be readily distinguished from it. For these calc. layers specially characterized by the goniatites found therein, the name *Cherry Valley ls.* (1903 Clarke) has been suggested.

T. C. Hopkins, 1914 (N. Y. State Mus. Bull. 171, pp. 6–26), gave thickness of *Cherry Valley or Agoniatites ls.* in Syracuse quad. as 3 ft., and described it as impure ls., very fossiliferous, lying 15 ft. above base of Marcellus sh.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 131–132), applied *Union Springs memb.* to basal beds of Marcellus sh., separating Cherry Valley ls. from underlying Onondaga ls.

Chesaning moraine.

Pleistocene (Wisconsin stage): Central Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Chesaning, Saginaw Co.

Chesapeake group.

Miocene (upper and middle): Eastern Maryland, Delaware, Virginia, and North Carolina.

N. H. Darton, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 431–450, map). *Chesapeake fm.*—The Mio. [marine] deposits of eastern Va. and Md., which attain their greatest development adjacent to Chesapeake Bay. Basal part is mainly dark-colored clays and fine mealy sands containing the extensive and well-known diatomaceous deposits. These are overlain by lighter-colored clays and sands with occasional local inclusions of blue marl. Upper part is coarser-grained and consists chiefly of white beach sands containing shells and deposits of shell fragments and occasional argill. members. Thickness of fm. 1,000 ft. It is a physical unit and can hardly be separated faunally into Marylandian and Virginian, as proposed by Heilprin. The faunal change is transitional. Uncon. underlies Appomattox fm. and uncon. overlies Pamunkey fm. (Eocene).

W. H. Dall, 1892 (U. S. G. S. Bull. 84, p. 123). For the Mio. strata extending from Del. to Fla., but best developed in Md., Va., and the Carolinas during Yorktown epoch of Dana, including a large part of Heilprin's Marylandian, Virginian, and Carolinian, I propose the name *Chesapeake group*. These beds are displayed in all their breadth on Chesapeake Bay and its estuaries. I have been unable to use Heilprin's names, as they have never been recognizably defined, nor am I convinced that they apply to any definite geologic facts, although there is a gradual change in fauna from older to newer beds. For the strata bordering on the Chesapeake in Md. and Va. which belong to the Mio., Darton has proposed (Bull. G. S. A., vol. 2, 1891, p. 443, but not known to writers till this essay was practically finished) the name *Chesapeake fm.* This term as used by him is = "Miocene" as heretofore understood in these states, and is strat. homonym of the chronologic "Yorktown epoch" of Dana. The term *Chesapeake group*, as independently suggested, here includes as typical Darton's Chesapeake fm. and also all other beds belonging to same horizon and containing same general fauna on Atlantic and Gulf coasts of U. S.

In Md. the Chesapeake group, as the Mio. deposits are now called, is divided into (descending) St. Marys, Choptank, and Calvert fms.; in eastern Va. into Yorktown, St. Marys, Choptank, and Calvert fms.; in eastern North Carolina N. of Hatteras axis into Yorktown and St. Marys fms., while S. of Hatteras axis the Duplin marl is sole representative of the group. In some early repts the name was used in Florida, but that usage no longer prevails.

Cheshewalla sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

D. E. Winchester, K. C. Heald et al., 1918 (U. S. G. S. Bull. 686G, pp. 60–61). *Cheshewalla ss.*—The first heavy bed of massive ss. below Labadie ls. in T. 25 N., R. 10 E. Thickness 20 to 50 ft. Is separated from the Labadie by 60± ft. of sh. and thin hard sss., with, in a few localities, a very thin ls. a few ft. above the Cheshewalla. The Cheshewalla is fine grained, moderately well cemented, rather soft, and cross bedded. Few fossils. Along most of its outcrop in this Twp it appears as a single heavy bed without interbedded sh., but locally it contains lentils of red sh. a mi. or less long, which cause the formation of benches. It lies 60 or 70 ft. above Revard ss. Is well developed near point where Cheshewalla Creek empties into Nelagoney Creek, in SE¼ sec. 9.

Cheshire quartzite.

Lower Cambrian: Western Massachusetts and Connecticut, southwestern Vermont, and southeastern New York.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet. i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). [*Cheshire qtzite* is shown as overlying Becket gneiss and underlying [it overlies] Dalton phyllite.]

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*Cheshire white granular qtzite* is shown as underlying Hoosac schist and overlying Becket gneiss in Berkshire Hills and Conn. Valley. As thus defined it included Dalton fm.]

B. K. Emerson, 1899 (U. S. G. S. Bull. 159). *Cheshire qtzite.*—White sugary qtzite, often tourmaline bearing. Divided on map into: (1) Phyllite at top of Cheshire qtzite; (2) Cheshire qtzite; (3) mica schist in Cheshire qtzite. Underlies Stockbridge ls. and overlies Becket gneiss in eastern Berkshire Co., including Dalton type loc. at N. [As thus defined and mapped *Cheshire* included Dalton fm.]

B. K. Emerson 1917 (U. S. G. S. Bull. 597, pp. 32–34 and map). *Cheshire qtzite.*—A granular quartz rock of very massive habit, rather fine and even grain, and colorless or slightly iron tinted. In places very feldspathic. Grades into underlying Dalton fm. and is overlain by Stockbridge ls. Typical exposures at and near Cheshire, Berkshire Co., Mass. [This is present approved definition of Cheshire.]

†Cheshire schist.

A name casually applied by R. Pumpelly (U. S. G. S. Mon. 23, 1894) to Berkshire schist in Cheshire, Mass.

†Chester sandstone.

Mississippian: Illinois and Missouri.

G. C. Swallow, 1858 (Am. Ass. Adv. Sci. Proc., vol. 11, pt. 2, p. 5). *Chester ss.*—Topmost ss., 75 ft. thick, of Lower Carbf. in Mo. Underlain by Upper Archimedes ls. (250 ft. thick) at Chester, Ill., succeeded below by Ferruginous ss. (195 ft. thick), and St. Louis ls. (225 ft. thick).

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41, p. 123). *Chester ss.* of Swallow (Am. Ass. Adv. Sci. Proc., vol. 11, pt. 2, p. 5, 1858) is Palestine ss.

In some early Ill. Geol. Surv. repts. the term "lower Chester ss." was applied to †Ferruginous ss. and treated as basal fm. of Chester group.

Named for exposures at Chester, Randolph Co., Ill.

Chester group.

Mississippian (upper): Illinois, southern Indiana, eastern Missouri, Kentucky, Tennessee, and northern Alabama.

A. H. Worthen, 1860 (Am. Ass. Adv. Sci. Proc., vol. 13, pp. 312–313). *Upper Archimedes or Chester ls.* usually consists of 3 subdivisions: (1) Upper ls., 40 to 60 ft. thick in Pope Co., Ill., massive, gray, in regular beds with argill. partings; (2) aren. or calcareo-argill. material, which in Pope Co. contains shaly ss. with terrestrial plants; (3) lower ls.

A. H. Worthen, 1866 (Ill. Geol. Surv. vol. 1, pp. 40, 77, 284–292, 305–308). *Chester group.*—In 1853 I designated in my notes the beds at Chester as *Chester ls.* In 1856 Hall read a paper before Albany Inst. His reasons for substituting *Kaskaskia* for *Chester ls.* do not appear, and we [Worthen and F. B. Meek] prefer to retain the name first given to it, when its true position in the series was determined. The group consists of 3 or more lss. with intercalated beds of aren. and argill. shales and sss., 500 to 800 ft. thick, underlying Coal Measures and Millstone grit and overlying St. Louis group [Meramec group]. Includes Ferruginous [Aux Vases] ss. at base.

In succeeding years *Chester group* acquired the greatly preponderant usage as the name for these rocks, and in 1911 the U. S. Geol. Survey decided to adopt that name for its publications, in preference to ***Kaskaskia*** *group*.

According to Worthen's definition of Chester group the †Ferruginous ss. was its basal fm. in Ill., its type area. According to original definition of Ste. Genevieve ls. (Shumard, 1860), that fm. underlies the †Ferruginous ss. and overlies St. Louis ls. (restricted to pre-Ste. Genevieve beds) in Ste. Genevieve Co., Mo., the Ste. Genevieve type area. In 1892 C. R. Keyes introduced the geographic name *Aux Vases ss.* to replace the descriptive term *Ferruginous ss.* of Shumard and others. The type loc. of Aux Vases ss. is on Aux Vases River, Ste. Genevieve Co., Mo. In subsequent repts the Cypress ss. was miscorrelated with Aux Vases ss., but it is now known to be younger.

In southern Ill. the Chester group is now divided into (descending): Kinkaid ls., Degonia ss., Clore ls., Palestine ss., Menard ls., Waltersburg ss., Vienna ls., Tar Springs ss., Glen Dean ls., Hardinsburg ss., Golconda fm., Cypress ss., Paint Creek fm., Yankeetown chert, Renault fm., and Aux Vases ss. There has long been disagreement as to whether the underlying Ste. Genevieve ls. belongs in whole or in part to Chester group or to Meramec group. (See under *Ste. Genevieve ls.*) The U. S. Geol. Survey did not for many years assign the Ste. Genevieve to either group, but in May 1937 it was decided to adopt Weller's interpretation that "Upper Ohara" of repts belongs to Renault fm., and to transfer the remainder of Ste. Genevieve ls. to Meramec group, as classified by Ill. Geol. Survey. For subdivisions of Chester group in other States, see the State correlation charts.

Named for Chester, Randolph Co., Ill.

†Chester limestone.

See 1st entry under *Chester group.*

Chester amphibolite.

Ordovician: Western Massachusetts and Connecticut and southeastern Vermont.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Chester amphibolite,* with beds of saxonite, serpentine, steatite, emery and magnetite. The unique emery bed at Chester gives the name. Underlies Savoy schist and overlies Rowe schist.

B. K. Emerson, 1894, as reported by R. Pumpelly (U. S. G. S. Mon. 23, pp. 29-30). *Chester amphibolite.*—Hornblende schist, often with serpentine. Thickness from a feather edge to 3,000 ft. Overlies Rowe schist and underlies Plainfield schist.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 78-156 and pl. 34). *Chester amphibolite.*—Dark green, flaggy hornblende schist, in places changed to serpentine and emery, with beds of altered ls. which are believed to be contemp. with Bellowspipe ls. Underlies Savoy schist and overlies Rowe schist. Named for the unique emery bed at Chester, Mass., which occurs in it. [See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 41-42).]

Chester County gneiss.

Pre-Cambrian(?): Southeastern Pennsylvania.

T. D. Rand, 1900 (Phila. Acad. Nat. Sci. Proc. 1900, pt. 1). *Chester County gneiss.*—Sometimes resembles a pegmatite, often a very feldspathic gneiss; occasionally it is a hornblende or mica schist or a micaceous gneiss. Name is provisional. Well exposed in Williams' quarry, on Phoenixville Branch of Pa. R. R., near Aldham Station.

According to G. W. Stose (personal communication Dec. 1936) the rock exposed at locality mentioned above is granite or pegmatite.

Chesterfield group.

Upper Triassic: Eastern Virginia (Richmond Basin).

N. S. Shaler and J. B. Woodworth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, pp. 435-436). *Chesterfield group* mapped over most of Chesterfield Co. Is divided into Otterdale sss. above and Vinita beds below. Top group of Newark system in Richmond Basin. Overlies Tuckahoe group.

Chesterfield zone.

Pre-Cambrian: Northern South Carolina.

See *Edgefield-Chesterfield zone.*

Named for exposures in Chesterfield Co.

Chesterfield limestone.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199, pp. 114-115 and fig. 25). *Chesterfield ls.*, 50 ft. thick, seems to be a new one in Grenville stratigraphy, although it may be a phase of Faxon ls. Uncertainty as to rock that underlies it, as exposures are rare [but on map it is shown above Dresden amphibolite]. Is overlain by "Dixon" schist.

Chesterian.

A time term applied by some geologists to the epoch during which the Chester group of rocks was deposited.

†Chester Valley limestone.

See under †*Valley ls.*

Chestnut sandstone member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 10). *Chestnut ss. memb.*—Persistent quartzose ss., 100 ft. thick, making Chestnut Ridge, and occurring in lower part of Pottsville fm. in Cahaba coal field. Immediately overlies Gould group of coals.

Named for Chestnut Ridge, Jefferson Co.

†Chestnut Hill schists and gneisses.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6, map and pp. 24-27). *Chestnut Hill garnetiferous schists* [on map], *Chestnut Hill group* of garnet schists, serpentines, and gneisses [in text]. Extends from vicinity of Chestnut Hill to Delaware Co. line at Bryn Mawr. Is younger than Manayunk group. [On his map of Delaware Co., Pa., he used *Chestnut Hill schists and slates.*]

In part Wissahickon fm., in part igneous rocks.

Chetamon limestone.

Upper Cambrian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 291, 300). *Chetamon ls.*, 200 ft. thick. Assigned to Upper Camb. [on p. 300]. [Appears to be named for Mount Chetamon.]

Chetang limestone.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 335, 338).

Chetopa shales.

A term employed by C. [R.] Keyes to replace Cherokee sh. (Penn.), because of prior use [long ago abandoned] of Cherokee in N. C. (See Pan.-Am. Geol., vol. 56, p. 349, 1931, and vol. 57, pp. 217, 219, 223, 1932.) Named for R. R. station near Kans.-Okla. line, across Grand River from Cherokee Co., Kans.

Cheverie formation.

Mississippian: Nova Scotia.

W. A. Bell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 162).

Chewacla marble.

Pre-Cambrian: Eastern Alabama (Lee County).

W. F. Prouty, 1916 (Ala. Geol. Surv. Bull. 18, pp. 94–95). *Chewacla dol. marble.*—A highly crystalline dol., for most part a beautiful pearly white stone. Occurs as a narrow NE.–SW. strip about 5 mi. SE. from Opelika, Lee Co. Has been extensively quarried.

G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 33). *Chewacla marble* tentatively assigned to Algonkian.

In view of fact that "Archean system" and "Algonkian system" have been discarded, this fm. is now classified by U. S. Geol. Survey as pre-Camb.

Chewaucan formation.

Pleistocene: Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Chewaucan fm.*—Oxidized gravel, containing pebbles and small boulders of all older fms. of region. Thickness 25 to 100 ft. Typically exposed along Chewaucan River in vicinity of Chewaucan Marsh, Lake Co.

Chewelah argillite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 63, map). *Chewelah argillite.*—Interbedded quartz mica schists, phyllites, argillites, calc. argillites, dolomitic lss., argill. lss., and narrow bands of qtzite; the quartz mica schists more abundant than in any other fm. of Stevens series, and range from silver white to shades of red and gray. Thickness 4,000± ft. Rests on Addy qtzite with apparent conformity, and to W. underlies Colville qtzite with apparent conformity. To N. it underlies Old Dominion ls. and Colville qtzite. Exposed btw. North and South forks of Chewelah Creek and to N. and S. of Chewelah.

Cheyenne sandstone.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1889 (Washburn Coll. Lab. Nat. Hist. Bull. 2, No. 10, p. 65). *Cheyenne ss.*—Obliquely laminated, mostly incoherent (rarely hard) ss., 20 to 40 ft. thick, often gray but in large part gorgeously decorated with crimson, purple, scarlet, orange, yellow, brown and other colors. Forms bed No. 6 of section at Belvidere, Kans. Supposed to be referable to Trinity div. of Tex. and Ark.

F. W. Cragin, 1890 (No. 11 of publication cited above). *Cheyenne ss.* of southern Kans. underlies Neocomian shales and rests uncon. on Triassic. [*Neocomian* is a European time term for basal Lower Cret. deposits.]

F. W. Cragin, 1894 (Colo. Coll. Studies 5th Ann. Pub., p. 49), introduced *Kiowa sh.* for the fm. overlying Cheyenne ss.

In 1895 Cragin divided Cheyenne ss. into the several "members" mentioned under *Elk Creek beds*. All of these "memb." names were discarded by U. S. Geol. Survey in 1921, being applied to local facies of the Cheyenne.

The commonly accepted definition of Cheyenne is that it underlies Kiowa sh. and rests uncon. on Perm., the Triassic and Jurassic being absent.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9). Writer does not consider it possible definitely to recognize any memb. of Cheyenne fm. beyond limits of one locality. Cragin's divisions are considered to have no validity for more than local application, and as his 3 members were not differentiated in same section it is possible 2 of them may be one Cheyenne ss. appears to be confined to E. part of area of Kiowa sh.

Named for Cheyenne Rock, at Belvidere, Kiowa Co.

Chibougamau complex.

Pre-Cambrian: Northern Quebec (Opemiska district).

C. Tolman, 1932 (Jour. Geol., vol. 40, No. 4, p. 356). Granitic intrusives include Opemiska granite, Presqu'ile granite, and *Chibougamau complex*. Is pre-Camb., and much younger than Opemiska series.

†Chicago group.

Silurian.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28). [On chart forming pl. 28 the name *Chicago* is applied, in "General time scale" column, to all rocks btw. top of Rochester sh. memb. of the Clinton and base of Cayugan, including Lockport dol. of N. Y.; and in the Central States to all beds btw. base of Laurel ls. and top of Louisville ls., some of which are shown to be older and some younger than Lockport dol. of N. Y.]

E. O. Ulrich, 1914 (12th Int. Geol. Cong., Canada, chart opp. p. 666), replaced *Chicago group* of his 1911 classification with *Lockport group*.

E. O. Ulrich and R. S. Bassler, 1923 (Md. Geol. Surv. Sil. vol., pp. 259–260), abandoned *Chicago group* for *Lockport group*, as explained in 1923 entry under *Guelph dol.*

Chicago formation.

Silurian (Niagaran): Northeastern Illinois (Chicago).

D. O. Taylor, 1930 (Ill. Acad. Sci. Trans., vol. 22, pp. 473–477). *Chicago fm.*—Upper fm. of Niagaran series exposed in Chicago Ave. tunnel at Chicago, Ill., whence the name proposed. Consists of interbedded fine-grained green sh. and fine-grained non-porous dol. Thickness 51± ft. Rests conformably on Port Byron fm., of Niagaran series. Savage states (personal communication) these beds are certainly Niagaran and correspond to strata at Le Claire that overlie Port Byron fm. Because of isolated occurrence it seems that a separate name should be tentatively given them, hence *Chicago* is proposed. Definitely determined to have E.-W. extension of at least 3 mi.

Chicago limestone.

See 1921 and 1932 entries under *Hidden Treasure ls.*

Chicago.

Name applied to a glacial lake, of Pleist. age, in Lake Michigan region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Chickachoc chert lentil (of Atoka formation).

Pennsylvanian: Central southern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Chickachoc chert lentil.*—White, calc., stratified but massive, cherty ss., 0 to 80 ft. thick, near base of Atoka fm.

Occurs in SE. part of Coalgate quad., extreme NE. corner of Atoka quad., and in SE. part of McAlester quad.

Named for post office called *Chickachoc* in 1901 and located at or near present station of *Chockie*, on Missouri, Kansas, and Texas R. R., just E. of border of Coalgate quad. and near type exposures of the chert lentil. (Letter from J. A. Taff dated Jan. 26, 1931.)

Chickaloon formation.

Eocene: Central southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 500, pp. 15, 42–52, map). *Chickaloon fm.*—Rather monotonous succession of shales and sss., the shales predominating and being gray to drab, rather soft, poorly bedded; the sss. are yellowish, rather soft, of diverse grain. Thickness appears to be at least 2,000 ft. Flora shows it to be certainly Tert. and probably Eo. Rests on 2,000± ft. of arkose, cgl., and sh. of Eo. age. Underlies Eska cgl. (Mio.?). Covers greater part of valley of Chickaloon River S. of Castle Mtn.

The flora of this fm. is now regarded as Eo.

Chickamauga limestone.

Upper, Middle, and Lower Ordovician: Northern Alabama, northwestern Georgia, eastern Tennessee, and southwestern Virginia.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 143, 148. Paper read in Dec. 1890). *Chickamauga ls.*—Blue lss., 1,200 to 1,800 ft. thick, forming middle div. of Sil. west of Coosa River, in southern Appalachians, and = Trenton, Chazy, or Maclurea of Smith and Safford. Underlies Rockwood fm. and overlies Knox dol. On E. side of valley [in NW. Ga.] is almost entirely replaced by Rockmart slates [which also underlie Rockwood fm.].

The lss. which in early repts were assembled under name *Chickamauga* are now in most areas divided into several fms. (see various State charts), but the name is still found useful in some areas.

Named for exposures along Chickamauga Creek, E. of Chattanooga, Tenn., and branches of that creek in Ringgold quad., N. W. Ga.

†Chickasaw formation.

†Chickasaw group.

†Chickasawan formation.

†Chickasawan stage.

Eocene: Arkansas, Louisiana, Mississippi, and southern Alabama.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 344–345). *Chickasawan fm.*—Name suggested by E. W. Hilgard. This group represents upper part of what has been loosely termed Lignitic or lignite-bearing beds of the Eocene, which lie beneath the Orangeburg, Tallahatta, or Buhrstone fm. It is not the Lignitic of several authors, who have applied the term to the whole or part of the strata formerly included in so-called Laramie fm. It does not include the earliest lignite beds of Gulf coast region, nor even the youngest of such beds. It was called Northern Lignitic by Hilgard (Agric. and Geol. Miss., 1860, p. 110); Heilprin has termed it *Eolignitic* (Proc. Acad. Nat. Sci. Phila. for 1881, p. 159, footnote), a name less accurate and otherwise equally objectionable. A portion of it is believed to be included in Camden series of R. T. Hill, of Camden, Ouachita Co., Ark. (Ann. Rept. Geol. Surv. Ark., vol. 2, 1888, p. 49), but these beds are not characteristic and not thoroughly known. Believing that, to conform to international rules for geologic nomenclature, it is desirable that a definite geographic term should be substituted for the present petrologic name, the subject was laid before Messrs. E. W. Hilgard and E. A. Smith, with request that they should suggest a suitable term to be adopted. Prof. Hilgard writes, under date of December 20, 1895: "The entire Northern Lignitic is within the 'Chickasaw Purchase,' and its most characteristic and conspicuous outcrops are on the four Chickasaw bluffs, of which the Memphis bluff is the last. It would thus seem eminently proper to let the name be Chickasaw, which I think is not preoccupied." Since communicating with Prof. Hilgard I have been informed by Prof. Shaler that the name Chickasaw was, he thinks, proposed for this group in some manuscript prepared for Ky. Survey at time it was under his direction, and while he is not sure that it ever got into print, he remembers distinctly that it was colloquially in use among members of the Survey for the fm. exposed, as stated by Prof. Hilgard, at bluffs of same name. Prof. Smith entirely accords with Prof. Hilgard's substitution; so that those chiefly interested having accepted the change, and a careful search not revealing any conflicting use of the term, nothing seems to stand in the way of its adoption. The relations of the Lignitic or Chickasaw stage with the Cret. and Lower Claibornian in NW. La. are discussed by Vaughan, U. S. G. S. Bull. 142, 1896, pp. 14–27, and Harris, The Lignitic Stage; pt. 1, Bull. Am. Pal. No. 9, June 15, 1897, vol. 2, pp. 195–294.

In table on p. 334 of U. S. G. S. 18th Ann. Rept., pt. 2, Dall shows *Chickasawan* as occupying interval btw. Claibornian above and Midwayan below. This interval corresponds to Wilcox group of present classification. But †Northern Lignitic of Hilgard, which †Chickasawan was introduced to replace, as originally defined by Hilgard (in 1860) included Midway group. In 1871, however, Hilgard stated that greater part or all of his †Northern Lignitic was included in the Claiborne. The upper Chickasaw bluffs (type loc. given for †Chickasawan fm.) are now considered to be of Jackson age, and "Chickasaw Purchase" (which included northern Miss., NW. Ala., and SW. Tenn.) to include Midway, Wilcox, Claiborne, and Jackson deposits.

Named "for the four Chickasaw bluffs, of which Memphis bluff is the last," along Mississippi River in NW. Miss., within the "Chickasaw Purchase."

See also under †*Northern Lignitic.*

Chickasawhay marl member (of Byram marl).

Oligocene (middle): Southeastern Mississippi (Clarke and Wayne Counties)and southwestern Alabama.

B. W. Blanpied et al., 1934 (11th Ann. Field Trip Shreveport Geol. Soc., charts; pp. 3, 4, 12, 16–19, etc.). Overlying Bucatunna memb. of Catahoula group there occurs throughout Wayne Co., Miss., in Smith and Jasper Counties, Miss., and in Washington and Clarke Counties, Ala., a series of marine beds which heretofore has been considered in published literature to be of Olig. Byram marl age. Detailed study of these beds and their faunas has been made, and the name *Chickasawhay* has been applied to this Mio. group. The *Upper Chickasawhay memb.* of Catahoula group consists of 25 ft. of fossiliferous claystones, marls, and blue clays, and the conformably underlying *Lower Chickasawhay memb.* consists of 30 ft. of fossiliferous gray chalky marls, lss., and clays. Type section of Upper Chickasawhay memb. is in sec. 10–8 N.–7 W., Wayne Co., Miss., on W. bank of Chickasawhay River at locality CX. Type section of Lower Chickasawhay memb. is at locality LC, on highway No. 45, 3 mi. N. of Waynesboro, Wayne Co.

C. W. Cooke, 1935 (A. A. P. G. Bull., vol. 19, No. 8, pp. 1162–1172). *Chickasawhay marl* and *Bucatunna clay* of Blanpied are accepted as members of *Byram marl* (of Vicksburg group, Olig.), in which fm. the beds thus designated have heretofore always been included.

Chickasha formation.

Permian: Central southern and southwestern Oklahoma.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, pp. 324–341, map). *Chickasha fm.*—A series of ss. and shales varying in lithologic character from place to place. Thickness 175 to 295 ft. Near SE. end of Anadarko Basin it consists of 175± ft.

of variegated sss. and shales. Has been locally called "purple ss." Overlies Duncan ss. and underlies Blaine gyp. Named because city of Chickasha (Grady Co.) is built on the fm. According to C. Becker, 3 divisions can be recognized in the Chickasha—an upper purple ss. memb., 70 to 80 ft. thick; a middle pink sand memb., 50 ft. thick; and a lower purple ss. memb., 50 ft. thick.

Chickies quartzite.

Lower Cambrian: Southeastern Pennsylvania.

J. P. Lesley, 1876 (2d Pa. Geol. Surv. Rept. A, p. 60). *Chiques Rock,* in Susquehanna River above Columbia, may not be Potsdam ss. in northern N. Y. and at Bethlehem and Allentown. If Chiques Rock be not Potsdam, why then it remains simply *Chiques.*

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. CC, on York, Adams, and other counties, index). *"Chicques (or Chickies) quartzite, page 202."* [Page 202 describes the section at Wrightsville, York Co., and states that "a very thick bed of qtzite underlies the slates and schists of the Wrightsville section (Chicque's rock, etc.)."]

J. P. Lesley and P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_3, map of Lancaster Co.). *Chikis qtzite (Potsdam?).* [Shown as older than hydromica schists and argillites and younger than Peach Bottom roofing slates.]

P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_3, pp. 6–8, 19–20, 108). *Chikis qtzite.*—The qtzite of Chikis rock [Lancaster Co.] is representative of Primal ss. of Rogers. Is found in large mass only on northern half of composite hills known as "Chikis." The qtzite and quartz sl. which belong with it do not extend more than 115 paces (say 100 meters or yards) from the first bold, bare escarpment back of Prof. Haldeman's house to the point where the qtzite character appears to give place upwards to the somewhat chloritic hydromica schists so often spoken of. As a rule the schists which underlie the Chikis qtzite are much more chloritic than those which overlie it. The qtzite of Chikis rock can be followed out into and across the river, and it plays a part in the long ridge on the York Co. side. Chikis Ridge consists in the main of a qtzite replaced in portions by quartz sl. and chloritic schists.

J. P. Lesley, 1885 (2d Pa. Geol. Surv. Rept. X, map 35, of Lancaster Co., 1878). *Chikis qtzite (Potsdam?).* [Shown as younger than Peach Bottom roofing sl. and older than Lower calc. slates, hydromica schists, and argillites.]

P. Frazer, 1886 (Am. Phil. Soc. Proc., vol. 23, pp. 346, 398–400). *Hellam qtzite, Cambric.*—Same as Potsdam ss. and Formation No. 1. The base of the Paleozoic. A part of it composes Chickis Mtn. Contains *Scolithus linearis.* The *Hellam or Chickis qtzite* is a hard quartzose rock, generally white or gray, tinted by some other color, usually pink, brown, or blue. Is almost always crystalline. In Chester Co. it lies uncon. on Archean schists.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 165–204). *Chiques ss.* is not only the oldest name for our fm. No. 1, but expresses the locality of its finest exposure. Is same as Hellam qtzite of York Co., North Valley Hill ss. of Chester Co., White Spot ss. at Reading, "Potsdam ss." of Repts. of Prog. (probably not same as Potsdam ss. of N. Y.) and Primal ss. Only fossil found in Chiques rock is *Scolithus,* but obscure shell-like forms have been seen in Hellam quarries. Is overlain by York County hydromica slates (on which rests the Great Valley ls.) and is underlain by South Valley Hill hydromica slates.

F. Bascom, 1904 (U. S. G. S. W. S. P. 106, p. 13). *Chickies qtzite* underlies Chester Valley ls. and overlies Baltimore gneiss in Phila. dist.

A. I. Jonas, 1905 (Am. Geol., vol. 36, pp. 301+). *Chickies qtzite.*—Thinly bedded crystalline rock full of sericite, which gives it a buff to green color and schistose character. Rests uncon. on pre-Camb. Baltimore gneiss in Phila. area.

F. Bascom, 1909 (U. S. G. S. Philadelphia folio, No. 162). *Chickies qtzite.*—Massive qtzite, with quartz cgl. at base [Hellam cgl. memb.] and quartz schist in upper part. Thickness 1,300± ft. Underlies Shenandoah ls. and uncon. overlies pre-Camb. Wissahickon mica gneiss.

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 360–362). *Chickies qtzite.*—Consists of (1) massive-bedded, *Scolithus*-bearing, light-colored vitreous qtzite, grainy qtzite with clear quartz grains, and some white clay beds in upper part, 400 ft. thick in Hellam-Chickies Hills and 400 ft. thick in Welsh Mtn; resting on (2) Hellam cgl. memb., 600 ft. thick in Hellam-Chickies Hills and 150 ft. thick in Welsh Mtn. The Chickies is overlain by Harpers phyllite and uncon. underlain by pre-Camb. greenstone and aporhyolite in Hellam Hills, and by gneiss and granitic rocks in Welsh Mtn. Lesley and Frazer did not apply name Chickies to Harpers phyllite [but the Chickies qtzite of many subsequent repts included the Harpers schist or phyllite and the overlying Antietam qtzite].

The definition of Chickies qtzite now followed by U. S. Geol. Survey and Pa. Geol. Survey restricts the name to beds beneath Harpers schist or phyllite. The Hellam cgl. is treated as basal memb. of the fm.

Chico formation (also **group**).

Upper Cretaceous: California and Oregon.

W. M. Gabb, 1869 (Calif. Geol. Surv. Pal., vol. 2, p. XIV, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb on p. 129). *Chico group.*—One of most extensive and important members of Pacific coast Cret. Is extensively represented in Shasta and Butte Counties; also in foothills of Sierra Nevada as far S. as Folsom; on E. face of Coast Ranges bordering Sacramento Valley; at Martinez; and in Oristamba Canyon, in Stanislaus Co. It includes all known Cret. of Oreg. and extreme N. part of Calif., and is the coal-bearing fm. of Vancouver's Island. It underlies Martinez group and overlies Shasta group, but Martinez group may eventually prove to be worthy of ranking only as a subdivision of Chico group. Typical localities are Chico Creek [Butte Co.], Pence's ranch, and Tuscan Springs.

The Chico rocks consist of sss., shales, and cgls. of marine origin, varying in thickness up to 21,000 ft. and characterized by an Upper Cret. fauna. In Diablo Range the Chico is of very great thickness and becomes a group, divided into Moreno fm. above and Panoche fm. below.

Chicontepec formation.

Eocene: Mexico (Tampico embayment, north end).

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, pp. 133, 134).

Chicopee shale. (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 451–456). *Chicopee sh.*, or the calc. red sh. of the Triassic of Mass.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). [See 1898 entry under *Longmeadow ss.*]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 91–97). *Chicopee sh.*—A central band of Newark sediments, which begins at Holyoke, Mass., and is best exposed along railroad cut near Holyoke dam, where it consists of a thin dark-gray coaly calc. sh. or shaly ss., showing many impressions of raindrops, ripple marks, mud cracks, and angular markings. At mouth of Chicopee River and in bed of Conn. River at Mittineague the rock consists of red shales with many nodules and thin beds of concretionary ls. and casts of skeleton salt crystals in calcite. As the waters rose and attained greater width the central portion of the basin was occupied by a deposit of offshore sands, the Longmeadow ss., and when the max. width was reached the middle portion of the sss. decreased in size of grain to the fine-grained sand and mud beds which have become the central Chicopee sh. Immediately after the outflow of the sheet of Hampden diabase an explosive eruption took place locally, and blocks and pulverized dust of diabase were spread by the waters over a broad area, forming the Granby tuff. Then followed the uppermost layer of *rusty sands*, in which most of the tracks have been preserved. The whole was capped down the middle of basin by the thin Chicopee sh., in which only leaves and small tracks are found. From Holyoke to S. line of State the Holyoke diabase rests on Longmeadow ss. and Chicopee sh.

Chico Ridge limestone. (In Graford formation.)

Pennsylvanian: Central northern Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 31). The name *Chico Ridge ls.* is here given to thick ls. mass the outcrop of which forms the extensive upland known as Chico Ridge, S. of Chico and N. of Lake Bridgeport Dam. The ls. N. of Trinity River interfingers laterally into the shales S. of that stream.

Two prominent tongues of the ls. (Rock Hill ls. at base and Devils Den ls. at top) are well developed S. of the river. They thin to SW., however, and lens out near Willow Point, Wise Co., and Joplin, Jack Co., respectively. To S. of river the interval btw. Rock Hill and Devils Den lss. is filled with more than 300 ft. of shales and sss., here named *Jasper Creek shales,* which are exact strat. equivalents of Chico Ridge ls. N. of river. Most of the ls. mass is white or gray, hard, and reeflike, but a small part of lower portion is dark and somewhat shaly.

†Chico-Tejon series.

A term introduced by C. A. White (U. S. G. S. Bull. 51, pp. 11–14, 1889) to include all Upper Cret. and Eocene rocks of Calif., because they were then believed to constitute an unbroken series of sediments without unconformities, but they are now known to contain several unconformities.

Chicotte formation.

Silurian: Quebec (Anticosti Island).

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 715).

Chief Consolidated limestone.

Ordovician: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Chief Consolidated ls.*—Lss., of different colors and characters, 617 ft. thick, underlying 542 ft. of Blue Fossiliferous ls. and overlying Gemini ls. [Detailed section given. Evidently named for Chief Consolidated mine.]

Crane's Chief Consolidated and Gemini lss. compose Bluebell dol.

Chieftain Hill volcanics.

Tertiary(?): Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Survey Summ. Rept. 1909, p. 51).

Chignik formation.

Upper Cretaceous: Southwestern Alaska (Alaska Peninsula).

W. W. Atwood, 1911 (U. S. G. S. Bull. 467, pp. 24, 41–48, map). *Chignik fm.*—Cgl., ss., sh., and coal seams, 600+ ft. thick. Underlies Kenai fm. (Eo.) and overlies Herendeen ls. (Lower Cret.). Occurs on shores of Chignik and Herendeen Bays and near Douglas Village. Type section is in Whalers Creek, ½ mi. from shore of Chignik Lagoon. Fossils are Upper Cret.

Chikis quartzite.

See *Chickies qtzite*, the approved spelling.

Childers sand.

A subsurface sand, of Penn. age, in Childers field, Brown Co., north-central Tex., lying at 600 ft. depth.

Childress dolomite member (of Dog Creek shale).

Permian: Panhandle of Texas and central northern Texas (Childress to Nolan Counties).

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, p. 952, pl. 10). A gyp. and dol. bed, not more than 2 ft. thick, 150 ft. above Guthrie memb. of Blaine fm., is called *Childress dol.,* from outcrops in and around Childress, Childress Co. Can be followed southward to Nolan Co., the only extensive gaps being an area of windblown sand in northern Stonewall Co., and north-central Fisher Co. In central Stonewall Co. it forms escarpment W. of Aspermont, and is composed of a bed of blocky gyp. which changes laterally into dol. and farther S. is replaced by a gyp. bed which has been referrerd to locally as *Ideal gyp.* It has been considered best to use Childress dol. as dividing line btw. Blaine and overlying Whitehorse fm., as it is best marker near the strat. change. Is included in Blaine fm. [Authors use *Blaine* to include Dog Creek sh. (see chart, p. 948) and they show this dol.=top bed of Dog Creek sh.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). *Childress dol. and gyp.* is top memb. of Blaine fm., and lies 150± ft. above Guthrie dol. in Childress Co.; it is same as Ideal gyp., discarded.

The U. S. Geol. Survey treats this dol. as top memb. of Dog Creek sh.

Childress sand.

A subsurface sand, of Dev. age, in SW. W. Va. Considered as possibly of Genesee age. Named for Thomas Childress No. 1 well at Sarah, Cabell Co., W. Va.

Chilhowee group.

Lower Cambrian: Eastern Tennessee and western North Carolina.

J. M. Safford, 1856 (Geol. Reconn. Tenn., 1st Rept., pp. 149, 152–153). *Chilhowee sss. and shales.*—Great group of dark-gray, micaceous, sandy shales and sss., and grayish white quartzose layers, several thousand ft. thick, composing Chilhowee Mtn, in Sevier and Blount [Counties], Tenn. Near upper part of fm., more or less in all the Unaka Counties, heavy beds of grayish white quartzose ss. occur, generally freely pierced by peculiar rod-like fossil *Scolithus linearis*. Underlies Camb. (provisionally) Mag. ls. and sh. group (Calciferous ss.) and overlies Azoic Ocoee cgls. and slates.

J. M. Safford and J. B. Killebrew, 1874 (Resources of Tenn.) and 1876 (Elem. Geol. Tenn.), included in Chilhowee ss. all beds btw. †Knox ss. (Rome fm.) and †Ocoee group. This usage probably did not include the so-called "Beaver" ls., which was discriminated many years later.

A. Keith, 1895 (Phil. Soc. Wash. Bull., vol. 12, p. 75). *Chilhowee group* of Chilhowee Mtn consists of (descending): Sh., 300 ft.; fine white ss., 800 ft.; sh., 800 ft.; white ss., 500 ft.; sh., 1,000+ ft.; white ss., 700 ft.; and, at base, Chilhowee cgl., 700 ft.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16), mapped the rocks of Chilhowee Mtn as consisting of (descending) Hesse ss., Murray sh., Nebo ss., Nichols sh., Cochran cgl., and Sandsuck sh.

J. M. Safford and J. B. Killebrew, 1900 (Elem. Geol. Tenn.). *Chilhowee ss.* of Chilhowee Mtn includes (descending) Murray sh., Nebo ss., Nichols sh., Cochran cgl., Sandsuck sh., and Starr cgl.

The U. S. Geol. Survey draws base of Chilhowee group at base of Cochran cgl. and top at top of Hesse ss. According to C. Butts, *Olenellus* and brachiopods occur at top of Hesse qtzite and at top of Erwin qtzite and lowest fossils found occur in Murray sl., and consist of *Olenellus* and brachiopods.

†Chilhowee conglomerate.

Lower Cambrian: Southeastern Tennessee.

A. Keith, 1895 (Phil. Soc. Wash. Bull., vol. 12, p. 75, pl. 1). *Chilhowee cgl.*—Lower Camb. cgl., 700 ft. thick, forming base of Chilhowee Mtn and basal fm. of Chilhowee group.

Preoccupied. Same as Cochran cgl.

Chillicothe till.

A term that has been applied to a till sheet of Wisconsin stage extending from Ohio to northern Wis. and Minn. (See C. [R.] Keyes, Pan-Am. Geol., vol. 58, p. 203, 1932.)

Chilliwack series.

Carboniferous and older(?): Southern British Columbia and central northern Washington (121° 30′ to 122° 30′).

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 15, 16, and 17). [Shows following blocks:]

Carboniferous:

1. *Chilliwack volcanic fm.* (Chiefly flows of augite and hornblende andesites with ash beds.) [Appears to correspond to part of No. 2.]
2. *Chilliwack series.* (Outcrops of fossiliferous ls.)

Carboniferous and older(?):

Chilliwack series. (Argillite, qtzitic ss., and ls., with interbeds of grit and cgl.)

Exposed along Chilliwack River, B. C.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 508). *Chilliwack series* is 6,780+ ft. thick. Neither top nor base found. Lower 4,600+ ft. consists of fossiliferous sediments, over which Chilliwack River flows. Little doubt as to Carbf. age. Overlying these fossiliferous sediments is the memb. here named *Chilliwack volcanic fm.* It is distinctly Upper Carbf., and consists of 2,000+ ft. of andesitic flows, tuffs, and aggls. The Chilliwack volcanic fm. is overlain by (ascending): Gray calc. qtzite and argillite 60± ft.; light-gray ls., 50 ft.; dark-gray argillite, 20 ft.; qtzitic ss., 50+ ft. Top of Chilliwack series not found.

Chilliwack volcanic formation.

See under *Chilliwack series*, of which it is a part.

Chilliwack granodiorite.

Miocene(?): Southern British Columbia and central northern Washington.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2). *Chilliwack granodiorite.*—Batholith intrusion in Chilliwack series. Forms bed of Chilliwack Lake and spreads far out on all sides. Extends into Wash. Assigned to Mio.(?).

Chilton sandstones. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, p. 271). *Chilton ss.*—Dull gray or dove-colored, fine-grained, micaceous ss., often containing calcareo-siliceous layers. Thickness 30 to 50 ft. Underlies Lower Winifrede ss. and rests on Chilton coal. [Probably named for occurrence at Chilton, Kanawha Co.]

R. V. Hennen, 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., pp. xxvi–xxviii). *Upper Chilton ss.*—Dull-gray, medium grained, micaceous ss., 20 to 40 ft. thick; underlies Winifrede ls. and overlies Chilton coal. *Lower Chilton ss.*—Dull gray, micaceous, 10 to 25 ft. thick; overlies Little Chilton coal and underlies fire clay beneath Chilton coal. [On another page he stated that *Chilton ss.* is name given to lower portion of Lower Winifrede ss. when it is, as sometimes happens, divided; and described it as consisting of 10 to 30 ft. of fine-grained, micaceous, dull gray or dove-colored ss., often containing limy layers, as resting on Chilton coal, and as included in Lower Winifrede ss.]

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 52, 61, 68, 78, 102, 110, 147–151). *Upper Chilton ss.*—Grayish brown, massive, medium-grained, micaceous ss., 20 to 65 ft. thick; separated from overlying Chilton A coal by 8 to 18 ft. of fire clay and sh.; rests on Chilton rider coal (which lies 0 to 20 ft. above Chilton coal) or on Chilton coal; lies 11 to 27 ft. below Lower Winifrede ss. *Lower Chilton ss.*—Massive, bluish gray and light gray, micaceous, medium grained and aren., 0 to 50 ft. thick; lies 0 to 5 ft. below Chilton coal and overlies Little Chilton coal.

Chimneyhill limestone.

Silurian (Niagaran and earlier): Central southern Oklahoma.

C. A. Reeds, 1911 (Am. Jour. Sci., 4th, vol. 32, pp. 256–268). *Chimneyhill ls.*—Top memb., pink crinoidal ls. 0 to 39 ft. thick, averaging 15 ft.; middle memb., glauconitic ls. 0 to 25 ft. thick, averaging 15 ft.; lower memb., oolitic ls. 0 to 12 ft. thick, averaging 5 ft. Originally included as basal memb. of Hunton fm. Uncon. underlies Henryhouse sh. and uncon. overlies Sylvan sh. Corresponds to Ohio Clinton (Brassfield ls.). It is named after Chimneyhill Creek, which crosses the fm. in NE. corner of Arbuckle Mtns. The type loc. is at confluence of 3 small creeks, sec. 4, T. 2 N., R. 6 E. Since there were no geographic names in this region suitable for fm. names it was necessary to change "South Fork of Jack Fork" Creek to Chimneyhill Creek.

C. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470–474). Fossils of Chimneyhill ls. correspond to Ohio Clinton and Brassfield beds.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 30). Chimneyhill ls. is of early Niagaran and late Medina age.

E. O. Ulrich, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73). *Chimneyhill* corresponds to (descending) St. Clair ls., Brassfield ls., and Noix ls. (post-Richmond). It uncon. overlies Sylvan sh.

Chinati series.

Permian: Southwestern Texas (Shafter district, Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10–25). *Chinati series.*—Shales, cgls., and lss., 5,938 ft. thick, changing from conglomeratic rocks below, through aren. beds and clays to lss. above. Divided into (descending) Cibola lss., Alta beds, and Cieneguita beds. Fossiliferous. Uncon. underlies Lower Cret. Presidio beds and overlies granite.

Assigned to Perm. by C. L. Baker, 1929 (Univ. Tex. Bull. 2901, pp. 73+). Is a local name for all of Perm. in Chinati Mtns.

Chinitna shale.

Upper Jurassic: Central southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 485, p. 65, table opp. p. 30, map). *Chinitna sh.*—Sh., with subordinate amounts of ss. and ls. Thickness 1,300 to 2,400 ft. Rests with apparent conformity on Tuxedni ss. and is overlain by Chisik cgl. Well exposed on W. side of Chisik Island, on both shores of Chinitna and Oil Bays, and on E. shore of Iniskin Bay. Fauna, according to T. W. Stanton, indicates boreal facies of Callovian stage [of European classification], which belongs at top of Middle Jurassic or base of Upper Jurassic. [The fm. was in this rept assigned to Middle Jurassic, but the Callovian fauna has for many years been classified as Upper Jurassic.]

Chinle formation.

Upper Triassic: Northern Arizona, southern Utah, southeastern Nevada, southwestern Colorado, and northern New Mexico.

H. E. Gregory, 1915 (Am. Jour. Sci., 4th, vol. 40, p. 102). *Chinle fm.* overlies Shinarump cgl. and underlies La Plata group in Navajo Ind. Res., Ariz. Name adopted for forthcoming rept. [Not described.]

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380). *Chinle fm.*—In Navajo country consists of (descending): (1) Red sh. and shaly ss.; (2) lenses of ls. cgl. containing red sh.; (3) purple, lavender, green, and light-colored variegated shales with ls. cgl. lenses; (4) chocolate-colored aren. shales, at base. Thickness 400 to 1,000 ft. Overlain, uncon.(?), by Wingate ss. and underlain, uncon.(?), by Shinarump cgl. The Chinle contains the fossil forests. Named for Chinle Valley, NE. Ariz.

For distribution and further details see U. S. G. S. P. P. 93, 1917 (by H. E. Gregory); U. S. G. S. P. P. 129, 1922 (by J. B. Reeside, Jr., and H. Bassler); U. S. G. S. Bull. 726, 1922 (by N. H. Darton); U. S. G. S. P. P. 132, 1923 (by C. R. Longwell); U. S. G. S. Bull. 751, 1924 (by H. D. Miser); U. S. G. S. P. P. 150, 1928 (by J. Gilluly and J. B. Reeside, Jr.); and U. S. G. S. P. P. 183, 1936 (by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.). In all of the States listed above the fm. underlies Wingate ss. and overlies Shinarump cgl.

Chino Quarry quartzite.

Paleozoic(?): Southern California (Riverside County).

J. W. Daly, 1935 (Am. Min., vol. 20, No. 9, pp. 638–647, map). *Chino Quarry qtzite.*—Interstratified thin-bedded qtzite and fissile mica schists. Thickness 75+ ft. Contact with overlying Sky Blue Quarry ls. obscured by intrusives; may be uncon. Where contact with underlying Chino Quarry ls. is exposed it appears to be conformable, but is partly obscured by intrusives. Included in Jurupa series. Named for quarry at Crestmore.

Chino Quarry limestone.

Paleozoic(?): Southern California (Riverside County).

J. W. Daly, 1935 (Am. Min., vol. 20, No. 9, pp. 638–647, map). *Chino Quarry ls.*—White, medium- to thin-bedded and, medium to coarsely granular ls.; graphitic beds throughout, but more common near base. Thickness 470+ ft. Best exposed in Chino Quarry, at Crestmore. Included in *Jurupa series*. *Probably conformable* with overlying Chino Quarry qtzite, and possibly conformable with underlying undiff. complex of Jurupa series.

Chipmonk sand.

A subsurface sand, of probable Dev. age, in Chipmonk pool of Cattaraugus and Allegany Counties, SW. N. Y. (See N. Y. State Mus. Bull. 239, 240, map opp. p. 16, 1922.) Some repts spell this name *Chipmunk*.

†Chipola marl member (of Chipola formation).

Miocene (lower): Northern Florida and southeastern Alabama.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 112–113, 120, 122, 157, 324). *Chipola marl.*—The lower bed (marl), 5 ft. thick, at Alum Bluff; characterized by *Orthaulax gabbi* Dall. At Baileys Ferry, on Chipola River, the Chattahoochee beds are overlain by a stratum of yellowish calc. sand containing well preserved fossils, identical with those at Alum Bluff, but in much better condition. Underlies Alum Bluff beds and overlies Chattahoochee ls.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., p. 102). *Chipola marl memb.* consists of a light gray to yellow marl, containing many shells and shell fragments. The matrix is composed of calc. clay containing a small percentage of fine sand. When weathered the marl becomes dark yellow or reddish yellow, from presence of hydrated iron oxide. Not known to have a thickness of more than 15 ft. and average is probably only a few ft. In some localities is represented by a very sandy marl. The Chipola marl memb. forms basal portion of Alum Bluff fm. and rests conformably on either the Chattahoochee or the Hawthorne fm. At type loc. of Alum Bluff fm. it constitutes basal div. of that fm., but farther N. it thins and permits the sandy beds of the Alum Bluff to overlap on the Chattahoochee.

Later studies by Julia Gardner resulted in finding the Chipola fauna in all beds stratigraphically btw. base of true Oak Grove sand and top of †Chattahoochee fm., and the name *Chipola fm.* was therefore adopted (U. S. G. S. P. P. 142, p. 2, 1926) to include not only †Chipola marl memb. of earlier repts but all overlying sands and clays up to horizon of Oak Grove sand.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Typical "Chipola marl" is a fine blue-gray to yellow sand loaded with shells. It is confined to vicinity of Chipola and Apalachicola Rivers, where it forms bottom memb. of Chipola fm. and is about 10 ft. thick.

Named for exposures on Chipola River, especially at McClelland farm, S. of Tenmile Creek, Jackson Co., Fla.

Chipola formation. (In Alum Bluff group.)

Miocene (lower): Northwestern Florida and southeastern Alabama.

Julia Gardner, 1926 (U. S. G. S. P. P. 142, pp. 1–2). *Chipola fm.*—Clays, marls, and sands overlying Chattahoochee fm. [Tampa ls.], and lying stratigraphically lower than Oak Grove sand. Characterized by distinctive fauna. Is basal fm. of Alum Bluff group. Includes "Chipola marl memb." of Matson and others and overlying sands and clays.

Named for exposures on Chipola River, Jackson Co., Fla. Type at McClelland's farm, near Bailey's ferry, N. part of Calhoun Co., Fla.

†Chipola beds.
†Chipola group.
†Chipola series.
†Chipola stage.
†Chipolan stage.

Terms used in early repts to include Miocene deposits (Alum Bluff group and Tampa ls.) of Fla., and now abandoned in favor of better-established and more useful name *Chipola fm.*, which is applied to basal fm. of Alum Bluff group.

Named for exposures on Chipola River, northern Fla.

Chippewa quartzite.

Pre-Cambrian (upper? Huronian): Central northern Wisconsin (Chippewa County).

E. T. Sweet, 1876 (Wis. Acad. Sci. Trans., vol. 3, pp. 40–55). On the Chippewa is a qtzite which has a layer the lowest stratum of which is a reddish metamorphic cgl. 300 ft. thick. The pebbles of this cgl. are either jasper or amorphous quartz. The cgl. and qtzite are distinctly and heavily bedded.

C. R. Van Hise, 1892 (U. S. G. S. Bull. 86, pp. 186–187, 195, and map, pl. 6). *Chippewa qtzites* assigned to upper Huronian. Younger than Baraboo qtzites. [On map they are called *Chippewa Valley qtzites.*]

R. D. Irving, 1892 (U. S. G. S. Mon. 19, pl. 1), mapped *Chippewa Valley qtzite.*

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 388). Slight metamorphism and geographical relations suggest upper Huronian age for the qtzite on Chippewa River.

Named for exposures on Chippewa River, Chippewa Co.

†Chippewa felsite. (In Ashbed group.)

Pre-Cambrian (Keweenawan): Northern Michigan (Porcupine Mountains).

W. C. Gordon, 1905 (Mich. Acad. Sci. 7th Rept., pp. 188–195). Felsite, having a known thickness of 460 ft. and cannot exceed 1,400 ft. called *Chippewa felsite* for convenience. Outcrops only in Black River and on Chippewa Bluff [near Bessemer, Gogebic Co.].

See also A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 560, 1911).

†Chippewa porphyry. (In Ashbed group.)

Pre-Cambrian (Keweenawan): Northern Michigan (Porcupine Mountains).

A name locally applied to a porphyritic facies of †Chippewa felsite. (See F. E. Wright and A. C. Lane, 1909, Mich. Geol. Surv. Rept. State Board for 1908, pl. 1.)

Chippewa granite.

Pre-Cambrian: Northwestern New York (Hammond quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 86). Differs from other fine-grained granite masses of region in that the potassic feldspar is almost wholly microcline instead of microperthite. Intrudes Grenville series. [Derivation of name not stated, but on p. 172 he speaks of granite exposed in valley of Chippewa Creek.]

†Chippewa Valley quartzite.

See under *Chippewa qtzite.*

Chiques quartzite.

See *Chickies qtzite.*

Chiquito sandstones.

Permian: Northern Arizona (Grand Canyon).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 336). *Chiquito sss.*—Sss. 50 ft. thick, underlying Huethawali lss. and composing basal fm. of Aubreyan series. Uncon. above [?] Coconino ss. Named for good exposures in lower valley of Rio Chiquito Colorado, Ariz.

Chiricahua limestone.

Permian: Southeastern Arizona (Chiricahua Mountains).

A. A. Stoyanow, April 30, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 532, 536). *Chiricahua ls.*—The youngest Perm. beds in SE. Ariz. which have same fauna as occurs in memb. B of Kaibab fm. of Grand Canyon. [Fossils listed.] [Objects to

R. E. King's proposal to use *Gym* for the Perm. of SE. Ariz., as present evidence does not warrant detailed and direct correlation.] Considered younger than Snyder Hill fm. Forms top of Carbf. sequence in Chiricahua Mtns near N. Mex. border.

Chiricahuan series.

A term introduced by C. [R.] Keyes to cover 300 ft. of qtzites (called *Lone* by him) of late Camb. age in N. Mex. and Ariz. Named for Chiricahua Range, N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 6.)

Chisholm shale.

Middle Cambrian: Eastern Nevada (near Pioche).

C. D. Walcott, 1916 (Smithsonian Misc. Coll., vol. 64, No. 5, Pub. 2420, pp. 409–410). *Chisholm shales.*—Pinkish, compact, argill. sh. with a few interbedded layers of ls. 3 to 15 inches thick. Thickness 100 to 125 ft. Type loc. is vicinity of Chisholm mine and Half Moon Gulch, 2 to 3 mi. NW. of Pioche. Contains Middle Camb. fossils [listed]. Lies about 1200 ft. above Lower Camb.

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Engrs. Trans., No. 1647, p. 5), and 1932 (U. S. G. S. P. P. 171). *Chisholm sh.* is 0 to 180 ft. thick in Pioche region, where it conformably underlies ls. here named *Highland Peak ls.* and conformably overlies ls. here named *Lyndon ls.* Is fine-grained, yellow brown to red, laminated, argill. sh. that weathers to small flat debris; contains interbedded lss. No mica. Fossils abundant (listed).

Chisik conglomerate member (of Naknek formation).

Upper Jurassic: Southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 485, pp. 68–69). *Chisik cgl.*—Predominantly coarse cgl. of well-rounded pebbles of granite and other crystalline rocks in andesitic tuffaceous matrix. Thickness 290 ft. at Iniskin Bay and probably somewhat thicker at Chisik Island. Overlies Chinitna sh. (Middle Jurassic) and underlies Naknek fm. (Upper Jurassic). Lithologically more closely related to Naknek fm., and therefore interpreted as basal cgl. of the Upper Jurassic.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 170–171, 273–274, charts, etc.). *Chisik cgl.* at type loc., on Chisik Island, is 300–400 ft. thick, and is conformable with both Chinitna sh. and *Aucella*-bearing beds of Naknek fm. It was called Upper Jurassic "aggl." by Martin in 1905 (U. S. G. S. Bull. 250, p. 44), and was described by Martin and T. W. Stanton (Geol. Soc. Am. Bull., vol. 16, p. 406, 1905) as a local lens of coarse aggl. constituting basal part of Naknek fm. It has recently been considered best by U. S. Geol. Survey to classify it as a local basal memb. of Naknek fm.

Chisna formation.

Carboniferous: Southeastern Alaska (central Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 33, map). *Chisna fm.*—Tuffs, qtzites, and cgls. with associated igneous rocks consisting of porphyritic intrusives and their effusive representatives. At base qtzitic cgl. 75 ft. thick. Outcrops at head of Chisna River and in hills E. and W. of the Chisna. No fossils. Tentatively assigned to lower Carbf. or Dev.

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, chart opp. p. 52, pp. 82–83), referred Chisna fm. to Carbf.

Chisos beds.

Upper Cretaceous (?): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 60–67). *Chisos beds.*—Tuffaceous sediments, stratified in thin and well-defined ledges and layers. Great bulk of strata bluish gray or white stratified rock in even, thoroughly consolidated ledges, with occasional layers of clay and ss. and even thin layers of cgl. Thickness at least 2,000 ft. Includes Crown cgl. at top. Grades into underlying Tornillo clays. Underlies Tert.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, p. 513), did not include Chisos beds of Udden in the Cret., but considered the underlying Tornillo clay as probably the highest Cret. fm. of that region (see p. 508). He stated that no fossils are known from these beds.

Named for Chisos Mtns, Brewster Co.

Chispa andesite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 64, etc.). *Chispa andesite.*—One to five flows of brownish gray porous andesite interbedded in the dacite vitrophyre on Chispa Hills. Younger than Milltown andesite and older than Meda rhyolite.

Chispa Summit formation.

Upper Cretaceous (Gulf series): Southwestern Texas (Jeff Davis County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 271, 426, 431). The Eagle Ford equivalent in Chispa Summit region, western Jeff Davis Co., has almost entirely the clay facies, with a subordinate amount of thin platy layers and bands of septaria and concretions. It is here called *Chispa Summit fm.* At Chispa Summit it overlies the Buda, apparently concordantly. Is overlain by Colquitt fm.

Chita sand member (of Catahoula formation).

Miocene ? (lower Mio ?): Eastern Texas (Trinity and Polk Counties).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 715, 717). *Chita sand memb.* introduced to include the coarsely textured, and in places conglomeratic, basal sands of Catahoula fm. exposed at Chita [Trinity Co.] and Corrigan [Polk Co.]. Kennedy named this sand *Corrigan,* and Dumble referred to it as *Catahoula memb. of Corrigan fm.* Since Dumble, Udden, Baker, and others have used *Corrigan* for whole Catahoula fm., it is confusing to use the name again in its original restricted sense, and it seems best to drop the name. Chita sand is 10 to 80 ft. thick, has white, polished grains called "rice sands," and is in places solidly cemented to hard qtzite with siliceous cement.' In most places it forms a persistent cuesta. Underlies Onalaska tuff memb. of Catahoula fm., and rests on Fayette fm. Type loc., the exposures along north facing escarpment near Chita, Trinity Co.

Chitistone limestone.

Upper Triassic: Eastern Alaska (Nizina-Tanana region).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 426). *Chitistone ls.*—Massive bed of dark-brown, dense, aphanitic ls. that weathers gray. Often brecciated. Overlies Nikolai greenstone and underlies McCarthy Creek sh. Thickness 500 ft. or more. Exposed at junction of Nizina and Chitistone Rivers, hence name. [On several pages (429, 431, 435, etc.) Rohn called this ls. *Nizina ls.*]

G. C. Martin, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 690), introduced *Nizina ls.* for the thin-bedded lss., shaly toward top, forming upper, and conformable, part of Chitistone ls. as first defined, and restricted *Chitistone ls.* to the lower massive lss. This is present approved nomenclature of U. S. Geol. Survey. (See also G. C. Martin, U. S. G. S. Bull. 776, 1926.)

Chittenango member. (In Marcellus shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 131, 219, etc.). *Chittenango memb. of Marcellus sh.*—Jet-black, fissile, non-calc. sh. overlying Cherry Valley ls. memb. of Marcellus from eastern N. Y. nearly to Cayuga Lake. Is separately designated because it is non-calc., nearly barren of fossils, and represents only part of time interval of Oatka Creek sh. of western N. Y. Type section is in a small gully 0.7 mi. N. of village of Chittenango Falls, where entire section, 120 ft. thick, is exposed. At top it interfingers with the blue-black Cardiff sh.

G. H. Chadwick, 1933 (16th Int. Geol. Cong. Guidebook 9A, p. 4), divided the Marcellus W. of Catskill region into (descending): Mount Marion ss., 800 ft., and *Chittenango black sh.,* 200 ft., and stated that the Chittenango of that region is probably=Union Springs, Cherry Valley, and *Chittenango members* of the Marcellus farther W. in N. Y.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 34). [See this entry under *Marcellus sh.*]

Chloride formation.

Devonian or Mississippian (?): Southwestern New Mexico (Sierra County).

C. R. Keyes, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 360–362). *Chloride fm.*—Dev. lss., 200 ft. thick. Underlie Lake Valley ls. and overlie Ord. lss.

Probably named for town in NW. part of Sierra Co., and probably refers to Dev. Percha sh. of present nomenclature or lower part of Lake Valley ls. (Miss.).

Chloridian series.

A term introduced by C. [R.] Keyes to cover 75 ft. of Upper Camb. lss. (called by him *Carrasco*) in N. Mex., and Abrigo ls. (700 ft. thick) of Ariz. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 6.)

†*Choccolocco shale.*

Lower Cambrian: Alabama.

See explanation under †*Montevallo sh.*

†Chocolate limestone.

A name, based on color of the rock, applied by G. C. Swallow to a ls. in Kans. that is now known as *Tarkio ls.*, according to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 229).

Chocorua granite.

Late Devonian or late Carboniferous: Northern New Hampshire (Mount Chocorua quadrangle, White Mountains).

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545). *Chocorua granite.*—Crystalline labradorite that gave rise to Chocorua Peak. Assigned to Labrador (pre-Huronian) period.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 154, 230, pl. xi). A typical variety of *Chocorua granite* consists only of greenish feldspar, apparently orthoclase and amorphous smoky quartz. At E. base of Chocorua Mtn there is a similar rock of greenish gray color, very fine-grained, prevailing to exclusion of everything else. These 2 types of rock represent our Chocorua granite. I called them labradorite, perhaps erroneously, in pt. 1. [On p. 230 he *tentatively* divided his *Chocorua group* into 3 parts, the third part being the sienite, and said: Whether these 3 kinds really belong to different eruptive periods, or should properly be grouped as one, is a question for the future.] Is younger than Conway and Albany granites, all of which belong to Eozoic or early Paleozoic. They cut Eozoic rocks.

M. Billings, 1928 (Proc. Am. Acad. Arts and Sci., vol. 63, No. 3, pp. 67–137, map). *Chocorua group.*—Same as Chocorua group of Hitchcock. Divided into riebeckite granite, hastingsite granite, and nordmarkite. Is intrusive. Assigned to Dev. (?). Well exposed on Mount Chocorua. [On his map he placed his Chocorua group btw. his Albany group (below) and his Conway group (above). In 1935 he assigned all of these intrusives to late Dev. or late Carbf.]

M. Billings, 1935 (letter dated Aug. 27). *Chocorua granite* belongs to White Mtn magma series.

†Choctaw buhrstone. (In Claiborne group.)

Eocene (middle): Southern Alabama and Mississippi.

W J McGee, 1890 (Am. Jour. Sci., 3d, vol. 40, pp. 27, 30, 32). Over the ridge [in vicinity of Meridian, Miss.] formed by the peculiar siliceous rocks of Eocene age called by Smith [unpublished] *Choctaw buhrstone*, the Appomattox [fm.] is uncommonly obdurate. (Page 27.) Still farther S. lies the great siliceous deposit of the middle Eocene commonly known as Buhrstone—the Choctaw buhrstone of Smith [unpublished]. (Pages 29–30.)

In 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, pp. 491, 493, 494) McGee introduced *Meridian fm.* to replace nongeographic term "Buhrstone," but other workers seem to have overlooked this name, as they continued to use "Buhrstone" until 1898, when W. H. Dall (U. S. G. S. 18th Ann. Rept., pt. 2, p. 344 and chart opp. p. 334) introduced *Tallahatta* (from Ala.) and *Orangeburg* (from S. C.) to replace "Buhrstone." *Tallahatta* soon gained currency as a name for the "Buhrstone" of Ala. and Miss.

"Orangeburg," however, was not adopted into the nomenclature of S. C., and more recent studies have shown that the beds to which the name presumably was intended to apply constitute the later discriminated McBean fm.

Name undoubtedly derived from the broad belt of the fm. across Choctaw Co., Ala.

†Choctaw limestone.

Lower Cretaceous (Comanche series): Northeastern Texas.

F. W. Cragin, 1894 (Colo. Coll. Studies, vol. 5, p. 41). *Choctaw ls.*—Fossiliferous quarry ls., 5 to 15 ft. thick, forming lower memb. of *Exogyra arietina* marl and Main Street ls. Underlies Grayson marls and overlies Pawpaw clays.

Same as Main Street ls. memb. as later restricted.

Named for Choctaw Creek, Grayson Co.

Choctawhatchee formation.

Miocene (upper and middle): Western Florida and St. Johns Valley, Florida.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 114–122). *Choctawhatchee marl.*—Greenish to light-gray sandy shell marl and greenish gray plastic sandy clay. Thickness 30 to 50 ft. Rests uncon. on Alum Bluff group and is overlain by Plio. beds. Is of marine origin.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Name changed to *Choctawhatchee fm.*, because the marl beds that contain the characteristic fossils of the Choctawhatchee make up only a part of fm. and are less persistent than the clay. Divided into (descending): (1) *Cancellaria* zone and (2) "aluminous clay," both upper Mio.; (3) *Ecphora* zone, (4) *Arca* zone, and (5) *Yoldia* zone, all middle Mio.

Named for exposure on Choctawhatchee River in Walton Co.

Chokecherry dolomite.

Lower Ordovician: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Chokecherry dol.*—Characterized by considerable silica, which occurs both as nodules and bands of chert, usually of dark gray to black color, and as sandy laminæ btw. thin beds of dol. Lower beds as a rule are rather massively bedded chert-bearing dark-mottled dol., locally oolitic and cross bedded and containing thin lenses of dol. cgl. These beds are supplanted higher in fm. by thinner bedded dol. with sandy laminæ or, locally, by bands of chert. Lower Ord. fossils near top. Thickness 850 to 1,000+ ft. Absent in N. part of area, so that there must be pronounced uncon. above the fm. Lies uncon. on Hicks fm. and is overlain by Fish Haven dol. Named for exposures in Chokecherry Canyon, just S. of Gold Hill quad.

See also U. S. G. S. P. P. 177, 1934.

Chopaka schist.

Carboniferous(?): Central northern Washington.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). *Chopaka schist.*—A large patch of schist that crowns Chopaka Mtn. Very similar to Kruger schist (Carbf.?), with which it may be contemp. May possibly be Triassic

Chopaka basic intrusives.

Carboniferous(?): Southern British Columbia and central northern Washington.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). *Chopaka basic intrusives.*—A strong body of gabbro apparently transitional into pure olivine rock. Cuts Chopaka schist, which caps Chopaka Mtn, Wash. May be Carbf. or Triassic.

Choptank formation.

Miocene (middle): Eastern Maryland and Virginia.

G. B. Shattuck, 1902. [See under *St. Marys fm.*]

W. B. Clark, 1903 (Md. Geol. Surv. St. Marys Co. Atlas). *Choptank fm.*—Middle fm. of Chesapeake group. Thickness 112 ft. Consists (descending) of sandy clay, fossil bed, sandy clay, fossil bed, clay and sand. Underlies St. Marys fm. and overlies Calvert fm.

Named for exposures on Choptank River, Md., a short distance below Dover Bridge, Talbot Co.

Chorreras granite.

Age(?): Mexico.

R. H. Burrows, 1910 (Soc. geol. Mexicana Bol., t. 7, p. 100).

Choteau limestone.

Incorrect spelling of *Chouteau ls.*

Chouteau limestone. (Of Kinderhook group.)

Mississippian: Central and eastern Missouri and southwestern Illinois.

G. C. Swallow, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pt. 1, p. 101 and sections opp. pp. 98, 103). *Chouteau ls.*—In Cooper Co. region upper part is thick-bedded, brownish gray, earthy, silico-mag. ls. 40 to 50 ft. thick; lower part compact, blue or drab, thin-bedded ls. 20 ft. thick. Underlies Encrinital [Burlington] ls. and overlies Vermicular ss. and shales [Hannibal sh.]. Included in Dev. Thins to E. and is only 10 to 30 ft. thick in Marion Co.

F. Springer, 1920 (Smithsonian Pub. 2501, p. 196). The upper part of what in Mo. is called the "Chouteau" is same thing as Lower Burlington beds in Iowa.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser.), restricted Chouteau ls. to lower memb., which he correlated with upper part of Kinderhook group, and named the upper memb. *Sedalia ls.*, which he correlated with Fern Glen ls., and assigned both to Osage group. This is present generally accepted definition of Chouteau ls.

See also under *Kinderhook group.*

Named for Chouteau Springs, Cooper Co., Mo.

†Chouteau group.

Mississippian: Missouri.

G. C. Broadhead, 1874 (Mo. Geol. Surv. vol. 1, pp. 26–65). *Chouteau group* proposed *to replace "Chemung" of old Mo. repts. Includes (descending)* Chouteau ls., Vermicular ss. and shales [Hannibal sh.], and Lithographic [Louisiana] ls.

Replaced by Kinderhook group, older name.

Named "for chief member of the group" [Chouteau ls.].

†Chowan formation. (Of Columbia group.)

Pleistocene: Coastal Plain of North Carolina, Virginia, and Maryland.

W. B. Clark, 1910 (Geol. Soc. Am. Bull., vol. 20, p. 651). Name proposed by L. W. Stephenson in unpublished ms. In N. C. the Talbot terrace divides into two terraces, constituting Chowan and Pamlico fms.

L. W. Stephenson, 1912 (N. C. Geol. Surv. vol. 3, pp. 282–286). *Chowan fm.*—Sandy loams, more or less aren. clays, sands, and gravels; the coarser materials at base, and grading up into finer sands and loams at top. Thickness 15 or 20 ft. Surface of fm. forms a plain that slopes up from elevations of about 25 to 40 ft. above sea level along its E. edge to about 50 ft. along foot of escarpment separating it from Wicomico plain above. Where it passes up river valleys, however, it probably reaches max. elevations of 70 ft. at inland extremities of extensions. Older than Pamlico fm. (25-foot terrace) and younger than Wicomico fm. (50 to 100-foot levels). Included in Columbia group. Named for Chowan River, N. C., to S. of which, in Hertford Co., the plain forming the surface of the fm. is typically developed.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 19, 1931). The following reclassification of Pleist. terrace fms. of Md., Va., and N. C. is proposed:

Pamlico fm., 25-foot level.

Talbot fm. *restricted,* 40-foot level.

(Same as *typical* "Chowan", abandoned, but not same as "Chowan" *as defined,* which included the deposits on 25, 40, and 70-foot levels.)

Penholoway terrace (deposits not yet named), 70-foot level.

[These deposits have heretofore been included in Wicomico to N. and in † Chowan to S., and are now called *Penholoway fm.*]

Wicomico fm. *restricted,* 100-foot level.

See also under *Columbia group.*

Choza formation.

Permian: Central and central northern Texas.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, map, p. 49). *Choza fm.*—Includes rocks from top of Bullwagon dol. to [uncon. in later repts] base of San Angelo fm. Consists of a series of red shales separated by groups of thin dol. beds, some of which are fossiliferous. Highest dol. in fm. is Merkel dol., which lies 270 ft. below top of fm. Thickness of fm. 870 ft. Named for Choza Mtn, near Tennyson, Coke Co.

J. W. Beede and D. D. Christner, 1926 (Univ. Tex. Bull. 2607). Near Sagerton [Haskell Co.] San Angelo fm. cuts out underlying Merkel dol., but on Colorado River S. of Bronte, Coke Co., its base is 270 ft. above Merkel dol.

Christie member (of Dundas formation).

Ordovician: Ontario.

M. Fritz, 1926 (Roy. Soc. Canada Proc. and Trans., 3d ser., vol. 20, pt. 1, sec. 4, p. 89).

Chrysler waterlime.

Silurian (Cayugan): Central New York (Syracuse region).

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 81). *Chrysler waterlime ("Rondout" of this region).*—Overlies Akron dol. and uncon. underlies Manlius group. Lies at top of Bertie (Tonoloway) group in central N. Y. Named for Chrysler's Glen [Syracuse quad.].

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 16–18), named the basal fm. of Manlius group in Skaneateles quad. the *Olney ls.;* stated that it rested on Chrysler fm. (as identified by him in this quad., on basis of strat. position and lithology); and that so far as he had been able to determine typical Chrysler is without fossils.

Chuar group.

Pre-Cambrian: Northern Arizona.

C. D. Walcott, 1883 (Am. Jour. Sci., vol. 26, pp. 439–442, 484). *Chuar group.*—Sandy and clay shales with interbedded sss. and lss., which are exposed in inner canyon valleys of Grand Canyon of the Colorado. Top group of Grand Canyon series. Overlies uncon. the Grand Canyon group [Unkar group].

C. D. Walcott, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pl. 60, etc.). *Chuar terrane.*—Upper div. consists of 1,700 ft. of sss. and shales with some ls. beds, reddish, brown, black, gray, buff, etc. in color; base is massive bed of reddish brown ss. Lower div. consists of 3,420 ft. of shales and sss. with some ls. beds; of brown, gray, black, drab, and chocolate color; basal part consists of argill. shales resting on massive mag. ls. Uncon. underlies Tonto and overlies Unkar terrane.

Named for Chuar Valley, Grand Canyon region.

Chuarian series.

A name employed by C.[R.] Keyes instead of *Chuar group* of other geologists.

Chubb siltstone member (of Maroon formation).

Permian: Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 971–1009). *Chubb siltstone memb. of Maroon fm.*—Gray to red brown siltstone, argill. and calc. near base, with sss. in upper part. Is 1,827 ft. thick on E. side of Chubb Gulch in sec. 16, T. 13 S., R. 77 W., for which it is named. Assigned to Perm. Conformably underlies Pony Spring siltstone memb. and conformably overlies Coffman cgl. memb., in Salt Creek area, Park and Chaffee Counties.

Chu Chua formation.

Eocene: British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 82).

Chuckanut formation.

Eocene (lower): Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 93, 136–138). *Chuckanut fm.*—Cross-bedded, arkosic sss. and cgls., with coal beds, occurring on N. part of Lummi Island and in vicinity of Bellingham Bay to E. They form lower part of White's Puget group. Thickness 500 ± ft. Contain leaves and plants identified by F. H. Knowlton as lower Eocene. Of brackish or fresh-water origin. Well exposed along Chuckanut Drive on Pacific Highway.

Chuctenunda.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Chuctenunda* introduced for upper middle Canajoharie or zone of *Lasiograptus eucharis* in Mohawk Valley.

Chugwater formation.

Triassic and Permian: Wyoming (rather widespread) and central southern Montana.

N. H. Darton, 1904 (Geol. Soc. Am. Bull. vol. 15, pp. 394–401). *Chugwater fm.* proposed for series of red beds extending along foot of Bighorn Range southward through Wyo. and Colo. In Black Hills region the red beds are divided near base by a ls. designated *Minnekahta,* and although there appears to be a continuous representative of this ls. in Bighorn uplift, a definite correlation cannot be ventured, so that a name is required for the undivided red beds. Thickness (1,250 ft.) is also greater than in Black Hills, but the fm. is believed to correlate with Spearfish, Minnekahta, and Opeche of that region. It uncon. underlies Sundance fm. (Jurassic), overlies Tensleep ss. (Carbf.), and is of Permian and Triassic(?) age. Named for Chugwater Creek near Iron Mtn, Wyo.

In 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 403–463) Darton divided the red beds of SE. Wyo. (Laramie Basin region) into (descending) Chugwater fm. (Perm. or Triassic), Forelle ls. (Carbf.), and Satanka sh. (Carbf.). He stated that the Forelle was separated on account of its fossils; but for which the ls. and underlying Satanka sh. might be regarded as a portion of Chugwater fm.

Later it was found that in some areas the upper part of red beds included in Chugwater fm. contained an Upper Jurassic (Sundance) marine fauna; and these beds are now included in Sundance fm. Still later the upper part of the restricted Chugwater was removed and named *Popo Agie beds* by Williston and *Jelm fm.* by Knight, and this restricted definition is that now employed by U. S. Geol. Survey. The Chugwater is almost wholly nonmarine, and as now interpreted is of Triassic and Perm. age. It usually uncon. underlies Sundance fm., but in places is overlain by intervening Jelm fm. In Wind River Mtns the characteristic Chugwater redbeds rest on Dinwoody fm. In other parts of Wyo. the redbeds occupy a much larger strat. interval and rest on Tensleep ss. In SE. Wyo. the Chugwater has been described as resting on Forelle ls., which overlies the red Satanka sh.; but H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1670, 1687), described Forelle ls. as an E. extension of middle part of Phosphoria fm., and Satanka sh. as basal part of Chugwater fm. as originally defined. He therefore applied *Satanka tongue of Chugwater fm.* to Satanka sh. of Darton, *Forelle tongue of Phosphoria fm.* to Forelle ls. of Darton, and the new name *Freezeout tongue of Chugwater fm.* to the red beds overlying the Forelle and underlying an E. extension of Dinwoody fm. which he named *Little Medicine tongue of Dinwoody fm.*

Chupadera formation.

Permian (lower): New Mexico.

E. H. Wells, 1919 [1920] (N. Mex. State School Mines Bull. 3, pp. 10–11, 17–18). *N. H. Darton's* plan of combining San Andreas and Yeso fms. under name of *Chupadera fm.* is followed in this rept. The plane of separation btw. Yeso and San Andreas is in many places difficult to locate, and plan of combining them under name of *Chupadera fm.* is especially appropriate in this (Puertecito) dist. The massive pink and light-yellow ss. 150 to 200 ft. thick, which is usual top memb. of old Yeso fm. of eastern Socorro Co., is absent near Puertecito, where upper part is entirely lss. and gyp. beds, with gyp. predominant; the colors of this part are cream, buff, and light bluish gray. Shaly strata are more abundant in lower part and decrease in amount toward top. Near base the colors are dark gray, yellowish brown, pink, and red. Thickness of fm. 1,000 to 1,200 ft. Rests on Abo ss., usually conformably. Uncon. overlain by Triassic. Is top fm. of Manzano group.

N. H. Darton, 1922 (U. S. G. S. Bull. 726 E, pp. 176–182). [The name *Chupadera fm.* was adopted by U. S. G. S. for this rept in July 1919, but rept was not published until March 31, 1922.] The name *Chupadera fm.* is here introduced for upper part of Manzano group, which Lee divided into Yeso fm. and San Andreas ls. In mapping these deposits it was found that while Lee's subdivisions were discernible in places, it was impracticable to separate them generally. Although ls. is conspicuous feature of San Andres ls. much of that subdivision consists of thick beds of gyp. and ss. which are not well exposed in the type localities. In future, wherever Lee's subdivisions can be recognized they will be treated as members of Chupadera fm., instead of as distinct fms. Named for Chupadera Mesa [E. part of Socorro Co.], a prominent topographic feature consisting of a very extensive capping of the fm., 1,500 or more ft. thick. Rests on Abo ss. Is overlain by Triassic.

A. G. Fiedler and S. S. Nye in 1933 (U. S. G. S. W. S. P. 639) divided the Perm. rocks of Roswell artesian basin of SE. N. Mex. into (descending): (1) Pecos fm., (2) Picacho ls. (considered to be same as San Andres ls. memb. of Chupadera fm. to W.), and (3) Nogal fm. (considered to be same as Yeso memb. of Chupadera fm. to W.).

W. B. Lang, 1935 (A. A. P. G. Bull., vol. 19, No. 2), abandoned Pecos fm., dividing it into (descending): Pierce Canyon redbeds, Rustler fm., Salado halite, and Castile anhydrite.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), replaced *Picacho ls.* with San Andres ls. memb. of Chupadera fm. and replaced *Nogal fm.*, with Hondo ss. memb. of Chupadera fm. and Yeso memb. of Chupadera fm. (below). The recognition of Hondo ss. (new) involves a slight redefinition of both San Andres ls. and Yeso.

Church limestone. (In Howard limestone.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 54). *Church ls.*—Lower ls. of Howard ls. memb. of Wabaunsee fm. Bluish gray, dense, brittle, massive, quite fossiliferous, and in 1 or 2 beds forming large blocks. Thickness 2 to 6 ft. Underlies Kiewitz sh. and overlies Severy sh. memb., which contains Nodaway coal 4 ft. below top. Named for Church farm, on Turner Creek, SE. of Du Bois, Nebr.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 20, 21, 94, 96), and R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), defined *Church ls.* as underlain by Aarde sh. (shown as a younger bed than Severy sh.) and overlain by Winzeler sh., and as belonging in middle of Howard ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 207–208). *Church ls.* is most persistent and important memb. of Howard ls. It overlies Aarde sh., or where Bachelor Creek ls. is absent and Aarde sh. is not differentiated, it forms basal unit of Howard ls. and rests on Severy sh. It underlies Winzeler sh. Thickness 1½ to 6 ft. Type loc., Church farm, on Turner Creek, SE. of Du Bois, Nebr.

Churchill arkose sandstone.

Cambrian: Hudson Bay region.

J. B. Tyrrell, 1898 (Canada Geol. Surv., n. s., vol. 9, p. 174 F).

Churchillian group.

Pre-Cambrian: Manitoba and Saskatchewan.

J. F. Wright, 1934 (Canada Geol. Surv., map 268A, The Pas Sheet, Manitoba and Saskatchewan, Pub. No. 2272).

Church Run conglomerate.

Term applied by J. F. Carll (2d Pa. Geol. Surv. Rept. I, pp. 38–40, 1875) to coarse cgl. in hill-tops at Church Run, Warren Co., NW. Pa. Probably same as Olean cgl. memb. of Pottsville fm.

Churn Creek member.

Mississippian: Southern Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 763). *Churn Creek memb.*—Argill. sh. with an occasional thin ss. passing gradually into underlying Vanceburg ss. memb. Thickness 50 to 100 or more ft. Present only in SW. part of Scioto and eastern Adams Counties, and only in vicinity of Buena Vista is Logan fm. found overlying it. Is top memb. of Cuyahoga fm. in SW. part of Scioto Co. [Cuyahoga as used above includes lower part of Black Hand fm., to which these beds belong.]

Named for Churn Creek, SE. part of Adams Co.

Chusa tuff member (of Catahoula tuff).

Tertiary (lower Miocene or Oligocene): Southwestern Texas coastal plain.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645, pp. 65, 89–105, 178–179). *Chusa memb. of Gueydan fm.*—Primarily friable tuffaceous clays and impure bentonites which have evidently been formed by action of streams on underlying Soledad and Fant members of Gueydan fm. Thickness 160+ ft. Is top memb. of Gueydan fm. Grades into underlying Soledad memb. of Gueydan fm. and is uncon. or discon. overlain by Oakville fm. Traced to NW. it overlies, apparently conformably, typical Catahoula ss. of Gonzales and Lavaca Counties and occupies strat. position of Fleming clay. It is therefore quite possible it is of lower Mio. age. Named for exposures on slopes of La Chusa Mesa, in SE. McMullen Co.

The Gueydan fm. is now considered same as Catahoula tuff, and "Gueydan" has been abandoned by both Tex. Geol. Survey and U. S. Geol. Survey. The Chusa is therefore now treated as a memb. of Catahoula tuff.

Chushina formation.

Lower Ordovician: Alberta and British Columbia.

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, p. 458). *Chushina fm.*—Bluish gray, thin-bedded lss., 1,500 ft. thick, occurring on N. slopes of Phillips and Lynx Mtns and Billings Butte, Robson Park, B. C. Fossils are Lower Ozarkian. Named for Chushina Glacier.

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 304), assigned this fm. to Lower Ord., and to B. C. and Alberta.

Chuska sandstone.

Tertiary (Eocene?): Northwestern New Mexico and northeastern Arizona.

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380). *Chuska ss.*—White and gray porous cross-bedded ss., 700 to 900 ft. thick. Overlies Tohachi sh., probably with uncon. Uncon. underlies basic lavas. Named for Chuska Peak, McKinley Co., NW. New Mex.

Cibao limestone.

Tertiary: Puerto Rico.

B. Hubbard, 1920 (Sci., n. s., vol. 51, p. 396).

Cibola limestone.

Silurian(?): Southwestern New Mexico (Silver City district).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 3, 6). *Cibola lss.*—Important mid-Siluric ls. memb. outcropping at Cibola mill, at Silver City. Thickness 175 ft. Underlies Naiad ls., and with it comprises Santa Ritan series. Assigned to Sil.

Cibolo formation.

Permian: Southwestern Texas (Shafter district, Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10–25). *Cibolo lss.*—Consist of (descending): Hard yellow dolomitic ls., 650 ft.; dark, even-bedded, compact ls., including some sandy strata, 470 ft.; thin-bedded ls. containing sponge spicules, 85 ft.; grayish white, heavy-bedded, brecciated ls., 133 ft.; gray marly sh., containing some lenticular ledges of organic and siliceous sand, forming basal transition beds, 100 ft. Fossiliferous. Top fm. of Chinati series. Uncon. underlie Lower Cret. Presidio beds and overlie Alta beds.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 908), state that underlying Cieneguita and Alta beds of Udden have been proved to be Perm.

Named for Cibolo Creek and Cibolo ranch, Presidio Co.

Cieneguita beds.

Permian: Southwestern Texas (Shafter district, Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10–25). *Cieneguita beds.*—Chiefly dark or almost black shales, but containing alternations of heavy lenticular masses of mortar rocks (indurated mixture of calc. mud and siliceous fragments of variable sizes and wear), cgls., dark lss., and mixtures of these materials. Thickness 1,000 ft. Fossiliferous. Basal fm. of Chinati series. Underlies Alta beds and overlies granite.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 908). Cieneguita and Alta beds, of Shafter region, formerly classed as Penn., have been proved to be of Leonard (Perm.) age.

Named for Cieneguita ranch, Presidio Co.

Cierbo sandstone. (In San Pablo group.)

Miocene (upper): Western California (Mount Diablo region).

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 586–614). *Cierbo group.*—The use of *San Pablo* for upper Mio. series of deposits on West Coast makes it necessary to dispense with the use of that name for a part of the group. The name *Cierbo* is therefore used in this paper in referring to middle group of San Pablo series. Type section of the Cierbo is in S. side of Canada del Cierbo near Carquinez Straits. These marine beds are recognized only in general region of San Francisco Bay, where they lie discon. below Santa Margarita group and rest discon. on Briones group.

B. L. Clark and A. O. Woodford, 1927. (See 1927 entry under *San Pablo group.*)

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770), included *Cierbo fm.* in San Pablo group, as explained under *San Pablo group*. This is present accepted definition of U. S. Geol. Survey.

Cimarron group.

Permian: Central southern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 18–48). *Cimarron series*—Upper part (1,100 to 1,250 ft. of prevailingly red unfossiliferous rocks) of Perm. of Kans. Overlies, probably uncon., the Big Blue or ls.-bearing series of Perm. and uncon. underlies Cret. deposits. Divided into ten fms. (descending): Big Basin ss., Hackberry shales, Day Creek dol., Red Bluff sss., Dog Creek shales, Cave Creek gypsums, Flower-pot shales, Cedar Hills sss., Salt Plain measures, and Harper sss.

Named for Cimarron River, Kans.

†Cimarron formation.

A term applied by C. R. Keyes (Am. Jour. Sci., 4th, vol. 18, pp. 360–362, 1904) to 1,000 ft. of sss. and sh. of N. Mex. uncon. underlying Comanche deposits, overlying the Carbf., and assigned by him to Triassic. In a later publication (Am. Jour. Sci., 4th, vol. 20, p. 425, 1905) he assigned these rocks to Perm.

Cimarron Creek latite.

Tertiary (Miocene or Pliocene): Southwestern Colorado (Ouray region).

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153). *Cimarron Creek latite.*—Quartz pyroxene latite. Intrusive into Potosi volcanic series. Especially common in drainage of Cimarron Creek in Ouray and Lake City quads.

Cimarronian series.

A term introduced by C. R. Keyes (Iowa Acad. Sci. Proc., vol. 16, pp. 159–163, 1909) for the post-Guadalupian Carbf. rocks of Rio Grande Valley, which he divided into (descending) Moencopie shales, unnamed sss., and Pecos shales. He also applied the name to supposedly equiv. deposits in other States, for example, to the Perm. (?) gyp. in Iowa that has been called "Fort Dodge gyp."

†Cincinnati group.

Originally proposed for the rocks now called *Cincinnatian series.* For definition see U. S. G. S. Bull. 769, p. 85.

†Cincinnati shale.

A name applied in early repts to Maquoketa sh. of Miss. Valley.

†Cincinnati limestone.

Upper Ordovician: Southwestern Ohio.

W. W. Mather, 1859 (Rept. State House Artesian Well at Columbus, Ohio, p. 6), applied incidentally, in one place, the term "Cincinnati ls." to the blue Ord. lss. [Cincinnatian series] of Cincinnati.

†Cincinnati beds proper.

Upper and Middle Ordovician: Southwestern Ohio and north-central Kentucky.

E. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 370–387). *Cincinnati beds proper.*—Alternating beds of blue ls. and sh. 425 ft. thick, forming middle part of Cincinnati group, having for their inferior limit low water of the Ohio, and for an upper bdy the highest stratum found in Cincinnati hills. Divided into Hill Quarry beds (at top), Eden sh. (in middle), and River Quarry beds (at base). Overlain by Lebanon beds and underlain by Point Pleasant beds.

Includes Maysville and Eden groups.

Named because they compose all of †Cincinnati group visible at Cincinnati, Ohio.

Cincinnatian series (or **epoch**).

A provincial series of Upper Ord. rocks in the Eastern States, and the time covered by their formation. Includes Utica to Richmond, both inclusive, as defined by U. S. Geol. Survey and geologists generally, but some geologists exclude the Richmond. For definition see U. S. G. S. Bull. 769, pp. 85–86.

Cincinnatic system.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 694). [Essentially same as Cincinnatian series of U. S. Geol. Survey.]

Cincinnatus sandstone.

Upper Devonian: Central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 24 and chart). In typical section in Cortland Co. the Ithaca beds are divided into (descending): *Cincinnatus flags,* Otselic sands and shales, and Sherburne ss. [On chart Cincinnatus *ss.* is used.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 82 and chart). *Cincinnatus flags* (from Cincinnatus Twp, Cortland Co.) is applied to the later beds of the Ithaca specially characterized by *Spirifer mesastrialis.* Typical exposures are along Otselic River.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 858). Oneonta red beds is=Cincinnatus ss. and probably underlying Otselic also.

Cinnamon.

Little Cinnamon of drillers of eastern Ohio has been identified as Sunbury sh., but W. Stout et al., 1935 (Geol. of nat. gas, A. A. P. G., p. 905), state it is now identified as Huron sh., and that the *Big Cinnamon* of the drillers is Cleveland sh.

Cinnemousun limestone.

Pre-Cambrian: British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 167).

Cinquefoil limestone.

Upper Devonian: Alberta (Interlaken to the Palisade).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 298, 300). *Cinquefoil ls.*—The western wholly calc. facies of upper part of Upper Dev. Thickness 2,500 ft. Well exposed on Cinquefoil Mtn. Corresponds to Upper Dev. Boule, Coronach, Fiddle, and Kiln fms. of area to E.

Cintura formation.

Lower Cretaceous (Comanche series): Southeastern Arizona (Bisbee region).

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, pp. 56, 68). *Cintura fm.*—Strongly resembles underlying Morita fm., from which it is separated by Mural ls. Consists of (descending): (1) 600 ft. of reddish nodular sh. interbedded with flaggy cross-bedded sss., one of latter (about 200 ft. below present top of fm.) being of pale cream color; (2) 300 ft. of flaggy cross-bedded gray and buff sss. with occasional layers of red sh.; (3) 700 to 800 ft. of red nodular sh. with occasional beds (some 6 ft. thick) of buff ss., and very subordinate beds or lenses of impure, greenish nodular ls.; (4) 100 to 150 ft. of red sh., thin-bedded sss., and aren. gray or greenish lss., some of latter fossiliferous; and (5) 10 to 15 ft. of buff qtzite. Total thickness at least 1,800 ft. Rests conformably on Mural ls. Uncon. overlain by Quat. deposits. Is top fm. of Bisbee group, of Comanche age. Named for Cintura Hill, near N. edge of Bisbee quad.

Cinturan series.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 64, No. 2, 1935, pp. 125–140) to cover the deposits named *Cintura fm.* by F. L. Ransome. Keyes divides these deposits into (descending) Dixie sh., Mexican ss., and Forrest sh.

Circle erosion cycle.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 316–340). Interglacial erosion cycle following Buffalo stage of glaciation and preceding Bull Lake stage of glaciation in central western Wyo. A fine remnant of a prominent terrace of this cycle stands out just E. of Circle post-office, on Wind River.

Circle volcanics.

Mississippian (early): Northeastern Alaska (Eagle-Circle district).

J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 816, p. 85). *Circle volcanics.*—Essentially basaltic lavas of greenstone habit, but includes some interbedded sediments, chiefly argillite and chert, with some tuffs and flow breccias. Named for exposures along E. bank of Yukon River for about 15 mi. upstream from Circle. Assigned to early Miss. on basis of strat. position and correlation.

Cisco formation (also **Cisco group**).

Pennsylvanian: Central northern and central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). *Waldrip-Cisco series.*—Alternating clays, shales, fire clays, and lss., with coal seams, overlying Brownwood-Ranger series and underlying Coleman-Albany series.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361–398). *Cisco div.*—Cgls., sss., lss., clays, and sandy shales, 840 ft. thick, overlying Canyon div. and underlying Albany div. [Wichita fm.].

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, etc.; Univ. Tex. Bull. 2132), divided Cisco group into (descending) Putnam, Moran, Pueblo, Harpersville, Thrifty, and Graham fms. E. H. Sellards, 1933 (Univ. Tex. Bull. 3232), excluded Putnam and Moran fms. from Cisco group and included them in Wichita group (Perm.), and this is present classification of U. S. Geol. Survey.

Named for Cisco, Eastland Co.

Cisco Branch facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 197, 210, etc., 1931) to a lithologic development of his Floyds Knob fm. in a part of southern Ind.

Citadel series.

Ordovician: Quebec.

R. W. Ells, 1890 (Geol. Soc. Am. Bull., vol. 1, p. 467). Included in Quebec group.

Citico conglomerate.

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 2). *Citico cgl.*—Entirely siliceous, varying from fine white ss. to coarse quartz cgl., with a few thin beds of sandy sl. Changes from fine to coarse sediment very sudden and accompanied by changes in thickness from 50 to 800 ft., the coarse beds being thickest. Total thickness of fm. 50 to 800 ft. Overlies Wilhite sl. and underlies Pigeon sl. [Foregoing is original definition of fm. The name, however, was incidentally used by C. D. Walcott in 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 196, 197), as "siliceous Citico cgl. (Keith)," which caps Wilhite sl. in Tenn.]

Named for Citico Creek, Monroe Co., Tenn.

Citronelle formation.

Pliocene (upper, middle, and lower): Gulf Coastal Plain from western Florida and southern Georgia to eastern Texas, inclusive.

G. C. Matson, 1916 (U. S. G. S. P. P. 98L and 98M, pp. 167–197). The name *Citronelle fm.* is applied to sediments of Plio. age, chiefly nonmarine, that occur near seaward margin of Gulf Coastal Plain, extending from short distance E. of W. bdy of Fla. westward to Tex. [Described on other pages as yellow and red sands and clays, locally gray where unweathered, with much gravel near landward margin.] Citronelle, a town on Mobile & Ohio R. R., in N. part of Mobile Co., Ala., was chosen as type loc. because of excellent exposures of fm. in its vicinity, especially to N. along the railroad for 3 or 4 mi. The best collection of fossils was obtained from a clay bed a few mi. S. of type loc., near a station called Lamberts, where a flora sufficiently well preserved to permit correlation of the beds with the Plio. was found. The Citronelle fm. is=part of deposits formerly classified as "Drift," "Orange sand," and "Lafayette." The name can not be regarded as a synonym for any of the older terms because in all earlier descriptions the old names were made to include not only Citronelle fm., but overlying alluvial and colluvial sands and gravels and extensive areas of sand and gravel lying farther inland and belonging to a number of different terranes. In addition, the earlier application of the old names were such as to include beds of Pleist. age, forming a fringe btw. the Plio. beds and the coast and extending into the river valleys. It uncon. overlies Pascagoula clay and uncon. underlies Pleist. terrace deposits. Thickness 50 to 400 ft.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept., pp. 180–181). No fossils from Citronelle fm. in Fla. Fossil plants from the fm. in Ala. are assigned by Berry to later half of Plio., but writers believe the fm. may represent all or any part of Plio.

F. B. Plummer, 1933 (Tex. Univ. Bull. 3232), applied *Citronelle group* to Plio. deposits of Tex. coastal plain, as explained under *Goliad sand.* In this group he included Goliad fm. and overlying "unnamed Pliocene? sand," and stated that it rested uncon. on Lagarto fm. (as restricted by him) and that it was overlain by Lissie fm. The U. S. Geol. Survey has not yet adopted this definition of *Citronelle.*

Named for exposures around Citronelle, Mobile Co., Ala.

City Bluffs shale. (In Shawnee formation.)

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

G. L. Smith, 1909 (Iowa Geol. Surv. vol. 19, pp. 613, 615, 617, 622, 631). *City Bluffs shales.*—Gray and yellow shales, 210 ft. thick, with three thin beds of ls. Forms middle part of Atchison shales. Underlain by cap rock of Nodaway coal [on p. 628 Nodaway coal is included in City Bluffs shales] and overlain by Tarkio ls. Included in Missouri stage.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2), stated City Bluffs sh.=Scranton sh.

Named for City Bluffs (now known as Burlington Junction), Nodaway Co., Mo.

City Lake sandstone member (of Springer formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

R. Roth, 1928 (Econ. Geol., vol. 23, p. 45). [See under *Overbrook ss. memb.* Derivation of name not stated.]

†City Ledge sandstone. (In Cuyahoga formation.)

Mississippian: Ohio and northeastern Kentucky.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 66, 67, 68). *City Ledge.*—Famous stratum of ss., 3 ft. 5 in. to 4 ft. 6 in. thick, called "city ledge." Separated from Waverly black sl. below by 5 ft. 4 in. of clay and sh. Overlain by 5½ ft. of soft bluish sh. Quarried at Rockville and Buena Vista, Ohio.

Nongeographic name. The bed belongs in Buena Vista ss. memb. of Cuyahoga fm.

Claggett formation. (Of Montana group.)

Upper Cretaceous: Central northern, eastern, and central southern Montana and Elk Basin region of central northern Wyoming.

J. B. Hatcher and T. W. Stanton, 1903 (Sci., n. s., vol. 18, pp. 211–212). *Claggett fm.*—Marine shales and sss., 400 ft. thick, overlying Eagle fm. and underlying Judith River beds. Named for old Fort Claggett [now called Judith], at mouth of Judith River, in neighborhood of which the fm. is well developed.

T. W. Stanton and J. B. Hatcher, 1905 (U. S. G. S. Bull. 257, p. 13). The beds to which name *Claggett fm.* has been given lie above Eagle fm. and below Judith River beds. In neighborhood of Judith (old Fort Claggett), where they are well exposed, they have total thickness of 400± ft. and consist largely of dark clay shales with variable intercalated bands and beds of ss., especially in upper half. The dark shales of lower part of fm. contain many calc. concretions containing fossils [listed]. The yellowish ss. beds higher in fm., especially one 200± ft. from top and another near summit, are often locally very fossiliferous [fossils listed].

Claiborne group.

Eocene (middle): Gulf Coastal Plain from Georgia to southern Texas.

T. A. Conrad, 1847 (Phila. Acad. Nat. Sci. Proc., vol. 3, pp. 280–282). [Described 105 new fossil species from Eocene of vicinity of Vicksburg, Miss. Divided the Eocene into "Upper or Newer Eocene," and "Lower or Older Eocene," and stated that *Vicksburg group* belongs to former and *Claiborne sands* to latter. Neither Vicksburg group nor Claiborne sands was described.]

T. A. Conrad, 1856 (Phila. Acad. Nat. Sci. Proc., vol. 7, pp. 257–258). [See 1856 entry under *Vicksburg group.*]

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 108, 123–128), described *Claiborne group* as consisting of:

"*Calcareous Claiborne group* (marls and limestone, white, sometimes indurate, and blue).

Lignitic clays and sands of North Clarke County.

Siliceous Claiborne group (siliceous sandstones and claystones)."

E. W. Hilgard, 1867 (Am. Jour. Sci., 2d, vol. 43, p. 33). *Claiborne group proper.*—The blue marl and white marlstone which I designate "Calcareous Claiborne" group in my Rept are strictly=the typical fossiliferous sand at Claiborne with the underlying ls. bed. Underlies Jackson group and overlies Siliceous Claiborne or Buhrstone group. [This restricted definition of *Claiborne group* was used for many years.]

In 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 303–304) G. D. Harris included the †Buhrstone (Tallahatta fm.) in his *Lower Claiborne stage*, but other writers continued for several years to exclude it from Claiborne group. In 1900 T. W. Vaughan (U. S. G. S. Mon. 39) included it in his *Claibornian stage*, but E. A. Smith of Ala. Geol. Survey, continued to exclude it. In 1920, however, J. E. Brantly (Ala. Geol. Surv. Bull. 22) included Tallahatta fm. in Claiborne group. The U. S. Geol. Survey has since 1906 included Tallahatta in Claiborne group. The Claiborne group as now understood is characterized by a distinctive fauna, is overlain by Jackson fm. and underlain by Wilcox group. It is chiefly of marine origin and in Miss. is divided into following fms. (descending):

Yegua (†Cockfield) fm.=Gosport sand of Ala. and includes †Claiborne sand and †*Ostrea sellaeformis* beds of earlier repts.

Lisbon fm. (type in Ala). } =St. Maurice fm. of La.
Tallahatta fm. (†Buhrstone); (type in Ala.). }

In Tex. it is divided into (descending) Yegua, Cook Mtn, and Mount Selman fms. and Carrizo sand.

Named for exposures at Claiborne Bluff and Claiborne Landing, on Alabama River, Monroe Co., Ala. (The Tallahatta fm. is not there exposed, but is exposed a few mi. up the river.)

†Claiborne sand. (In Claiborne group.)

Eocene (middle): Southern Alabama and Mississippi.

T. A. Conrad, 1847 (Phila. Acad. Nat. Sci. Proc., vol. 3, pp. 280–281), described new fossils from Vicksburg group, divided the Eocene into *Upper or Newer Eocene* and *Lower or Older Eocene,* and stated that *Vicksburg group* belongs to former and *Claiborne sands* to latter. Neither Vicksburg group nor Claiborne sands is described, but Conrad stated he refers to the sand at Claiborne, Ala.; also that his "Lower or Older Eocene" is characterized by *Ostrea sellaeformis,* which occurs abundantly beneath the fossiliferous sands at Claiborne.

In 1887 (U. S. G. S. Bull. 43, pp. 29–30) E. A. Smith and L. C. Johnson published a detailed section of Claiborne bluff, in which *Claiborne sand* is defined as consisting of 15 to 17 ft. of ferruginous sand, holding vast numbers of comminuted as well as well-preserved shells, with thin bands of lignite near center and laminated gray clays with leaf impressions forming upper part along the ferry road. Their section shows it resting on †Ostrea sellaeformis beds and underlying 6 ft. of coarse ferruginous sand, with glauconite, fossiliferous, passing below into more calc. material, which is indurated and projects from the face of the bluff.

Is a bed in upper part of Gosport sand, top fm. of Claiborne group in Ala. and in upper part of Yegua fm. of Miss. The use of Claiborne in this narrow sense has been abandoned for the name in the broader or group sense.

Named for exposures at Claiborne Bluff, on Alabama River, in Monroe Co., Ala.

Claibornian.

Time term used by some authors to cover the interval of Claiborne group (middle Eocene).

Clallam formation.

Miocene and Oligocene: Northwestern Washington.

R. Arnold, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 451–468, map). *Clallam fm.*—Cgl. and breccia alternating with ss. and sh., also much clayey sh. and coal. Thickness 15,000 ft. Uncon. underlies Quinaielt fm. and uncon. overlies Crescent fm. Upper part Mio. and lower part Olig. Well exposed in region btw. Clallam Bay and Pillar Point.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13, p. 202, map), restricted Clallam fm. to the Olig. marine deposits, and stated there is probably an uncon. btw. the Mio. (*Arca montereyensis* zone) and Olig. parts of the fm. as previously defined. "Lower two-thirds of area mapped as *Clallam* is of Olig. age."

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 245, 261–264). If name *Clallam* is to be used it should be restricted to the Mio.

beds, as its founder (Arnold) in 1913 limited it to the beds of Monterey-Temblor age in the NW. Arnold and Hannibal considered Clallam to be=Monterey-Temblor fm. of Calif. It seems advisable to retain name *Clallam fm.* at present. Weaver's so-called Clallam fm. appears to be identical with Astoria series as used by Arnold and Hannibal.

Clam Bank series.

Lower Devonian: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 104).

Clansayes beds.

Cretaceous: Mexico.

E. Böse and O. A. Cavins, 1927 (Univ. Tex. Bull. 2748, p. 85).

Claremont shale. (In Monterey group.)

Miocene (middle): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Claremont sh.*—Bituminous sh. In Sobrante anticline it is in part soft and distinctly shaly or chalky and in places contains a large admixture of fine detrital material, but in Berkeley Hills it is notably cherty, consisting of beds of hard flinty chert alternating at regular intervals with partings of sh. Thickness 250 to 1,000 ft. A fm. of Monterey group. Underlies Oursan ss. and overlies Sobrante ss. Named for exposures on Claremont Creek, Concord quad.

†Claremore formation.

Pennsylvanian: Northeastern and central eastern Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 6, 7, 10). *Claremore fm.*—Approx.=Fort Scott. ls. of Kans., which is correlated with Calvin ss. of Coalgate folio. Includes three lss. and two sh. beds, the lower ls. coming in below Fort Scott ls. of Kans., which consists of two ls. beds and one sh. bed. Basal fm. of Tulsa group.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 15). *Claremore fm.*—Shales and lss., one prominent ss., and 2 or more coals. Thickness 50 to 135 ft. Underlies Labette sh. and overlies Vinita fm. Includes Fort Scott ls. and uppermost part of Cherokee sh. Named for Claremore, Rogers Co.

Clarendon beds.

Pliocene: Panhandle of Texas.

J. W. Gidley, 1903 (Am. Mus. Nat. Hist. Bull., vol. 19, pp. 632–635). *Clarendon beds.*—Local name proposed for deposits heretofore called Loup Fork in this region. Chiefly cross-bedded sands and sss. intermixed and cross-bedded with yellow and bluish sandy clays. Thickness 400 ft. Upper Mio. fossils. Beds identical with Goodnight (Paloduro) beds, which name as a distinct horizon should be abandoned.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem, n. s., vol. 2, pt. 1, pp. 25, 26). *Clarendon beds* are Upper Mio. or Lower Plio.

H. F. Osborn, 1918 (Geol. Soc. Am. Bull., vol. 32, p. 330), cited a sub-family of mastodon as appearing in "the Lower Pliocene of the Clarendon beds of Tex."

G. G. Simpson, 1933 (Am. Mus. Nat. Hist. Bull., vol. 67, p. 98). Clarendon and Goodnight-Hemphill are both distinctly older than Blanco.

There seems to now be unanimity of opinion that there is no Mio. in this part of Tex. All of these beds are mapped as *Ogallala fm.* (*Plio.*) on 1937 geol. map of Tex.

Named for Clarendon, Donley Co.

Clarendon gravel.

Pleistocene: Northwestern Pennsylvania (Warren County).

E. H. Williams, Jr., 1920 (Am. Phil. Soc. Proc., vol. 59, pp. 62, 73). The following glacial outwashes were dropped during the discharge of Conewango Ponding at Barnes [Warren Co.]: (1) *Clarendon gravels* (coarse gravel with interbedded quicksand); (2) *Upper Indian Hollow sands*, which underlie Clarendon gravels; (3) *Lower Indian Hollow sands*, 0 to 125 ft. thick, along the Conewango, which rest in the (4) blued sticky *Conewango clay* (sometimes over 200 ft. thick, and carrying wood fragments and logs). All referred to Kansan stage.

Named for Clarendon, Warren Co.

Clarendon sand.

Drillers' term. Western Pa. Of Chemung age. Younger than Cherry Grove sand. Lies 125 to 175 ft. higher than Clarendon gas sand, according to J. F. Carll, 2d Pa. Geol. Surv. Rept. I_4, 1883. Named for Clarendon, Warren Co., Pa.

Clarendon Springs dolomite.

Lower (?) Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 397). *Clarendon Springs dol.*—Fine-grained dol. of light gray or dove color. Differs from the older Wallingford dol. mainly by absence of ss. and qtzite. Grades up into Shelburne marble, without interbedding or other notable features. Thickness 100 to 200 ft. Type loc., Clarendon Springs [Castleton quad.]. Correlates with Milton dol. (*Lower Camb.*), which underlies St. Albans sl.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 353–381), stated that the fm. that underlies St. Albans sl. is not true Milton dol., which is Upper Camb., but a local basal cgl., 0 to 20 ft. thick, which he named *Rugg Brook dol. cgl.* and assigned to Middle Camb. Keith correlated his Clarendon Springs dol. with so-called Milton dol. (Rugg Brook cgl. of Schuchert). If this correlation is correct the nonfossiliferous Rugg Brook of Schuchert may be Lower Camb., or the unfossiliferous Clarendon Springs dol. may be Middle Camb.

Clarenville series.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Clarenville series.*—Basal part of Lower Ord. Discon. overlain by Bell Island series and underlain by Upper Camb. Divided into (descending) Riders Brook, Maidment, Apsey, and Brown Mead fms. Correlated with Tremadoc of Europe. [Derivation of name not stated.]

Clarion coal group. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477). *Clarion group,* 100 to 200 ft. thick. Underlies Freeport or contorted ss. and overlies Tionesta ss. Includes Kittanning coal (75 ft. below top), Ferriferous ls., Clarion coal, and Brookville coal (0 to 15 ft. above base).

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. xxiii). Lower Productive Coal Measures [Allegheny fm.] divided into (descending) Freeport coal group, Kittanning coal group, and *Clarion coal group.*

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Clarion group* extends from top of Buhrstone iron ore that overlies Ferriferous (Vanport) ls. to base of fire clay that underlies Brookville coal.

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas No. 65, Punxsutawney quad., pl. 4, p. 29). *Clarion fm.* extends from top of Vanport ls. to top of Homewood fm.

Clarion coal group is treated by U. S. Geol. Survey as an economic memb. in lower part of Allegheny fm., extending from top of Vanport ls. memb. to top of Pottsville fm., of which Homewood ss. is top memb.

Clarion sandstone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland and eastern Ohio.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). *Clarion ss.,* 35 ft. thick, lies 10 ft. below Clarion coal and 30 ft. above Brookville coal in Fayette and Westmoreland Counties.

H. M. Chance, 1884 (2d Pa. Geol. Surv. Rept. H_7, p. 26). In some localities (in Clearfield Co.) the whole interval from Kittanning Lower coal down to Brookville coal is occupied by *Clarion ss.* This ss. singularly resembles Homewood ss., being often massive and conglomeratic and in some places a true cgl., but it is more commonly a rather friable yellowish ss.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied *Clarion ss.* to a ss. *overlying* the Clarion coal in Pa., W. Va., and Md., and did not apply any name to the ss. beneath the Clarion coal.

Clarion clay. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania.

W. G. Platt, 1880 (2d Pa. Geol. Surv. Rept. H_5). *Clarion fire clay*, 2 to 7 ft. thick, underlies Clarion coal and overlies Clarion ss. in Armstrong Co.

Clarion formation.

See under *Clarion coal group*, G. H. Ashley, 1926.

Clark formation.

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 3). *Clark fm.*—Alternating sss., shales, and coals, with heavy ss. at bottom and top. Limited below by top of Pocahontas (No. 3) coal and above by base of Quinnimont coal. Thickness 430 to 440 ft.

Overlies Pocahontas fm. and underlies Quinnimont sh.

Named for Clark Gap, in Flat Top Mtn, Mercer Co., W. Va.

†Clark County littorals.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 79–83). The deposits spoken of here as "*Clark County littorals*," namely, "the second blue dirt," "Koster joint clays," and "Big De Gray beds," are purely local, and have therefore been given no place in synoptical table of widespread fms. of SW. Ark. Are probably littoral or near shore beds deposited at time when Big Deciper fm., High Bluff blue sands, Washington or High Bluff greensands, Marlbrook-Columbus chalk marls, Brownstown marls, and White Cliffs chalk were being deposited in deeper waters.

Now differentiated into several fms. Probably include Nacatoch sand, Saratoga chalk, Marlbrook marl restricted and Annona chalk.

Named for exposures in Clark Co.

Clarke interglacial.

Pleistocene: Ontario.

A. P. Coleman, 1909 (Ontario Bur. Mines Ann. Rept., vol. 18, pt. 1, p. 297).

Clarke oil zone.

Subsurface beds, of Plio. age, encountered in wells in Santa Fe oil field, Los Angeles Co., Calif., that lie lower than O'Connell oil zone and higher than Hathaway zone.

†Clark Fork beds.

Eocene (basal): North-central Wyoming (Bighorn Basin region).

W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, p. 204). *Clark Fork beds.*—Low-lying gray shales, sparingly fossiliferous and 500 ft. thick, occurring at SW. base of McCulloch Peak and in vicinity of low divide btw. Clark Fork and Bighorn basins N. of Ralston. Underlie Sand Coulee beds (lower Eo.), perhaps with angular uncon., and rest on beds of undet. age, perhaps Fort Union, or perhaps Cret. Perhaps belong to Paleocene series. Named for Clark Fork basin.

According to H. F. Osborn (U. S. G. S. Mon. 55, 1929) these beds are a mammal faunal zone in basal part of Wasatch fm.

Clark Peak schist.

Paleozoic and infolded Triassic(?): Southeastern Alaska (Juneau region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 93, 94, 247). *Clark Peak schist.*—Schistose rocks derived from sl., ss., ls., and cgl. Oldest fm. exposed in Juneau dist. Underlies Perseverance sl. (Triassic or older). Writer believes it is Paleozoic, but may include some infolded Triassic beds.

Named for Clark Peak, Juneau dist.

Clark Reservation limestone.

Silurian(?): Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 26, 27, 30–35). *Clark Reservation ls.*—Compact blue ls., usually sharply separated from overlying Jamesville ls. and underlying Elmwood beds, all included in Manlius group. Undoubtedly included in Vanuxem's Manlius. Some authors have included this ls. and overlying Jamesville ls. in Helderbergian. Thickness 0 to 3 ft. 8 in. Named for Clark Reservation State Park, slightly over 1 mi. W. of Jamesville. Type section, in cliff S. of the lake which is included in the park.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 18). [See 1935 entry under *Manlius ls.*]

Clarksburg limestone member (of Conemaugh formation).

Pennsylvanian: Southwestern Pennsylvania, western Maryland, West Virginia, and eastern Ohio.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 88). *Clarksburg ls.*—Upper part rather slaty; beneath this the layers are very compact and come out in rhomboidal blocks; some layers are very ferruginous. Thickness 20 to 30 ft. Directly underlies Little Clarksburg coal and is separated from underlying Morgantown ss. by 25 to 40 ft. of soft shales. Finely exposed in vicinity of Clarksburg [Harrison Co., W. Va.], along bed of Elk and the West Fork River.

See also *Little Clarksburg ls.*

Clarksburg volcanics.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 604). *Clarksburg fm.*—Greenstones and volcanic cgls. Replaces upper part of Ishpeming fm. and lower part of Michigamme fm. in part of Marquette dist. Extends E. and W. from Clarksburg.

W. S. Bayley, 1897 (U. S. G. S. Mon. 28, pp. 461, 484). *Clarksburg fm.* is a set of interbedded tuffs, lavas, sedimentary and volcanic cgls. and breccias and other sediments, cut through and through by dikes and bosses of altered diabase or basalt. Contemp. with closing stages of Ishpeming time and opening stages of Michigamme time. Overlies Goodrich qtzite. In places rests on Negaunee fm. Is overlain by sl. of Michigamme fm.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Clarksburg volcanics* (upper Huronian) underlie Michigamme sl. and overlie Greenwood iron-fm., which rests on Goodrich qtzite. [The Greenwood iron-fm. appears to have been included in Goodrich qtzite or Clarksburg volcanics of previous repts.]

Clarksburg red shale. (In Conemaugh formation.)

Pennsylvanian: West Virginia and southwestern Pennsylvania.

R. V. Hennen, 1912 (W. Va. Geol. Surv. Rept. Doddridge and Harrison Counties, p. 240). *Clarksburg red sh.*—Red and variegated sh. 25 to 40 ft. thick. Underlies Clarksburg ls. and overlies Morgantown ss. [Named for Clarksburg, Harrison Co.]

Clarksburg fire clay shale. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

R. V. Hennen, 1912 (W. Va. Geol. Surv. Rept. Doddridge and Harrison Counties, p. 236). *Clarksburg fire clay sh.*—Fairly pure fire clay sh., 0 to 5 ft. thick, underlying Little Clarksburg coal and overlying Clarksburg ls. Named because of its association with Little Clarksburg coal.

Clark's Mill beds.

Lower Devonian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 59–62, 181–184). ***Clark's Mill beds.***—Thin-bedded lss. and calc. shales, 100 to 150 ft. thick. Exposed at Clark's Mill, Centre Twp, Perry Co. Divided into 9 fossiliferous zones. Rests on Lewistown (Bossardville) ls. Overlain by 8 ft. of black cherty ls. Included in Lower Helderberg.

†Clarksville.

Upper Cretaceous: Southern Arkansas and northeastern Texas. See *†sub-Clarksville sand.*

Clarksville division. (In Richmond group.)

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, p. 292). ***Clarksville div.***—Includes all of Waynesville bed of Richmond fm. btw. base of *Orthoceras fosteri* horizon below and base of lower *Hebertella insculpta* layer above. Is overlain by Blanchester div. and underlain by Fort Ancient div.

Named for Clarksville, Clinton Co., Ohio.

Clarksville oil sand.

Name applied in some early repts to sand lying about 75 ft. below Richburg or Allegany oil sand in Allegany Co., N. Y. According to C. R. Fettke (Geol. Soc. Am. Bull., vol. 44, No. 3, p. 626, 1933) this sand is 6 ft. thick, of Chemung age, and occupies interval btw. 1,268 and 1,274 ft. in Gilbert No. 1 well, on Gilbert farm, 2 mi. N. of Richburg, Allegany Co., N. Y.

Clarno formation.

Oligocene (lower) and Eocene (upper): Central northern Oregon (John Day Basin).

J. C. Merriam, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 496–497, and Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9, p. 285). *Clarno fm.*—Made up entirely of tuffs, ashes, and andesitic and rhyolitic lavas. Thickness 400+ ft. Many fossil plants. Presumably Eo. The beds at Bridge Creek are considered to be upper Eo.; those on Cherry Creek are held to be earlier. Typically exposed at Clarnos ferry, on the John Day, E. of Antelope. Underlies (probably uncon.) John Day fm. and overlies Chico fm. (Upper Cret.).

F. H. Knowlton, 1902 (U. S. G. S. Bull. 204, p. 113), assigned flora from beds at Bridge Creek (upper Clarno) to upper Eo., and flora from Cherry Creek (lower Clarno) to lower Eo.

J. C. Merriam and W. J. Sinclair, 1907 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 5, No. 11, p. 173). *Clarno fm.* has yielded an abundant flora but no vertebrates. The upper beds are upper Eo. and the lower Clarno is lower Eo.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, p. 105, and Jour. Geol., vol. 27, p. 105), assigned Clarno fm. to lower Eo.; M. R. Thorpe, 1921 (Am. Jour. Sci., 5th, vol. 1, pp. 217–219), assigned it to upper Eo.; R. W. Chaney, 1922 (Am. Jour. Sci., 5th, vol. 4, p. 220) assigned upper part of Clarno to Olig.; W. D. Smith, 1924 (Commonwealth Review Univ. Oreg., vol. 6, No. 4, p. 74) assigned it to lower Eo.; J. P. Buwalda, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 155), and 1928 (Geol. Soc. Am. Bull., vol. 39, p. 270), stated that Clarno is probably Olig.

F. H. Knowlton, 1926 (U. S. G. S. P. P. 140, p. 23), after comparing flora from Bridge Creek (upper Clarno) with Latah and other floras, stated that flora from Bridge Creek is probably lower Mio.; and E. W. Berry also considered that this flora "might be as young as Mio."

R. W. Chaney, 1927 (Carnegie Inst. Wash. Pub. 346). Knowlton has referred lower Clarno flora of John Day Basin to Lower Eo., on basis of occurrence of a considerable number of Fort Union sp. Writer is not prepared to question seriously this reference, but wishes to point out several reasons for supposing that this flora may be as young as Lower Olig. The so-called upper Clarno, which includes *Bridge Creek leaf shales* of John Day Basin, and which is also represented in Crooked River Basin, is here referred to lower div. of John Day series (Olig.).

R. W. Chaney, 1927 (Carnegie Inst. Wash. Pub. 349, pp. 1–22), included his *Bridge Creek shales* in John Day fm. (See under *Bridge Creek shales.*)

R. W. Chaney, 1932 (16th Int. Geol. Cong. Guidebook 21, p. 4), assigned Clarno fm. (probably exclusive of the beds on Bridge Creek) to upper or middle Eo.

The U. S. Geol. Survey now assigns Clarno fm. as originally defined to lower Olig. and upper Eo. R. W. Brown classifies the flora from Bridge Creek as lower Mio.

Claron limestone.

Eocene: Southwestern Utah (Iron Springs region).

C. K. Leith and E. C. Harder, 1908 (U. S. G. S. Bull. 338, p. 41). *Claron ls.*—Includes some ss. and cgl. Thickness 800 ft. Overlies (uncon.) Pinto ss. (Cret.) and underlies late Mio. igneous rocks. Occurs at and around Mount Claron.

Corresponds to Wasatch fm.

Clarysville sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties) and northeastern West Virginia.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Clarysville ss.*—Underlies Lower Hoffman coal and overlies Clarksburg ls.; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 67, pl. 6). *Clarysville ss.*—Thick ss., usually thin-bedded and somewhat argill. Locally replaced by sh. Exposed above the Clarysville coals in Hoffman Drainage Tunnel at Clarysville, Allegany Co.

Clay Creek limestone. (In Kanwaka shale.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). A very persistent ls. in upper Kanwaka sh. is named *Clay Creek ls.* and the portions of the Kanwaka above and below are given the names *Stull sh.* and *Jackson Park sh.*, respectively. [On p. 52 *Clay Creek ls.* is described as consisting of 2 ft. of hard bluish ls. that weathers brown; shelly. Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 171), more fully described this ls. and gave type loc. as Clay Creek, about 1 mi. W. of Atchison, Kans.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Claypool formation.

Pennsylvanian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 9+). *Claypool fm.*—Predominantly sh. and sandy sh. (of brown, gray, and yellow colors, chiefly brown with irregular gray and blue mottling), with one or more uniform ss. members. The sss. are thin bedded, gray to buff in color, soft and friable. Is quite different in lithologic appearance from overlying Addington fm. (Perm.), with which it may not be entirely conformable. Thickness several hundred ft. Covers large area to S. and E. of Claypool, Jefferson Co. Overlies Asphaltum ss. Is top fm. of Penn. in Jefferson Co.

Claypool sand.

A subsurface sand in Carbondale fm. (Penn.) of Clark Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Clay Spur bentonite bed. (In Mowry siliceous shale member.)

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165, p. 4). *Clay Spur bentonite bed,* 1 to 4 ft. thick, lies at top of Mowry siliceous sh. memb. of Graneros sh. over entire area discussed [in NE. Wyo. and SE. Mont.]. Named for exposures near Clay Spur, sec. 30, T. 47 N., R. 63 W., Weston Co., Wyo.

Claysville limestone member (of Greene formation).

Permian: Western Pennsylvania (Washington County).

W. T. Griswold and M. J. Munn, 1907 (U. S. G. S. Bull. 318, p. 78). From 205 to 225 ft. above base of Greene fm. in S. and W. parts of Claysville quad., is a ls.

separated into 2 layers by 6 to 8 ft. of yellow sh. Top layer is 6 to 8 inches thick, bluish white, and dark brown on fresh fracture. Bottom layer (in places 18" thick) is dark gray on fresh fracture and weathers with rough surface to reddish or yellow. In N. part of East and West Finley and Morris Twps the ls. is a rather compact bed, 6 to 8 ft. thick, the top layers being heaviest and all of dark-gray color. Can not be correlated with any bed previously named and is among most prominent lss. in Greene fm. Is therefore named *Claysville ls.*, from town in Donegal Twp, Washington Co.

Clayton formation. (In Midway group.)

Eocene (lower): Southern Alabama, southwestern Georgia, northeastern Mississippi, southern Tennessee, and southeastern Missouri.

D. W. Langdon, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 589–605). *Midway or Clayton group.*—Consists of (descending): (1) 200 ft. of white calc. sand containing few casts of *Ostrea*(?); sometimes irregularly indurated; in upper 10 ft. pockets of white sand enclosed in black clay; (2) light-yellow siliceous ls., large *Ostrea* and many obscure casts, 10 ft.; (3) massive coarse-grained ss., almost a cgl., 8 ft. Underlies Black Bluff group [Sucarnoochee (Porters Creek) clay] and overlies Ripley group.

Is now treated as basal fm. of Midway group, the foregoing narrow use of *Midway* having been discontinued. (See under *Midway group, broad sense*, and under *†Midway series, narrow sense.*) It is a marine deposit. Named for exposures near Clayton, Barbour Co., Ala.

Clayton sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 383). *Clayton ss.*—Usually reddish brown, fine-grained, smooth-textured, medium hard, thick-bedded. Thickness 20 to 40 ft. Underlies Coney sh. and overlies Clayton sh.; all members of Bluefield group [fm.]. Type loc. on waters of Griffith Creek, on road that descends into this valley 1.2 mi. NE. of Clayton, Summers Co. Also occurs in Mercer and Monroe Counties, W. Va., and in Giles Co., Va.

Clayton shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 384). *Clayton sh.*—Red and variegated or greenish; streaks of ss. and marine fossils. Thickness 50 to 95 ft. Underlies Clayton ss. and overlies Graham ss.; all members of Bluefield group [fm.]. Type loc. same as Clayton ss.

Clayton clay.

Name applied by R. F. Flint (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 965–987, 1933) to a late Pleist. clay exposed at Clayton, Hartford Co., Conn.

†Clayton Peak quartz diorite.

A name that has been applied to the stock of diorite (of late Cret. or early Tert. age) in Park City and adjacent dists. of northern central Utah. (See S. F. Emmons, 1903, Am. Jour. Sci., 4th, vol. 16, pp. 141–147, and F. F. Hintze, Jr., 1913, N. Y. Acad. Sci. Annals, vol. 23, pp. 85–143.) As there is only one diorite in the dists., the U. S. Geol. Survey has not adopted a geographic name for the rock, but uses the term *Clayton Peak stock* for the structural feature which it forms.

Claytonville dolomite.

Permian: Central northern Texas (Nolan and Fisher Counties).

M. G. Cheney, 1929 (Univ. Tex. Bull. No. 2913, p. 26, pl. 1). *Claytonville dol.*—White to gray dol., 1 to 3 ft. thick. Usually underlain by red ss. and followed by red sh. and gyp. Caps escarpment 2 mi. W. of Sweetwater, Nolan Co., also at town of Claytonville, Fisher Co. The name *Sweetwater*, formerly used for this dol., is preoccupied. Lies near top of Double Mtn group.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 166). *Claytonville dol.* of Cheney lies 50± ft. below Quartermaster fm. in Fisher Co. It replaces "Sweetwater," preoccupied.

Claytonville gypsum. (In Double Mountain group.)

Permian: Central northern Texas (Fisher County).

H. T. Morley, 1929 (Tex. Bur. Econ. Geol., geol. map of Fisher Co.). *Claytonville gyp.* lies 325± ft. above Eskota dol. and 320± ft. below Sweetwater dol.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 167). *Claytonville dol.* (Cheney, 1929) replaced "Sweetwater dol.," which is preoccupied. *Claytonville gyp.* is therefore preoccupied and is discarded. It lies 300± ft. below Claytonville (Sweetwater) dol.

Clear Branch sandstone.

Lower Devonian: Northern central Alabama (Birmingham Valley).

C. Butts, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 366, 367; U. S. G. S. Bessemer-Vandiver folio, No. 221). *Clear Branch ss.*—Ss., containing fossils of Oriskany age, heretofore included in Frog Mtn ss. At Clear Branch Gap the fm. contains an Oriskany fauna, and consists of (descending): (1) A quartz lens, 4 inches thick, crowded with brachiopod shells stained with manganese oxide; (2) a 4-inch lens of black chert; and (3) 5 ft. of ss. with fine pebbles of quartz. It is there overlain by 1½ ft. of green sh. (Chattanooga? sh.) and underlain by beds that probably belong to Red Mtn fm. Believed to extend northward to Birmingham, but no fossils were found in the ss. of that area which occupies strat. position of Clear Branch ss. The 50 ft. of ss. in cuts of Alabama Great Southern R. R. a mi. or 2 W. of Vance, Tuscaloosa Co., is also believed to be of Oriskany age and to belong to Clear Branch ss. So far as present knowledge goes, the beds of Oriskany age in Ala. are confined to SW. end of Appalachian Valley from Tuscaloosa to Chilton Co. and do not extend NE. of present margin of Coastal Plain.

Named for exposures at Clear Branch Gap through Red Mtn, in Jefferson Co., 5 mi. S.-SW. of Bessemer.

Clear Creek limestone.

Middle and Lower Devonian (Onondaga and Oriskany): Southwestern Illinois and southeastern Missouri.

A. H. Worthen, 1866 (Ill. Geol. Surv. vol. 1, pp. 126-129). *Clear Creek ls.*—Fossiliferous lss., 250 to 350 ft. thick, of Lower Helderberg and Oriskany age, in Jackson, Union, and Alexander Counties, Ill. Consists of 300 ft. of yellowish gray thin-bedded siliceous lss., underlain by 10 to 25 ft. of mottled lss. with, locally, at base, 4 ft. of fossiliferous coarse-textured dark bluish gray lss. Overlies Niagara ls. and underlies Oriskany ss.

A. H. Worthen, 1868 (Ill. Geol. Surv. vol. 3), assigned *Clear Creek lss.*, 200-250 ft. thick, to Oriskany.

In some subsequent repts *Clear Creek ls.* was assigned to Oriskany and Lower Helderberg.

A. H. Worthen, 1882 (Econ. Geol. Ill., vol. 1), assigned *Clear Creek lss.* (200 to 250 ft. thick in Jackson and Union Counties, Ill.) to Oriskany.

C. Schuchert, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 272, 319), assigned lower 200 ft. of Clear Creek ls. of Ill. to Helderberg and rest of it to lower Oriskany.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110), restricted *Clear Creek ls.* to beds said to be of Oriskany age, and named the beds of New Scotland (Helderberg) age *Bailey ls.* As he defined it, it was said to be overlain by Grand Tower ls.

S. Weller, 1906 (Ill. Geol. Surv. Bull. 1, map), assigned *Clear Creek ls.* of southern Ill., 200-250 ft. thick, to Oriskany. In 1907 (Ill. Geol. Surv. Bull. 6) Weller stated that fauna of Clear Creek fm., 300 ft. thick in Ill., suggests Oriskany, although some fossils resemble Onondaga sp.

T. E. Savage, 1908 (Am. Jour. Sci., 4th, vol. 25, pp. 431-443, and Ill. Geol. Surv. Bull. 8, pp. 104-116). *Clear Creek fm.* (*or chert*) of SW. Ill., 237 ft. thick, corresponds in age to Camden chert of Tenn., and is Upper Oriskany. Is underlain, with short break, by New Scotland ls. (Helderbergian) and conformably overlain by Onondaga.

T. E. Savage, 1910 (Ill. State Acad. Sci. Trans., vol. 3, pp. 116+). Grand Tower fm. of Keyes in Mo. is here divided into Grand Tower (Onondaga) fm. (restricted) and Clear Creek fm. (of upper Oriskany age). [The 1912 geol. map of Ill.

(F. W. DeWolf, Director) restricted *Clear Creek* to 200 to 240 ft. of chert and ls. of upper Oriskany age, overlain by Grand Tower ls. (of Onondaga age), and uncon. underlain by New Scotland ls. (of Helderberg age). This classification was followed by E. F. Lines, 1912 (Ill. Geol. Surv. Bull. 17, pp. 59–76); R. S. Blatchley, 1913 (Ill. Geol. Surv. Bull. 22, pp. 26–32), and 1914 (Ill. Geol. Surv. Bull. 28, pp. 14–15), and the 1917 geol. map of Ill.]

C. O. Dunbar, 1919 (Tenn. Geol. Surv. Bull. 21, pp. 68–69, 89, 91, etc.). *Clear Creek chert* of southern Ill. is northward extension of Camden chert of Tenn. They have heretofore been regarded as of upper Oriskany age, but they belong with the Onondaga instead. They may be partially at least time equiv. of Esopus and Schoharie grits of N. Y.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Clear Creek chert* [restricted] of SW. Ill. and SE. Mo. is in large part a succession, 300+ ft. thick, of chert and ls. layers 3 to 8 inches thick. Uppermost layers are in places interbedded with ss. layers containing Onondaga fossils. Where present in Mo. it uncon. overlies Little Saline River ls.; in SW. Ill. it is uncon. on Backbone ls., of Helderbergian age. Is almost everywhere overlain by Dutch Creek ss. In previous rept by writer the chert was thought to be of upper Oriskany age, but Dunbar has shown that Camden chert of W. Tenn., which is = in age to Clear Creek fm., occurs uncon. above the typical upper Oriskany strata. There is lack of any hiatus btw. Clear Creek chert and undoubted Onondaga strata, and it is now referred to basal part of Ulsterian (Onondaga) series. [On his chart on pp. 170–171, however, *Clear Creek chert* stands opposite "Possibly Esopus and Schoharie," which are pre-Onondaga.]

T. E. Savage, 1925 (Jour. Geol., vol. 33, pp. 550–558), assigned *Clear Creek chert* of SW. Ill. to Onondaga; called overlying fm. (also of Onondaga age) *Dutch Creek ss.*, and called underlying fm. (of Oriskany age) *Little Saline ls.*

C. F. Bassett, 1925 (Ill. Acad. Sci. Trans., vol. 18, pp. 360–368). *Clear Creek chert* of SW. Ill., 300 ft. thick, is assigned to basal Onondaga by Savage, on basis of fossils. It is overlain by Dutch Creek ss. and uncon. underlain by Backbone ls. (of Oriskany age). In Mo. it is underlain by Little Saline ls. (= lower part of Backbone ls.) and overlain by Dutch Creek ss.

E. R. Pohl, 1930 (Tenn. Acad. Sci. Jour., vol. 5, pp. 54–63), assigned Clear Creek of Ill. and Mo. to Schoharie.

The U. S. Geol. Survey at present classifies Clear Creek ls. as of Oriskany and Onondaga age.

Named for exposures on Clear Creek, Union Co., Ill.

†Clear Creek sandstone. (In Cherokee shale.)

Pennsylvanian: Western Missouri.

G. C. Broadhead, 1874 (Mo. Geol. Surv. vol. 1, pp. 57–61, 69, 100). *Clear Creek ss.*—Rather fine-grained ss., 50 ft. thick, containing some micaceous beds, forming basal part of Coal Measures in Bates Co. and E. and N. parts of Vernon Co. In Barton Co. underlain by 99 ft. of cgl. and iron ore belonging to Coal Measures.

F. C. Greene and W. F. Pond, 1926 (Mo. Bur. Geol. and Mines vol. 19, 2d ser.). *Clear Creek ss. memb. of Cherokee fm.*, 82 to 130 ft. thick, is = Graydon ss. and cgl. of Shepard. Overlies Dederick sh. memb. of Cherokee with sharp contact.

Named for exposures on Clear Creek, Vernon Co.

†Clear Creek limestone member (of Graford formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 392). *Clear Creek bed.*—To S. practically all ls.; to N. contains considerable clay and in places is divided by 20 to 50 ft. of clay. Upper ls. 5 to 15 ft. thick; lower ls. 25 to 75 ft. thick. Fossiliferous. Total thickness 20 to 140 ft. Memb. of Canyon div. Underlies bed No. 7 (25 to 100 ft. of clay) and overlies Cedarton bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 35; Univ. Tex. Bull. 2132, pp. 109, 111, 113, 115). *Clear Creek ls.*, 10 to 25 ft. thick, is a memb. of Brad fm. in Colorado River Valley. Underlies Placid sh. and overlies Cedarton sh. and ss.; all members of Brad fm. West of Brownwood and along its outcrop across Brown Co. it is a yellow-brown ls. made up of several more or less discontinuous layers which in places combine to form a solid ledge, but in other places are separated by thin beds of sh. In places it can be distinguished by its dark yellow-brown color; in other places it is light gray and massively bedded.

E. H. Sellards, 1931 (News Letter from Bur. Econ. Geol. Univ. Tex., dated Sept. 1931). Clear Creek ls. is same as Adams Branch ls. W. of Graford.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 111), extended Graford fm. up to base of Placid sh. and restricted Brad fm. to Placid sh. and Ranger ls. members. He also discarded *Clear Creek ls.*, stating that it is preoccupied and "may be replaced by *Merriman*, a term applied originally to a part of the Clear Creek."

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), divided Brad fm. of McCulloch Co., Colorado River region, into following members (descending): Ranger ls., Placid sh., Clear Creek ls., and Cedarton sh., and stated (p. 205): Clear Creek ls. is also known as Merriman ls.

Named for Clear Creek, Brown Co.

According to Wallace Lee (ms. soon to be published by Tex. Geol. Survey), Merriman ls. of Brazos River region as originally defined by Reeves corresponds to only the upper (3 to 4 ft. thick) of the 2 lss. that were included in Clear Creek ls. of Drake and of Plummer and Moore in Colorado River region. The beds called "Clear Creek ls." (preoccupied) in Colorado River region are now included, without a name, in upper part of Graford fm. This is present definition of U. S. Geol. Survey.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 24) showed *Clear Creek ls.* as much younger than Merriman ls., and included both in Brad fm., drawing base of Brad considerably lower than Merriman ls., and at top of Staff ls. of Brown Co., Colorado River Valley.

Clear Creek greenstone.

Mississippian (?): Northwestern California (Klamath Mountains region).

O. H. Hershey, 1901 (Am. Geol., vol. 27, pp. 226, 233, 238). *Clear Creek greenstone.*—The foundation rock of basin of Trinity River btw. Trinity Center and Lewiston, the Trinity Mtns and the ridges eastward to Sacramento River. Provisionally assigned to Jurassic. Is made up of a variety of deposits of a volcanic nature, but all having something in common, so that it appears over wide areas as a massive, fine-grained, dull-green rock. Much of it is of a detrital character, chiefly diabasic tuffs and ashes, although in places it is brecciated and occasionally it has a cgl. structure. In large part is extrusive. Was deposited on land. Thickness more than 1,000 ft. Is associated with Bragdon slates [Miss.]. Rests uncon. on Devono-Carbf. rocks.

Probably named for exposures on or near Clear Creek, Shasta Co.

Clear Creek series.

Mississippian (?): Northwestern California (southern part of Klamath Mountains).

O. H. Hershey, 1903 (Am. Geol., vol. 31, pp. 231–245). *Clear Creek series.*—Volcanic materials, such as andesite and rhyolite lavas and tuffs, intruded by dikes of diorite, diabase, and rhyolite porphyry, all altered. Thickness 200 to 2,000 ft. Associated with Bragdon fm. [Miss.].

Clear Creek volcanic series.

Triassic (?): Northwestern California (Trinity and Shasta Counties).

O. H. Hershey, 1904 (Am. Geol., vol. 33, pp. 248–256, 347–360). *Clear Creek volcanic series.*—Lavas and tuffs, which grade into overlying Pit shales by interstratification. Assigned to Triassic.

According to J. S. Diller (Am. Jour. Sci., 4th, vol. 19, pp. 380–385, 1905) the Clear Creek volcanics of Hershey are pre-Bragdon and in part at least pre-Middle Dev.

Clear Creek gneiss.

Pre-Cambrian: Central northern Colorado (Jefferson and Clear Creek Counties).

J. Underhill, 1906 (Univ. Colo. Studies, vol. 3, No. 4, p. 270; also Colo. Sci. Soc. Proc., vol. 8, pp. 103–122). *Clear Creek gneiss.*—Characterized by quartz, feldspar, and mica. Not so plicated as older Fundamental gneiss, into which it grades. Occurs along Clear Creek [Jefferson and Clear Creek Counties].

†Clear Fork group.

Pennsylvanian: Western Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. Rept. on Iron Ores, pt. 2, pp. 169, 170). *Clear Fork group.*—Shales and clays, with 2 or 3 coal seams; 84 ft. thick; includes beds Nos. 1 to 10 of detailed section of lower Coal Measures from Sedalia to Kansas City. Overlies lower Carbf.

Is a part of Cherokee sh.

Named for exposures on Clear Fork, 6 mi. SW. of Kansas City.

Clear Fork formation (also **group**).

Permian: Central and central northern Texas and western Oklahoma.

E. T. Dumble and W. F. Cummins, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxix, 188). *Clear Fork beds.*—Fossiliferous mag. and earthy lss., calc. clays and sss., with small quantities of gyp. and cgl. Overlie Wichita beds and conformably underlie Double Mtn beds.

Some geologists include Arroyo fm. of Beede and Waite in Clear Fork group, but Beede, Waite, and Wrather include it in Wichita group. The U. S. Geol. Survey includes it in Clear Fork group.

Probably named for Clear Fork of Brazos River, Jones and Shackelford Counties, Tex.

Clear Lake sediments.

Pleistocene: Northern California (Lake County).

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 201-202). The body of water in which these Cache Lake beds were laid down overlapped area at present occupied by Clear Lake, with which Dr. G. F. Becker shows its geol. history has been continuous. The later andesite overlies the Cache Lake deposits and also underlies the *Clear Lake sediments.*

Clearwater shale.

Cretaceous: Alberta, Canada.

R. G. McConnell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 30D-32D, 55D-58D). [Assigned to Colorado epoch of Upper Cret. Some recent repts by other geologists assign this fm. to Lower Cret.]

Clem Creek sandstone member (of Ochelata formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

W. B. Emery, 1918 (U. S. G. S. Bull. 686B, pp. 2, 3). *Clem Creek ss.*—A series of massive medium-grained sss. and thin lenticular shales aggregating 60 to 65 ft., exposed along Clem Creek in NW. part of T. 23 N., R. 11 E. Rests on red ls. and its upper limit is top of a massive ss. 18 ft. thick, which is marked by a line of woods at base of a grass-covered prairie, developed on the overlying sh. Top lies 195± ft. above top of Avant ls. and 175± ft. below Bigheart ss.

Clemville formation. (In Chaleur series.)

Silurian (Niagaran): Quebec (Gaspe Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 44).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). Clemville and LaVieille fms. of middle Sil. Chaleur series are correlated by faunas with Clinton.

Cleopatra quartz porphyry.

A sill of pre-Camb. rock intrusive into greenstone complex of Jerome dist., Ariz., and said to be younger than Deception quartz porphyry. (See L. E. Reber, Jr., Am. Inst. Min. Engrs. Trans., 1920, and J. L. Fearing, Jr., Econ. Geol., vol. 21, pp. 757-773, 1926.)

Clepsydrops shale.

A paleontologic name (listed in U. S. G. S. Bull. 191) applied by E. D. Cope, 1879 (U. S. Geol. and Geog. Surv. Terr. Bull. 5, pp. 51-52), to a thin stratum of black and rarely reddish carbonaceous shales and clays in SE. Ill. and SW. Ind., "which appear to lie conformably on the Coal Measures, to which they have been referred by previous geologists, but Collett, Gibson, and others have shown that it is uncon. over considerable areas. It does not belong to Coal Measures."

Clermont limestone. (In Allegheny formation.)

Pennsylvanian: Central northern Pennsylvania (McKean County).

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R, pp. 46, 128). *Clermont (Ferriferous) ls.*—Bluish gray siliceous ls., 4 to 8 ft. thick. First studied in vicinity of Clermont, McKean Co. Has been traced through and identified as Ferriferous ls. Lies 30 ft. above Clermont (Clarion) coal and 8 to 32 ft. below Lower Kittanning coal.

Same as Vanport ls. memb., the older name.

Clermont group. (In Allegheny formation.)

Pennsylvanian: Central northern Pennsylvania (Elk County).

C. A. Ashburner, 1882 (Am. Phil. Soc. Proc., vol. 19, btw. pp. 337 and 348). *Clermont group.*—Includes Clermont or Ferriferous ls. at top and Clermont (Clarion) coal at base in Elk Co. Rests on Homewood ss. (top of Pottsville cgl.).

Clermont shale. (In Maquoketa group.)

Upper Ordovician (Richmond): Northeastern Iowa.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 98). *Clermont sh.*—Bluish, plastic, fine-grained sh., 15 ft. thick, in lower part of Maquoketa stage. Overlain by Fort Atkinson ls., of Maquoketa stage [group], and underlain by Elgin shaly ls., also of Maquoketa stage.

Named for exposures at Clermont, Fayette Co.

Cleveland shale.

Upper Devonian or Mississippian: Northern Ohio.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 19, 21). *Cleveland sh.*—Black bituminous sh., 20 to 60 ft. thick, underlying Bedford sh. and forming basal fm. of Waverly group in northern Ohio. Overlies Erie [Chagrin] sh. Is Carbf.

Named for exposures at Cleveland.

For many years this fm. was placed in Carbf. by Ohio geologists. About 1875 geologists began to assign it to Dev. E. Orton followed latter classification from 1880 on. In 1911 (Geol. Soc. Am. Bull., vol. 22) E. O. Ulrich assigned this sh. to Miss., and since then much has been written on the subject. Most geologists (Prosser, Kindle, Claypole, Cushing, Burroughs, VerWiebe, Decker, Stout, and others) continued to assign the Cleveland to Dev., and the U. S. Geol. Survey classified it as Dev. until 1927, when they changed to *Dev. or Carbf.*

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 154). *Cleveland sh.* does not contain, so far as known at present, a single invertebrate fossil whose presence would unquestionably indicate a Miss. age. Yet it would be premature to pass judgment, for at present very little is known about Miss. black sh. fossils. The facies aspects seem to indicate Dev. age.

Cleveland sandstone. (In Kanawha formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, pp. 75, 172). *Cleveland ss.*—Massive gray ss. and sandy sh. 45 to 55 ft. thick, outcropping along N. bank of Little Kanawha River at Cleveland, Webster Co. Underlies Winifrede coal and overlies Chilton (?) coal. Is lowest outcropping fm. recognized in either Lewis or Gilmer Co. May be same as Upper Chilton ss.

Cleveland moraine.

Pleistocene (Wisconsin stage): Northeastern Ohio and northwestern Pennsylvania. Shown on moraine map (fig. 8) in U. S. G. S. Columbus folio (No. 197), p. 12. Named for Cleveland, Ohio.

Cleveland sand.

A subsurface sand, of Penn. age and 0 to 160± ft. thick, in Okla., that originally was correlated with a part of Nowata sh. Named for early production in it on townsite of Cleveland, Pawnee Co. According to N. W. Bass (U. S. Dept. Int. Press Rept. 105,368 [1936], map, pl. 1) this sand belongs in Coffeyville fm., instead of in Nowata sh.

Cleveland magnafacies.

Upper Devonian or Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 28–29). The next western [than Chagrin] magnafacies is a black fissile sh. which seems to have been the typical "open sea" deposit in Neodevonian time. For this westernmost magnafacies the name *Cleveland* is tentatively selected. The Cleveland sh. is also a terrane embracing several stages, and the use of the name in this manner is clarifying.

Cleveland County red lands.

Eocene: Southeastern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 58–59, 61, 188). The "red lands" of Cleveland Co. constitute a fossiliferous horizon at or near top of Camden series [which included Jackson fm., Claiborne, Wilcox, and Midway groups, and Upper Cret. fms.]. This fm. consists of the characteristic sediments of that series, but is accompanied by extensive deposits of marine shells and greensand which bring into these strata an ingredient of lime, which is conspicuously lacking in underlying beds. This lime renders the otherwise almost sterile micaceous sands and clays a fertile calc. marl. Fossils are all characteristic of Claiborne fm. of Ala. and Miss.

The 1929 geol. map of Ark., by G. C. Branner, maps the rocks of Cleveland Co. as Claiborne and Jackson.

Named for exposures at O. H. Mark's place, Red Land Twp, Cleveland Co.

†Click series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvii, 274). *Click series.*—Metamorphosed calc. rock or dolomitic marble, overlying Iron Mtn series and forming top div. of Fernandan system.

Part of Packsaddle schist of modern nomenclature.

Probably named for Click, Llano Co.

†Cliff limestone.

Silurian and Devonian: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

John Locke, 1838 (Ohio Geol. Surv. 2d Ann. Rept., pl. opp. p. 205, pp. 206, 211). *Cliff ls.*—Generally compact, often soft and friable, sometimes porous and spongy ls., also aren. ls.; fossiliferous in places; of yellowish, reddish, gray, or nearly white color. Thickness 89 ft. Overlies the blue ls., from which it is separated by marls and by a siliceous fm. which in Adams Co., Ohio, is 50 ft. thick but elsewhere is reduced to few inches or is absent.

Nongeographic name. Rocks now divided into several fms.

Named because it forms cliffs in banks of Ohio River and tributaries.

Cliff House sandstone. (In Mesaverde group.)

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

A. J. Collier, 1919 (U. S. G. S. Bull. 691K). *Cliff House ss.*—Upper fm. of Mesaverde group. Is "Upper Escarpment" of W. H. Holmes's subdivision of the Mesaverde on SW. side of Mesa Verde [Montezuma Co., Colo.], where it consists of hard ss. In area S. of Mancos it is too friable to form cliffs, tho it still contains many thin beds of ss., and it is there nowhere covered by overlying fms., being partly eroded. At Echo Cliff it occurs as a sheer face of ss. more than 400 ft. thick. As it is most strikingly exposed in the canyons above the cliff houses of

Mesa Verde National Park, which were built along a shaly parting in it, it is here named Cliff House ss. Overlies Menefee fm.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). [See under *Mesaverde group*, 1924 entry.]

Cliff Lake granite porphyry.

Pre-Cambrian: Manitoba.

A. T. Bruce, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. D, p. 5).

†Cliffwood clays.

Upper Cretaceous: Northeastern New Jersey.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 166). *Cliffwood lignitic sands and clays.*—White sand, with seams of black lignite and thin beds of black clay. Its many ss. concretions have yielded numerous plant remains. Thickness 15 to 20 ft. Top memb. of Raritan clay series. Underlies Merchantville clay and rests on No. 4 sand (laminated sand 40 to 75 ft. thick). Exposed in clay pits about Cliffwood [and at Cliffwood Point, on S. shore of Raritan Bay].

W. B. Clark, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 435–440), restricted Raritan fm. as explained under *Raritan fm.*, and correlated (Johns Hopkins Univ. Circ. vol. 23, No. 7, 1904) Cliffwood clays with Magothy fm. of current nomenclature.

Clifton formation.

Silurian (Niagaran): Western central Tennessee.

J. M. Safford and J. B. Killebrew, 1876 (Elements of geol. of Tenn., pp. 108, 142–146). *Clifton ls.*—Chiefly thick-bedded, gray, fossiliferous ls., sometimes containing clayey layers and weathering into sh. Thickness 0 to 200 ft. In western valley, the region of its greatest development, it is equally divided into a lower variegated ls. and marble and an upper gray ls., each 100 ft. thick. Clifton [Wayne Co.] is located on lower part of fm. Same as Meniscus ls. Underlies Linden ls. [Dev.], and overlies Dyestone group.

Clifton formation.

Pennsylvanian: New Brunswick.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 95).

Clifton Forge sandstone member (of Keyser limestone).

Lower Devonian (Helderberg): Central western Virginia.

F. M. Swartz, 1930 (U. S. G. S. P. P. 158 C). *Clifton Forge ss. memb.*—Calc. sss. and shaly sss., with some aren. sh., composing middle memb. of Keyser ls. at Clifton Forge, Hot Springs, Gala, and other places in western Va. Thickness 66 to 102 ft. (66 ft. thick at Clifton Forge). Intertongues with and finally replaces the upper ls. and Big Mtn sh. members of Keyser ls. Rests on lower ls. memb. of the Keyser.

Clifty limestone.

Middle Devonian: Northwestern Arkansas (Eureka Springs-Harrison region).

H. D. Miser, 1916 (U. S. G. S. Eureka Springs–Harrison folio, No. 202). *Clifty ls.*—A bed of ls. nowhere more than 2½ ft. thick. Named for East Fork of Little Clifty Creek, Eureka Springs quad., where, within an area not exceeding ½ sq. mi., all its known exposures occur. Lower 1½ ft. is gray, compact, laminated, cross-bedded ls. with few fossils and large amount of quartz sand, the grains of which are rounded and translucent. Upper 12 inches is compact, light bluish-gray ls., with conchoidal fracture and small amount of sand like that in underlying bed. Uncon. underlies Sylamore ss. memb. of Chattanooga sh. and uncon. overlies Kings River ss. memb. of Everton ls. Contains Hamilton fossils in lower 18 inches.

†Clifty conglomerate lentil.

Pennsylvanian: Eastern Tennessee (White County).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 370–371). [See quotation under †*Clifty sh.*, which contains all of definition.]

†Clifty shale.

Pennsylvanian: Eastern Tennessee (White County).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 370–371). About Clifty and Bon Air in White Co. the Lee fm. consists of following, in descending order: Rockcastle cgl., in remnants on hilltops; Vandever sh.; Clifty cgl. lentil (upper part of Bonair cgl.); Clifty sh., with Clifty coal in top part; Bonair cgl. (lower part); Whitwell sh., with Bon Air coals; Sewanee cgl.; and Gizzard sh. The Clifty cgl. merges, when traced W. toward De Rossett [White Co.] with upper part of Bonair cgl. by lensing out of Clifty sh. and coal. It is here assumed that Clifty sh. lentil also disappears to N. and that Clifty cgl. either disappears or more probably unites with and forms top part of Bonair or Monterey cgl., thus losing its identity as a separate memb.

Clinch sandstone.

Silurian (early): Eastern Tennessee, southwestern Virginia, and southern West Virginia.

J. M. Safford, 1856 (Geol. Reconn. Tenn. 1st Rept., p. 157). *Clinch Mtn ss.*—Light-gray, generally thick-bedded ss., at many points abounding in fucoids; sometimes contains layers of cgl. with pebbles the size of small peas. In some places upper [lower?] part is red and highly ferruginous. [If *upper* was meant, the red beds are part of Rockwood fm.; if *lower* was meant, as in all of Safford's later repts, the red beds are the Ord. Sequatchie fm. In some of Safford's later repts this lower red sh. was called *Clinch Mtn red sh.* and *Clinch sh.*] Thickness several hundred ft. Is the great protecting rock of many high ridges in NE. Tenn. Underlies 200 or 300 ft. of shales with thin fine sss. and iron ore. Overlies Nashville or top memb. of Hudson River group.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 161, 292, 297). *Clinch Mtn ss.* (*Medina*) [also called Clinch group].—Hard ss., mostly white or grayish-white, 400 or more ft. thick [called *Clinch ss.* on pp. 295, 298, etc.], overlying 400 ft. of red calc. shales, provisionally included in fm. [and called *Clinch red sh.*, on pp. 295, 298, etc.]. Confined to E. Tenn. Included in Niagara group. Underlies White Oak Mtn sss. and overlies Nashville or Nash group.

In 1895 (U. S. G. S. Knoxville folio, No. 16) and 1896 (U. S. G. S. Loudon folio, No. 25, and Morristown folio, No. 27) A. Keith restricted Clinch ss. to upper massive white ss. of Safford's Clinch Mtn ss. and applied new name *Bays ss.* to underlying red sss. and shales. He defined Bays ss. as underlying white Clinch ss. and overlying Sevier sh., and as 300 to 1,100 ft. thick. Later work by several geologists indicated that the red sss. of Bays Mtn (type loc. of Bays ss.) are older than the red sss. underlying Clinch ss. on Clinch Mtn. (See under *Bays ss.*) The fm. underlying Clinch ss. is now called *Juniata fm.* in eastern belt and *Sequatchie fm.* in western belt. The overlying fm. is of Clinton age. E. O. Ulrich and C. Butts correlate Clinch ss. with Albion ss. of N. Y.

Named for exposures on Clinch Mtn, Hancock and Hawkins Counties, Tenn., and Scott Co., Va.

†Clinch red shale.

Upper Ordovician: Eastern Tennessee.

See 1869 entry under *Clinch ss.* Is same as Sequatchie fm. of present nomenclature.

†Clinch Mountain sandstone.

Silurian and Upper Ordovician: Eastern Tennessee and western Virginia.

See explanation under *Clinch ss.* Included Clinch ss. and Sequatchie fm. of present nomenclature.

†Clinch Mountain red shale.

Upper Ordovician: Eastern Tennessee.

See explanation under *Clinch ss.* Is same as Sequatchie fm. of present nomenclature.

†Cline.

Upper Cretaceous (Gulf series): Southern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 114), used *Cline*, in table only, for beds btw. Austin chalk and Anacacho fm. in Uvalde section.

Probably named for Cline, Uvalde Co.

Clingman conglomerate. (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Clingman cgl.*—Of precisely same composition as Thunderhead cgl., and none of its beds can be distinguished from the Thunderhead. Only noticeable difference is smaller development of sl. beds in Clingman cgl. Thickness 1,000 ft. Overlies Hazel sl.

Named for Clingmans Dome (spelled thus on the map), Swain Co., N. C.

Clinton formation. (In Niagara group.)

Silurian: New York to northeastern Tennessee; also Michigan.

T. A. Conrad, 1839 (Phila. Acad. Nat. Sci. Jour., vol. 8, pt. 1, pp. 228–235), applied *Clinton group* to beds underlying Niagara sh. [Rochester sh. memb. of Clinton fm.] and overlying Niagara ss. [Albion ss.].

L. Vanuxem, 1842 (Geol. N. Y., pt. 3), defined *Clinton group* of Third Dist. of N. Y. as consisting of green and black-blue sh., greenish and gray ss., red ss. often laminated, calc. ss., encrinal ss., and red fossiliferous iron ore beds, the most prominent memb. being the sh., the next most prominent memb. the greenish ss., and the third persistent memb. the iron ore beds. He stated that characteristic masses of these rocks occur around Clinton, Oneida Co., N. Y.; that overlying fm. is *Niagara group=Lockport group;* and that underlying fm. is *Oneida or Shawangunk cgl.*

The application of the names *Clinton group* and *Clinton fm.* to the beds btw. so-called *Niagara sh.* (or Rochester sh.) above and Medina ss. [=Albion ss.] below was universally followed until 1908, when A. W. Grabau (Sci., n. s., vol. 27, pp. 622–623) included the *Upper Medina* [Albion ss.] in the Clinton, and repeated this classification in 1909 (Jour. Geol., vol. 17, pp. 234–237). This proposed change was not, however, adopted by other geologists.

In 1910 (N. Y. State Mus. Bull. 140, pp. 21–23) J. M. Clarke stated that as originally described the upper limit of *Clinton fm.* was not defined; "or in other words the entire section exposed at Clinton village above the Medina ss. was left as the exponent of the Clinton fm.;" but that "with the progress of knowledge it is satisfactorily determined that at the Clinton section at Clinton there is a weak development of the Rochester sh., and this was included by inference in Vanuxem's definition of the Clinton fm." "In the Clinton section no entirely satisfactory division of the strata has yet been made. How far the division of the Rochester section can be correlated with or applied to the Clinton section is still to be determined, but they now seem to have little in common. The fauna indicates the presence of species of the Rochester member well down in the strata, and in paleontology it may be unwise to separate the Rochester member and its fauna from the series with which it is so intimately bound in this typical section."

In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28, etc.) E. O. Ulrich redefined *Clinton group* to include Rochester sh. at top and Brassfield ls. of Ky. ("the oldest Clinton known") at base, defining the Brassfield as lying strat. btw. Sodus sh. (above) and Medina ss. (below), but as not present in N. Y. He stated: It being now conceded that the Rochester sh. zone is included in and forms the top div. of the typical Clinton, and as the part beneath the Rochester is locally divisible into several lithologically and faunally distinct members or fms., the composite Clinton unit manifestly has become a group. He also showed a hiatus of considerable magnitude btw. Rochester sh. and overlying Lockport dol.

In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel included Rochester sh. in the Clinton.

In 1913 (Geol. Soc. Am. Bull., vol. 24) A. W. Grabau stated: The hiatus which Ulrich places btw. the Rochester and Lockport, in order to make room for some southern fms., is absolutely nonexistent; the Rochester sh. by becoming more calc. passes without a break upward into the Lockport dol.

In 1913 the U. S. Geol. Survey adopted *Rochester sh. memb. of Clinton fm.* (See Niagara folio, No. 190.)

In Canada Geol. Surv. Guidebook No. 4, 1913, F. B. Taylor and W. A. Parks excluded Rochester from Clinton, thus following the old classification, as did M. Y. Williams in 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 40–41, and Canada Geol. Surv. Summ. Rept. for 1913); also 1919 (Canada Dept. Mines, Geol. Surv. Mem. 111); E. M. Kindle (Sci., n. s., vol. 39, p. 918, 1914), who stated that "there is no excuse for including Rochester in the Clinton;" and C. Schuchert (Geol. Soc. Am. Bull., vol. 25, pp. 277–320, 1914), who stated that from Rochester, N. Y., westward into Ontario there is an easily discerned discon. or time break of considerable length btw. Lockport dol. and Rochester sh., the latter pinching out along Niagara escarpment.

In 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4) R. S. Bassler included Rochester in Clinton.

In 1918 (Geol. Soc. Am. Bull., vol. 29, p. 82) E. O. Ulrich introduced, without definition, *Kirkland fm.* for *Lower Clinton* of Pa. and Md. [The name *Kirkland* was suggested to U. S. Geol. Survey as a name for the pre-Rochester part of Clinton fm. in a letter from J. M. Clarke dated April 24, 1916.] In same vol. (pp. 327–368) G. H. Chadwick subdivided Clinton fm. into many minor units [see N. Y. chart] and (pp. 349, 359, 364) applied, in heading, the name *Kirkland iron ore* to what he described as "really a ferriferous ls., conspicuously crinoidal, and known locally as the 'red-flux bed,'" its "finest exposures being across the town of Kirkland, in which lies Clinton village." On many pages he used *Kirkland ls. and ore.* He defined his Kirkland as 0 to 6 ft. thick, and as located in upper part of Clinton fm., underlying his Phoenix sh. memb. and overlying his Brewerton sh. memb. He suggested dropping Clinton, and substituting a new name for each half, and stated: "Stratigraphically the Rochester sh. is excluded from the type section of the Clinton." He also restricted Rochester sh., by removing from it (under name *Gates ls.*) the upper 20 ft. of calc. beds ("really a ls.") heretofore included in the Rochester.

In 1923 (Md. Geol. Surv. Sil. vol., see index) C. K. Swartz introduced *Rose Hill fm.* for the pre-Rochester part of *Clinton group* of Md., and stated that "the close relationship of the Rose Hill and the pre-Rochester Clinton of central N. Y. in fauna, lithology, stratigraphic position, and geographic variation justify their correlation." He also expressed the opinion that Clinton might still fittingly be retained for the beds beneath the strata containing the Rochester fauna, although some at least of the iron ores occur in the beds assigned to the Rochester by Ulrich. In same vol.

(pp. 244, 267, etc.) Ulrich again redefined the Clinton by including in it, at base, the Thorold ss. [memb. of Albion ss.], but he still treated the Rochester as top memb. of Clinton. He also stated that in paper read by him before Geol. Soc. Am. in 1917 [published in 1918] the term *Kirkland* was proposed for *Middle* Clinton [published *Lower* Clinton], and suggested that Chadwick's name *Sauquoit* may be the one finally adopted for *Middle* Clinton, which he showed (p. 347) as present in only the Clinton and Crugers Mill sections of N. Y., its horizon being btw. Williamson sh. and Wolcott ls. On pp. 349–362 of same vol. Ulrich and R. S. Bassler divided the Clinton of *Appalachian Valley region* (p. 349) into *Upper Clinton or Lakemont fm.*, Middle Clinton, and Lower Clinton. On p. 359 they stated: "The term *Lakemont ls. or fm.* is proposed for the Upper Clinton as developed in *central Pa.* The type section is at Lakemont Park along the highway between Hollidaysburg and Altoona, Pa. The advantage of using this new name for the Upper Clinton in Md. seems assured, but in southwestern Va., where the corresponding beds consist entirely of ss. and sandy sh., some other designation probably is desirable. The propriety of its use for N. Y. deposits of similar age also is questionable." In correlation chart on p. 244 Ulrich showed Lakemont=Rochester sh., Irondequoit ls., and Williamson sh. of N. Y. subdivisions of Clinton.

The thickness of the Clinton at Clinton, N. Y., is stated by Ulrich (1923) to exceed 86 ft. In central Pa. it is 890 ft. thick.

The U. S. Geol. Survey treats *Clinton fm.* as basal div. of Niagara group, and includes Rochester sh. memb. in the Clinton, at top, but does not include Thorold ss. at base. In N. Y. the Clinton is overlain by Lockport dol. and underlain by Albion ss. In central Pa. the Lockport is absent and Cayuga group rests on the Clinton, which is in turn underlain by Tuscarora qtzite (correlated with Albion ss.). In eastern Tenn. the deposits of Clinton and Albion age are included in Rockwood fm.; in Ala. they are included in Red Mountain fm., where, according to E. O. Ulrich, they possess a different facies from the deposits of similar age in Tenn.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), included Rochester sh. and Thorold ss. ("=Oneida cgl.") in the Clinton.

C. Schuchert and C. R. Longwell, 1932 (Am. Jour. Sci., 5th, vol. 23, pp. 305–311), excluded Oneida cgl. from the Clinton.

J. T. Sanford, 1936 (Jour. Geol., vol. 44, p. 811), excluded Oneida cgl. from the Clinton.

The U. S. Geol. Survey does not include Oneida cgl. in Clinton fm.

Clinton quartzites.

A name tentatively applied (N. Y. State Mus. Bull. 80) to Binnewater ss. of eastern N. Y., because the beds are in some respects similar to Clinton fm. of western N. Y.

Clinton sand.

A subsurface sand in basal part of Sil. of Ohio.

Clintonville oil sand.

Drillers' term for a sand in basal part of Venango oil sand group of NW. Pa.

Clipper Gap formation.

Mississippian (probably): Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66). *Clipper Gap fm.*—A highly compressed sequence of black clay slates and dark argill. sss. Bodies of ls. abundant but usually lenticular. Bluish or grayish chert is also common, and so closely connected with the ls. as to strongly suggest its derivation from that rock by a process of silicification. Contains lower Carbf. fossils. Corresponds to upper part of Calaveras fm. Overlies Delhi fm. Is top fm. of Carbf. age in area. Named for exposures at village of Clipper Gap, Placer Co.

Cloche Island beds.

Middle Ordovician: Ontario (Manitoulin Island).

A. F. Foerste, 1921 (Ohio Nat., vol. 13, p. 39). *Cloche Island beds.*—Darker lss. [than underlying Swift Current beds] probably reaching thickness of 150 ft. Are of post-Leray Black River age. In lower part fine-grained lss. alternate with coarser grained layers for vertical distance of about 30 ft.; these are overlain by coarser grained lss. in which finer grained layers are not conspicuous and which reach thickness of about 50 ft. Form almost entire surface of Cloche Island. Overlain by lss. of Trenton age. Fauna discussed.

†Cloquet slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Carlton County). See under †*Thomson sl.*

Cloquet moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Cloquet, Carlton Co.

Clore limestone. (Of Chester group.)

Mississippian: Southwestern Illinois and western Kentucky.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 129). *Clore fm.*—Variable lss., more than 30 ft. thick, some beds thin-bedded and shaly, other beds hard and similar to Menard ls., and still other beds more granular or crystalline; passage beds at base, in places 25 ft. thick, consist of aren. and calc. shales with some ls. beds. Topmost fm. of Chester group. Overlies Palestine ss.

S. Weller, 1920 (Jour. Geol., vol. 28, Nos. 4 and 5), named topmost fms. of Chester group in southern and western Ill., Kinkaid ls. (above) and Degonia ss. (below), and stated that the Degonia rested on Clore ls. [restricted] (0 to 40 ft. thick) and that both Kinkaid and Degonia had been included in Penn. in earlier repts.

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41, pp. 212 to 222), stated that *Clore fm.* of earlier *mapping* included Kinkaid ls. and Degonia ss.

Named for Clore School, Randolph Co., Ill. Typically exposed in heads of ravines along SW. side of high ridge extending from Clore School to Randolph County Farm.

Cloud Chief gypsum.

Permian: Southwestern Oklahoma.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, pp. 324–341, map). *Cloud Chief fm.*—Two or more ledges of massive gyp. interbedded in red clay sh.; the gypsums vary much in number and thickness. Includes what was originally described as "eastern area" of the Greer. The name "Cyril" was used for this gyp. in Cement area by Clapp, who erroneously considered it to be = the Blaine. Reeves recognized Clapp's error in correlation, but himself falls into error when he states that "only the basal part of the Greer is present in this area, where it is represented by Cyril memb." In point of fact, so far as can be determined, the entire Greer is present at Cement. Because of fact that both geologists who have used the name Cyril have fallen into error in use of the term, in order to avoid additional confusion, it appears wise to introduce an entirely new name. Therefore the name *Cloud Chief* is proposed for this fm. Typically exposed near town of Cloud Chief in eastern Washita Co. Rests on Day Creek dol. and is overlain by Quartermaster fm., with erosion uncon. according to Beede.

C. N. Gould, 1924 (Okla. Geol. Surv. Bull. 35, p. 95), stated that this fm. varies in thickness up to 115 ft.

H. D. Miser, 1926 (geol. map of Okla.), placed Cloud Chief gyp. below Quartermaster fm. and above Day Creek dol.

C. N. Gould and F. E. Lewis, 1926 (Okla. Geol. Surv. Circ. No. 13), suggested that "it might be well to consider the Day Creek the basal part of Cloud Chief gyp."

J. W. Beede and D. D. Christner, 1926 (Univ. Tex. Bull. 2607, pp. 14–15), recognized no fm. btw. Cloud Chief gyp. and Whitehorse ss. in Okla.

R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40HH). In Kiowa and Washita Counties *Cloud Chief fm.* overlies Whitehorse ss. and underlies Quartermaster fm. The term "Day Creek dol." of Cragin has been applied to Weatherford dol., Greenfield dol. and Quartermaster dol. It is believed its continued use will only serve to confuse. Writer does not know what bed, if any, in SW. Okla., corresponds to Day Creek dol. of Kans.

R. L. Clifton, 1930 (A. A. P. G. Bull., vol. 14, pp. 161–172). Evidences in field suggest *Cloud Chief* is not a geologic unit, but rather that it represents a group of more or less continuous strat. units. Writer believes Cloud Chief as a fm. name should be dropped and that another fm. name should be adopted to include the beds from *base* of Day Creek up to base of Quartermaster. [See further details under *Quartermaster fm.*]

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 408–432). Day Creek dol. *overlies* Cloud Chief gyp., and Cloud Chief should be made a memb. of Whitehorse fm. [See under *Quartermaster fm.*]

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437), does not regard Evans' interpretation of strat. relations of the various fms. as proved.

R. Roth, 1932 (Jour. Geol., vol. 40, No. 8, p. 700), believes there is no way of retaining *Cloud Chief* as a formational name; if used at all it should be as a zone name.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 146), placed Cloud Chief below Quartermaster and above Whitehorse. On p. 184 he stated that the Cloud Chief and Whitehorse fms. are not separable in Tex. either on the surface or underground.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454, 1458, 1473). Quartermaster fm. is here divided into (descending): (1) Elk City ss. memb.; (2) Doxey sh. memb.; and (3) *Cloud Chief memb.* (consisting of ss., gyp., and dol. facies). The strat. section in which the gypsums at Cloud Chief are developed is predominantly a ss. section, when considered in a large area, in which the gyp. facies occur as lenses, and has max. thickness of 300 ft., as shown by sample log of well S. of Cordell, in sec. 23, T. 9 N., R. 17 W. At type loc. the basal 100 ft. is solid gyp. and next 50 ft. lenticular gypsums in ss. To NW. of Clinton the contact of the Cloud Chief with Doxey memb. is irregular gradation. Greatest problem in Cloud Chief memb. is occurrence of Quartermaster dolomites, which in many places suggest chemical alteration from gyp. to dol. Many exposures indicate that Cloud Chief gyp. facies and Quartermaster dolomites are in same strat. horizon. Which of these dolomites, if any, is = Day Creek dol. of NW. Okla. is open question.

Cloud Mountain series.

Cambrian or pre-Cambrian: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 32).

Clough conglomerate.

Silurian (middle or lower): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings, 1934 (Sci., vol. 79, No. 2038, pp. 55–56, Jan. 19). *Clough cgl.* (*lower Sil.*).—Qtz cgl. and qtzite, 0 to 200 ft. thick. Underlies Fitch fm. (middle Sil.) and uncon. overlies Partridge sl. (Upper Ord.?).

M. Billings, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 413–415, Dec.). *Clough cgl.* is absent from most of Littleton quad., by overlap, but is well developed in Moosilauke quad. No fossils, but it is uncon. on underlying pre-Sil. rocks, and grades into overlying Fitch fm. (middle Sil.), and is therefore believed to be middle or lower Sil. Named for Clough Hill dist. [Moosilauke quad.].

See also M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps and text).

M. Billings, 1935 (letter dated Aug. 27). Coos qtzite of Hitchcock is our Clough cgl.

Clover quartzites.

Clover Canyon quartzites.

Pre-Cambrian: Northwestern Nevada.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, p. 69), in his description of the "Archean rocks" of Humboldt Range, Nev., mentioned *Clover Canyon qtzites* and *Clover qtzites.*

Clover Creek limestone. (In Chester group.)

Mississippian: Western central Kentucky (Breckinridge County).

A. F. Foerste, 1910 (Ky. Geol. Surv. Rept. Prog. 1908 and 1909, pp. 83, 85). *Clover Creek ls.*—Ls., 11 and perhaps 15 ft. thick, underlying Garfield ss. and overlying Big Clifty ss. in Meade and Breckenridge Counties.

Named for exposures at mouth of Clover Creek, Breckinridge Co.

Clover Creek greenstone.

Permian: Northeastern Oregon (Baker quadrangle).

J. Gilluly, 1937 (U. S. G. S. Bull. 879). *Clover Creek greenstone.*—Altered volcanic flows and pyroclastic rocks, with subordinate ls. and chert. Thickness 4,000+ ft. Uncon. underlies pre-Mio. gravels. Relation to Elkhorn Ridge argillite (Penn.?) unknown. Named for exposures along Clover Creek, secs. 24, 25, 26, and 35, T. 7 S., R. 42 E.

Cloverly formation.

Lower Cretaceous: Central, eastern, and northern Wyoming and central southern Montana (Stillwater-Rosebud Counties region).

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). *Cloverly fm.*—Gray to reddish purple clay, 30 to 40 ft. thick, resembling Fuson fm., underlain by 10 to 60 ft. of coarse-grained buff or dirty gray cross-bedded massive ss., with some very thin deposits of coal or coaly sh., and believed to represent the Lakota of the Black Hills. Owing to lack of definite evidence as to equivalency of these beds on E. side of Bighorn Mtns to the Fuson and Lakota, and especially in consideration of apparent absence of deposits representing the Dakota ss., it has been thought best to give the series a separate designation. Underlies Benton fm., the lower part of which as here discriminated may possibly include beds representing Dakota ss. Rests on Morrison fm. Named for Cloverly, a post office on E. side of Bighorn Basin, Wyo.

C. T. Lupton, 1916 (U. S. G. S. Bull. 621, table opp. p. 166, pp. 167, 168). At type loc. of Cloverly fm., near Cloverly, Wyo., about 15 mi. NE. of Basin, Bighorn Co., Wyo., the Cloverly fm., according to N. H. Darton (U. S. G. S. P. P. 51, p. 52, 1906), consists of 113 ft. of strata, a detailed section of which is here given. Upper 20 ft. (light-buff or tan-colored ss.) of this fm. constitutes Greybull sand, which carries oil and gas in Greybull field and water in Lamb anticline and Torchlight dome. The Greybull sand is overlain by Thermopolis sh.

D. F. Hewett and C. T. Lupton, 1917 (U. S. G. S. Bull. 656, p. 19), defined base of Thermopolis sh. and top of Cloverly fm. as top of Greybull ss. memb., and stated that the Thermopolis includes the "rusty beds" [20 to 100 ft. thick] described by Washburne (in U. S. G. S. Bull. 340, p. 350, 1908) as basal memb. of Colorado fm. in Bighorn Basin, Wyo.

W. T. Lee, 1927 (U. S. G. S. P. P. 149, p. 64), included the "rusty beds" in his Greybull ss. memb. of Cloverly fm.

R. S. Knappen and G. F. Moulton, 1931 (U. S. G. S. Bull. 822, pp. 23–28), included the "rusty beds" in Thermopolis sh. [of Colorado age] and treated Greybull ss. as top memb. of Cloverly fm. This is present approved definition of Cloverly fm. The Greybull ss. is tentatively classified as Lower (?) Cret.

Cloverport "sand."

Drillers' name for 15± ft. of gray *ls.* in Keokuk ls. (Miss.) of NW. Ky. It is source of oil at Cloverport, Breckinridge Co.

Clugston limestone.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 71; map). *Clugston ls.*—Varies from pure white, dense, fine-grained, massive, crystalline rock to bluish gray and dark-gray banded ls. that becomes somewhat argill. The pure white varieties often show well-defined banding or stratification. In some cases the purer types are interstratified with less pure phases, and in other cases they grade over into the other impurer types. Medium-grained bluish gray to very light-gray tints prevail. Rocks commonly shattered and squeezed. Thickness 1,200±ft. Overlies Colville qtzite and underlies Mission argillite. [Mapped around headwaters of Clugston Creek.]

Clyburn formation.

Pre-Cambrian (?): Canada (Cape Breton Island).

W. J. Wright, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 273).

Clyde formation. (In Wichita group.)

Permian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192, 197–198 and charts). *Clyde fm.*—Included in Wichita group, and includes all strata btw. top of Bead Mtn ls. memb. of underlying Belle Plains fm. and top of Talpa ls. bed of Drake. Thickness averages 475 ft. In Colorado Valley is overlain by higher ls. strata that outcrop 2 mi. E. of Talpa, on Santa Fe R. R. Named for town of Clyde, 8 mi. W. of Baird, Callahan Co. It is a poor name because in vicinity of the town the Perm. is covered by Cret. sand and it is necessary to go several mi. S. of town to get good exposures. But it is only locality along its outcrop available as a name.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). *Talpa ls. of Drake* is top bed of Clyde fm.

Coachella fanglomerate.

Miocene (middle or upper): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 386–387, 391, and map). *Coachella fangl.*—A clastic rock having all characteristics of a fangl. For most part the fragments are angular and show little sorting, but material varies somewhat throughout the mass. Greater part of mass is light-gray and dark purplish gray, rather persistent coarse gravel and subangular polygenetic pebbles 2 inches to a foot in diam., probably derived from the old rocks to N. In places it consists mostly of sharply angular fragments varying in size up to 3 ft. across. The fragments are of porphyry, granite, and, largely, basalt. To E. this fangl. dips beneath more recent (Cabezon) fangl., which differs from it in being more uniform and massive, of yellowish color, and in lying nearly horizontal. The Coachella fangl. rests on old schists and gneisses. Is younger than Deep Canyon fangls.

Named for Coachella Valley, Riverside Co., near which it occurs.

Coahuila silt.

Pleistocene: Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, p. 435). The Yuha Reefs are followed by an enormous thickness of silt deposited in fresh waters of ancient Lake Coahuila, an appropriate name for which is *"Coahuila silt."* It is exposed where San Diego-El Centro highway crosses New River about 1 mi. W. of El Centro. Total thickness of these silts is not known but they contain fresh-water fossils to base of exposure indicated.

†Coal Bluff series. } (In Wilcox group.)
†Coal Bluff beds. }

Eocene (lower): Southern Alabama.

D. W. Langdon, Jr., 1894 (Ala. Geol. Surv. Rept. on Coastal Plain, p. 421). *Coal Bluff series of sands and lignites.*—Cross-bedded sands and sandy clays, 0 to 70 ft. thick, including Coal Bluff lignite, 5 ft. thick, at base. Is that portion of the Tert. below Nanafalia group and above Coal Bluff lignite, inclusive.

This term, as above defined, restricted Nanafalia fm. by separation, from its basal part, of these beds as well as the underlying lignite. The 1886 and 1892 uses of *Nanafalia* by E. A. Smith were *Nanafalia and Coal Bluff section,* in which these beds were included. The term "Coal Bluff" fell into disuse until 1920, when J. E. Brantly (Ala. Geol. Surv. Bull. 22, pp. 148–152) revived it, applying "Coal Bluff beds" to 42 to 77 ft. of strata forming basal memb. of Nanafalia fm. in Ala. and calling the rest of the Nanafalia the "Gullette Bluff beds." In 1932 C. W. Cooke extended Ackerman fm. of Miss. into Ala. to replace *Coal Bluff beds* and restricted Nanafalia fm. to the beds above the †Coal Bluff. This is present approved definition of Nanafalia fm.

Named for exposures on Alabama River at Coal Bluff, Wilcox Co.

Coalburg sandstones. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, pp. 271, 468). *Coalburg ss.*—Coarse, massive, bluish gray ss., often weathering into "chimney rock" columns on summits. Thickness 40 to 80 ft. Lies 5 to 10 ft. above Coalburg coal and 6 to 52 ft. below Kanawha black flint. [Probably named for occurrence at Coalburg, Kanawha Co.]

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 137–141). *Upper Coalburg ss.*—Massive, coarse, bluish gray and brown rock, often weathering into "chimney towers" and "table rocks" when exposed near summits; thickness 50 to 80 ft.; lies 25 to 50 ft. below Stockton coal and 0 to 10 ft. above Coalburg coal. *Lower Coalburg ss.*—Massive, gray and brown, medium-grained and aren. stratum, 20 to 50 ft. thick, lying 22 ft. below Little Coalburg coal and 5 to 9 ft. above Buffalo Creek coal.

Coalburg shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

D. B. Reger, 1921 (W. Va. Geol. Surv. Rept. Nicholas Co., p. 243). *Coalburg sh.*—Dark-gray or black, argill. deposit, coming just above Coalburg coal at Mollie Frame Farm Mine, 0.3 mi. W. of Birch River village, where it is only 3 inches thick, but it is 5 ft. thick at S. end of Powell Mtn, on Brushy Fork of Muddlety Creek. Contains plant and brackish water or possibly marine fossils. It is not quite clear whether Coalburg sh. belongs above or below Coalburg A coal, as the two members were not noted in conjunction, but indications are that the sh. underlies that coal.

Coal Creek formation.

Pennsylvanian: New Brunswick.

W. S. Dyer, 1926 (Canada Geol. Surv. Mem. 151, p. 7).

Coal Creek formation.

Silurian to Mississippian: New Brunswick (Queens and Sunbury Counties).

W. J. Wright, 1935 (Canadian Inst. Min. Metallurgy Trans., vol. 38, p. 211).

Coal Creek limestone. (In Topeka limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). The upper unit of Topeka ls. was named *Union ls.* by Condra and Bengston in 1915. That name being preoccupied the div. is here named *Coal Creek ls.*, from exposures on Coal Creek, N. of Union, Nebr. The ls. is dark blue, dense, brittle, and quite fossiliferous. At places it is split into 2 or 3 beds. Overlies Holt sh.

Coal Creek quartzite.

Pre-Cambrian: Central northern Colorado (Boulder region).

M. F. and C. M. Boos, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 2, p. 306), mentioned the pre-Camb. *Coal Creek qtzite* and *Ralston fm.*, both of sed. origin, of Boulder region, but did not define them, and stated that they were taken from unpublished thesis of J. Adler, Univ. Chicago, 1930. Both are intruded by Boulder Creek granite gneiss.

Coaledo formation. (In Arago group.)

Eocene: Southwestern Oregon.

J. S. Diller, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 319–320). *Coaledo fm.*—The coal-bearing strata of Arago fm. of Coos Bay coal field. In lower part sss. predominate. Then comes the part where the workable coal beds occur, and the associated rocks are about equal quantities of sss. and rather dark-colored shales. In upper part light-colored shales are abundant and characteristic. Distinguished from Pulaski fm. (the main body of Arago fm.) by presence of coal beds and relatively large proportions of beds containing brackish water fossils. Well exposed in vicinity of Coaledo. [Arago fm. as defined by Diller included all beds in Coos Bay dist. btw. Empire fm. (Mio.) and †Pulaski fm.]

J. S. Diller, 1901 (U. S. G. S. Coos Bay folio, No. 73). [Repeated above description and stated that Coaledo fm. rests on Pulaski fm.]

W. H. Dall, 1909 (U. S. G. S. P. P. 59), assigned the beds at Tunnel Point to Olig., and stated that they uncon. overlie Arago fm., which includes Coaledo and Pulaski fms. The separation of the beds at Tunnel Point from Coaledo fm. constituted a restriction of Coaledo.

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., Oreg. Bur. Min. and Geol., vol. 3, No. 1). *Coaledo fm.*—A series of fresh, brackish, and marine beds of ss. and muddy sh. In Coos Bay region there are a number of coal seams. Thickness 4,000 ft. [In table they placed Coaledo above Tyee ss., but stated that Tyee of Florence and Newport doubtless includes same horizon as Coaledo of Coos Bay.]

W. D. Smith, 1924 (Econ. Geol., vol. 19, p. 458), placed Coaledo above Tyee ss.

H. G. Schenck, 1927 (Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 16, No. 12) and 1928 (Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 18, No. 1). Tunnel Point ss. of Coos Bay dist. is middle Olig. and overlies Bassendorf sh. (lower Olig.), which rests on Coaledo fm. [*restricted*], upper Eocene. [Tunnel Point ss. and Bassendorf sh. of Schenck must have been included in Coaledo fm. of Diller, and Schenck's Bassendorf sh.—judging by thicknesses given—appears to have been partly included in Tunnel Point beds of Dall and partly in Coaledo fm. of Dall. This restricted definition has not been considered by U. S. Geol. Survey.]

†Coalinga beds.

Pliocene and Miocene: Southern California (Fresno and Kings Counties).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 174–185). *Coalinga beds.*—The series of beds uncon. underlying Etchegoin fm. and resting uncon. on all underlying fms., the youngest of which is Monterey sh. Includes (descending):

Sands, etc., 1,300 ft.
Tamiosoma bed (oyster bed), 20 ft.
Sands and shales, 600+ ft. (Includes *"Rainbow beds."*) [See p. 177 of book cited above.]
Reef bed, 15–50 ft.
Basal sands and gravels, 120–250 ft.

F. M. Anderson, 1908 (Calif. Acad. Sci. Proc., 4th ser., vol. 3, pp. 1–40). It is now proposed to restrict Coalinga beds to lower part of a series that is uncon. related to older members of the Mio. The Santa Margarita beds of San Luis folio are clearly related to Coalinga beds. Overlain, generally conformably, by Etchegoin fm., and underlain, in places uncon., by Monterey shales. The "Reef bed" of former rept is properly a part of Temblor beds.

The "Coalinga beds" as originally described included rocks belonging to Jacalitos fm., Santa Margarita (?) fm., †Maricopa sh., and Vaqueros ss. of subsequent repts. The restricted definition applied to essentially same rocks that were called *Santa Margarita (?) fm.* in U. S. G. S. Bull. 398, descriptive of Coalinga dist.

Named for exposures N., NW., and W. of Coalinga, Fresno Co.

†Coal Measure conglomerate.

A term formerly applied to basal cgl. of Penn. series. In Pa. it was applied to Pottsville fm. of present terminology.

†Coal Measures.

A term commonly applied in early repts to the Perm. and Penn. rocks of present terminology. (See U. S. G. S. Bull. 769, 1925, pp. 65–70.)

Coalmont formation.

Eocene: North Park, Colorado.

A. L. Beekly, 1915 (U. S. G. S. Bull. 596, pp. 20, 49–71). *Coalmont fm.*—By evidence now available the 4,000 to 5,000 ft. of fresh-water beds lying btw. the marine Cret. and North Park fm. (Tert.) can be no more definitely assigned than to "Cret. or Tert." Lithologic differences in these rocks indicate they are made up of two more or less distinct members. The 3,000 to 4,000 ft. of dark-colored coal-bearing beds that immediately overlie the marine Cret. on E. side of North Park field and outcrop in various localities in W. and SW. parts appear to be the older and to be uncon. overlain by about 2,000 ft. of lighter colored ss. and cgl., which outcrop over a large part of park floor, and in many localities appear to overlap the lower beds. No definite line of demarcation btw. the coal-bearing and sandy members can be drawn, for no unmistakable contact btw. them is exposed at any locality in the field. The sandy memb. may be a separate and distinct fm., resting uncon. on the dark-colored coal-bearing rocks; or the two sets of beds may belong to an unbroken fm., and lithologic differences represent varying phases of contemp. deposition. Meanwhile, in default of a decisive solution of problem, all strata resting uncon. on marine Cret. and overlain by North Park (Tert.) fm. are here treated as a single fm., to which name *Coalmont* is applied. The fm. is better exposed along North Platte River than in vicinity of Coalmont, but *Coalmont* is used as the most acceptable name not preoccupied or otherwise unsuitable. [See also 1915 entry under *North Park fm.*]

The fm. is now regarded as unquestionably of Eocene age.

Coamo tuff limestone.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 19, 61).

Coamo Springs limestone series.

Eocene: Puerto Rico.

E. T. Hodge, 1920 (Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 153, N. Y. Acad. Sci.).

†Coast clays.

†Coast formation.

†Coast Pliocene.

†Coastal clays.

Descriptive terms used in early repts on Gulf Coastal Plain. In part replaced by Port Hudson fm. (Pleist.), and in part by Beaumont clay (Pleist.).

Coast complex.

Pre-Franciscan (possibly pre-Cambrian): Southern California (northwestern part of Monterey County).

B. Willis, 1900 (Geol. Soc. Am. Bull., vol. 11, p. 419). *Coast complex.*—Crystalline rocks, chiefly metamorphic, including marble, qtzitic schists, mica schists, gneisses, and intrusive granite. The marbles and schists are of sed. origin. The gneisses may be partly or wholly igneous. Occurs at base of geologic column in Coast Ranges. Is long pre-Cret. May be Paleozoic. Is "basement complex" of Fairbanks.

Same as Santa Lucia series of Willis.

†Coast group.

†Coastal series.

†Coastal group.

Pre-Cambrian: New Brunswick.

G. F. Matthew and L. W. Bailey, 1872 (Canada Geol. Surv. Rept. Prog. 1870–71).

See also C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, index).

Coastal series.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 82–99).

Coastal limestone.

Quaternary: Sierra Maestra of Cuba.

S. Taber, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 589).

Coasters Harbor Island arkose.

Carboniferous: Southern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, p. 380). *Coasters Harbor Island arkose.*—Occurs at S. end of Coasters Harbor Island. May be contemp. with some part of Aquidneck sh. series. May be younger than Conanicut arkose. Not so thick as Conanicut arkose.

A part of Wamsutta fm. as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

Coast Range complex.

A name that has been applied to the pre-Franciscan rocks of Coast Ranges of southern Calif.

Coast Range intrusives.

Jurassic or Cretaceous: Southeastern Alaska, Yukon Territory, and British Columbia.

Name applied to the intrusive rocks of the Coast Range. Locally divided into many map units. In Hyder dist. of SE. Alaska includes (descending) Hyder quartz monzonite, Boundary granodiorite, and Texas Creek granodiorite, also many dikes of different lithology. (See U. S. G. S. Bull. 807, 1929.)

Coast Range diorite.

Age (?): Alaska.

A. C. Spencer, 1906 (U. S. G. S. Bull. 287, map opp. p. 12).

†Coata sandstone member (of Atoka formation).

See *Coody ss. memb.*

Coatzacoalcos formation.

Miocene: Mexico.

J. W. W. Spencer, 1897 (Geol. Soc. Am. Bull., vol. 9, pp. 13, 23).

Cobalt series.

Pre-Cambrian (late Huronian): Quebec and Ontario.

R. Harvie, Jr., 1911 (Quebec Dept. Colonization, Mines, and Fisheries, Mines Branch, pp. 9, 17).

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned these rocks to late Huronian.

Cobb coal group.

A group of coal beds, in Pottsville fm. (Penn.) of Warrior coal field, central Ala., lying above Camp Branch ss. memb., and including the Cobb upper and Cobb lower coals.

Cobblestone Hill moraine.

Pleistocene (Wisconsin stage): Northeastern New York. Same as Cannon Corners moraine. See Geol. Soc. Am. Bull., vol. 35, pp. 669–676, and Jour. Geol., vol. 32, p. 665, 1924. Named for hill 3 mi. NW. of West Chazy, Clinton Co.

Cobequid series.

Silurian: Nova Scotia.

G. M. Dawson, 1880 (Canadian Nat., 2d ser., vol. 9, p. 332).

Cobham conglomerate member.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 61, 112, 116, 117). *Cobham cgl. memb.*—The upper and most persistent cgl. of Knapp formational suite. Is a typical flat-pebble cgl. of varying texture. Thickness 75 to 100 ft. on Cobham Hill, where it is exposed along SE. and SW. faces of the hill, at Glade, Warren Co. This name replaces *Glade cgl.* (preoccupied) of writer's 1933 rept. Underlies Tidioute sh. memb. and overlies East Kane sh. memb. [According to C. Butts (personal communication, Jan. 1936) the above named cgl. is true Knapp and all of true Knapp present in area cited, and it contains fossils of Kinderhook age.]

Cobleskill limestone (also dolomite). (In Cayuga group.)

Silurian (late): New York and Ontario.

See first three paragraphs under *Rondout ls.*

In 1903 (N. Y. State Mus. Mem. 5, pp. 136–137) C. A. Hartnagel described the Cobleskill in its typical development at Schoharie and Howes Cave, Schoharie Co., N. Y., as consisting of a massive layer of dark-gray somewhat mag. ls. averaging 6 ft. in thickness, underlying the Rondout and overlying green argill. shales "which doubtless pertain to the Salina stage." In 1905 (N. Y. State Mus. Bull. 82) J. M. Clarke and D. D. Luther described it as consisting, in Tully quad., N. Y., of very hard, rather fine-grained, dark-gray ls. little altered, underlying Rondout dol. or waterlime and overlying Bertie dol., top fm. of Salina group.

In 1913 (Md. Geol. Surv. Lower Dev. vol., pp. 115–116) E. O. Ulrich stated the beds heretofore called *Manlius ls.* occur at much higher horizon than the ls. at Manlius, and gave following as correct strat. succession (descending): Coeymans ls.; Keyser ls ("Manlius of the literature"); Rondout ls.; and Decker Ferry ls. (all Lower Dev.); *typical* Manlius ls., and Cobleskill ls., the latter two Sil. In same volume C. K. Swartz, C. Schuchert, and C. S. Prosser classified the Cobleskill of N. Y. as Lower Dev., but Schuchert's 1924 Textbook of geol. assigned it to Sil. (Cayugan).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), placed *Cobleskill ls.* beneath Rondout ls. and above Salina, and included all in Sil.

See also under †*Akron dol.*

In western N. Y. the Cobleskill consists of dol. and is called *Cobleskill dol.;* it has also been called "Akron dol.," "Bullhead rock," "Bullhead ls.," and "Greenfield ls.," the latter an Ohio name.

Named for exposures on Cobleskill Creek, Schoharie Co., N. Y.

Coboconk limestone.

Ordovician: Ontario.

W. A. Johnston, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 191).

Cobourg limestone.

Ordovician: Ontario.

P. E. Raymond, 1921 (Canada Geol. Surv. Mus. Bull. No. 31, geol. ser. No. 38, Feb. 17, 1921, p. 1). *Picton* having been used by Prof. Cushing in 1910 for a granite, the name *Cobourg* is here used in its stead, the upper Trenton being fossiliferous in vicinity of that town. The Utica is here considered as a shaly phase of Trenton group. The Cobourg underlies Collingwood of Ont., which is = Utica of northern N. Y. The *Upper Cobourg* (Upper Picton of former papers) corresponds to lower part of "Utica" of Quebec, or *Hormotoma* zone. The *Lower Cobourg*

(Lower Picton of former papers) corresponds to *Rafinesquina deltoidea* zone of the Trenton, and rests on Trenton restricted.

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, chart opp. p. 58), assigned Cobourg ls. to upper Trenton and placed overlying Collingwood and Gloucester in Utica.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 51, 62, 63, 149), assigned *Cobourg ls.* to Utica.

G. M. Kay, 1933 (Am. Jour. Sci., 5th, vol. 26, No. 151, pp. 2, 6), applied *Cobourg ls.* in N. Y., to beds beneath Collingwood and above Sherman Fall, and included them *all in Trenton group. He stated type loc. is in Northumberland Co., Ont.,* and divided the rocks into *Upper Cobourg ls.*, 75+ ft. thick, and *Lower Cobourg ls.*, 175 ft. thick. Fossils listed. In 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 227–228) he also assigned all 3 fms. to Trenton.

Cobre.

Tertiary: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 78).

†Cobscook series.

Silurian and Devonian: Southeastern Maine.

N. S. Shaler, 1886 (Am. Jour. Sci., 3d, vol. 32, pp. 44–60). Greater part of sed. rocks of *Cobscook series* consist of very fine-grained sss. and dark-blue and blackish shales, which at certain points contain a good deal of lime, but rarely are pure lss. The fossiliferous rocks are mostly thin bedded, even the impure lss. At many points there are strata that contain small scattered fragments of hypogene rocks, presumably of volcanic origin. Believed to have been formed at some distance from shore. Thickness not less than 4,000 ft. Underlies Perry beds. Rests on Campobello series, with undoubted uncon., although contact has not been seen. Devonian fossils in upper beds. Includes, at top, Moose Island shales [which are a sed. facies of Eastport fm. (Sil.)]. Also includes Leighton's Cove series. Carries fossils related to Clinton, Niagara, lower Helderberg, and Dev. faunas.

Includes five fms. of Sil. age. (See Maine table.)

Named for development in Cobscook Bay dist., east coast of Washington Co.

Cobscook Bay series.

Silurian and Devonian: Southeastern Maine.

H. S. Williams, 1900 (U. S. G. S. Bull., 165, pp. 34–35). *Cobscook Bay series.*—Prof. Shaler (A. J. S., vol. 32) has described an interesting series of Sil. deposits on extreme SE. coast of Me., which contain faunas similar to those of Ashland and Sheridan series of Aroostook Co. [Lists the fossils and assigns them to Lower Helderberg, Lockport, and Clinton. Some fossils from Moose Island "probably belong to horizon of Ohio sh. (Dev.)."]

Coburn formation.

Middle Ordovician: Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 404, 420). *Coburn fm.*—Top fm. of Trenton group. Upper beds become increasingly shaly and finally merge into overlying Reedsville sh. The middle and lower beds consist of alternations of crystalline, highly fossiliferous ls., and black shaly ls. At base, wherever exposed, is *Parastrophia hemiplicata* zone. Thickness 400 ft. Is faunally and lithologically distinct from underlying Salona fm. Named for town [in Center Co.].

Cocalico shale.

Ordovician: Southeastern Pennsylvania (Lancaster County).

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 359, 365). *Cocalico sh.*—Dark gray sh. containing graptolites of Normanskill type and thin crinoidal ls. at base; gray, green, and purple slates and green impure ss. above. Thickness 1,000± ft. Rests on Beekmantown ls. NE. of Lancaster.

G. W. Stose and A. I. Jonas, 1927 (Wash. Acad. Sci. Jour., vol. 17, No. 9). The Ord. sh., generally called *Martinsburg* but locally named *Cocalico* in area N. of Lancaster, occurs in a broad belt NW. of Appalachian Valley and in several smaller areas S. of the main belt.

The U. S. Geol. Survey at present uses *Cocalico sh.* to S. of main Triassic belt and *Martinsburg sh.* to N. of main Triassic belt, the Cocalico being regarded as in part=Martinsburg sh., but E. O. Ulrich is still of opinion that basal part of Cocalico sh. is older than Martinsburg, which is considered to be of Upper and Middle Ord. age.

Named for fact it is exposed on Cocalico Creek.

Cochahee sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

D. E. Winchester, K. C. Heald et al., 1918 (U. S. G. S. Bull. 686G, p. 60). *Cochahee ss.*—Flaggy bed, massive, hard, fossiliferous, having a peculiar weathered surface suggesting turkey tracks. *Fusulina* abundant. Thickness 3 to 25 ft. Lies 45± ft. above Labadie ls. and 125 ft. below Oread ls. Named for good exposures on headwaters of Cochahee Creek, in SW. part of T. 25 N., R. 10 E.

Cochise limestones.

Lower Cretaceous (Comanche series): Southeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 336). *Cochise sandy ls.*—Lower part of Fredericksburg section of Tex., finely exposed in SE. part of Ariz. Thickness 300 ft.

Probably named for exposures at or near Cochise, Cochise Co.

Cochise formation.

Middle Cambrian: Southeastern Arizona (Whetstone Mountains and Bisbee region).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 466, 479, 480, 482). *Cochise fm.*—At type loc., in Whetstone Mtns, it is 311 ft. thick, and consists of (descending): (1) Upper div. characterized by blue ls., which at base is rather grayish, brownish, and mottled, and alternates with sh., and in upper part contains some thin-bedded, calc., micaceous ss. layers with *Neolenus intermedius pugio* Walcott; (2) yellow, pink, gray, white, purple, buff, and red shales, in upper part alternating with calc. sh. and thin rubbly ls., the pink and gray sh. containing *Obolus* (*Westonia*) *chuarensis* (Walcott) and *Agraulos* n. sp., 116 ft.; (3) pink and reddish, thin-bedded sss., 30 ft. Rests on Pima ss. and underlies Abrigo fm. [restricted to middle part of Abrigo ls. of previous repts, or to 420 to 430 ft. of thin-bedded, cherty, dolomitic gray ls. containing listed fossils]. Is Middle Camb. [Derivation of name not stated.]

Cochran conglomerate. (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S., Knoxville folio, No. 16, p. 3). *Cochran cgl.*—Ss., 600 to 900 ft. thick, underlain by bluish-gray sh. 0 to 100 ft. thick, in turn underlain by 500 to 700 ft. of coarse greenish-white cgl. The ss. is composed of round grains of white quartz; the sh. is argill., micaceous, and slightly sandy; the cgl. is composed of quartz and feldspar embedded in a matrix of argill. sand. A small bed of reddish brown ss. occurs near base of the white ss. Overlies Sandsuck sh. Underlies Nichols sh.

Is basal fm. of Chilhowee group.

Named for Cochran Creek, Sevier Co., Tenn., on S. slope of Chilhowee Mtn.

Cockeysville marble.

Pre-Cambrian (Glenarm series): Maryland, southeastern Pennsylvania, and northeastern Virginia.

G. H. Williams and N. H. Darton, 1892 (U. S. G. S. map of Baltimore and vicinity, to accompany "Guide to Baltimore," prepared for Baltimore meeting Am. Inst. Min. Engrs., Feb. 1892). *Cockeysville marble.*—Highly crystalline dol. with all its original impurities separated in form of well-defined minerals. Extensively quarried at Cockeysville, Md. Overlies Setters quartz schist and underlies gneiss [Wissahickon fm.].

E. B. Mathews, 1904 (Am. Jour. Sci., 4th, vol. 17, pp. 141–159), gave thickness of Cockeysville marble as 0 to 2,000 ft., and in 1909 (Md. Geol. Surv. vol. 8, pp. 334–338) as 2,300 ft.

E. B. Knopf and A. I. Jonas, 1922 (Am. Jour. Sci., 5th, vol. 5, pp. 45–49, 61–62). *Cockeysville marble* included in Glenarm series. Underlies Wissahickon fm. and overlaps Setters fm. Thickness 400± ft.

The Glenarm series was formerly classified by U. S. Geol. Survey as of Algonkian age, but that term having been discarded it is now classified as pre-Camb.

Cockeysville volcanics.

Pre-Cambrian: Maryland.

E. B. Mathews, 1933 (Md. Geol. Surv. geol. map of Md.). *Cockeysville volcanics.*—Volcanics interbedded with Cockeysville marble.

†Cockfield formation. (In Claiborne group.)

Eocene (middle): Northwestern Louisiana, eastern Texas, and Mississippi.

T. W. Vaughan, 1895 (Am. Geol., vol. 15, p. 220). *Cocksfield Ferry beds.*—Lignitiferous sands and clays, which in a general way represent the Claiborne sands of Ala. Underlie Jackson stage and overlie Lower Claiborne stage [=St. Maurice fm. of present nomenclature].

The term "Cocksfield Ferry beds" was later changed to *Cockfield memb. of Claiborne fm.* Afterward the Claiborne was elevated to a group and Cockfield to a fm. In 1912 the equivalency of Cockfield fm. of La. with Yegua fm. of Tex. was established, and "Cockfield" was dropped for the earlier name, Yegua fm. It was later revived, and again dropped, as explained under *Yegua fm.*

Named for Cockfield Ferry (correct spelling), on Red River, near Petite Ecore, Winn Co., La.

†Cockfield lignite.

Eocene (middle): Mississippi.

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 77). *Cockfield lignite.*—Lignitic clays and lignites, with abundant impressions of leaves of land and marsh plants. Thickness 30 to 40 ft. Named for Cockfield Ferry [Winn Co.], La. Top memb. of Lisbon fm. in Miss.

According to C. W. Cooke (personal communication Dec. 1936) the beds described above are same as Cockfield fm. of other authors, now replaced by Yegua fm. The Yegua overlies Lisbon fm.

†Cocksfield Ferry beds.

See †*Cockfield fm.*

Cockpit limestone group.

Oligocene: Jamaica.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 422). The ***White or Cockpit ls. group,*** about 1,500 ft. thick, was divided by [R. T.] Hill into 3 members (descending): Cobre chalky-white ls., 1,000 ft.; Moneague ls., no great thickness; and Montpelier ls., 500± ft.

†Cock-tail grit.

A descriptive term applied in early repts to Esopus grit, the rock being characterized by the fossil *Fucoides caudagalli*, which resembles in appearance the tail of a chicken cock.

Cocoa sand member (of Jackson formation).

Eocene (upper): Southwestern Alabama.

J. A. Cushman, 1925 (Cushman Lab. Foram. Research Contr., vol. 1, pt. 3, pp. 65–69), described foraminifera "from the Cocoa sand of Ala., which is of upper Eocene (Jackson) age and occurs at Cocoa Post Office, Ala."

C. W. Cooke, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1387–1388). *Cocoa sand memb. of Jackson fm.*—Fine yellow sand with soft white calc. lumps and large irregular lumps of hard yellow sandy marl. Thickness 6 ft. Grades up into *Zeuglodon*-bearing bed (which consists of gray or drab sandy and argill. marl with harder ledges and irregular calc. concretions, very argill. in upper part, and 11 ft. thick). Separated from underlying *Periarchus*-bearing bed (so-called *Scutella* bed) by 30 to 50 ft. of light-green plastic calc. clay with shells, in part micaceous and sandy. Named for an abandoned country postoffice called Cocoa, which many years ago stood in SW¼ sec. 13, T. 11 N., R. 5 W., Choctaw Co., Ala., about 2½ mi. E. of Melvin, on road to Gilbertown. Probably represents part of Yazoo clay of Miss. [Cooke now regards this sand as represented in lower part of Yazoo clay of Miss. (Personal communication, Feb. 1935.)]

Coconino sandstone. (Of Aubrey group.)

Permian: Northern Arizona, southern Utah, and southeastern Nevada.

N. H. Darton, 1910 (U. S. G. S. Bull. 435, pp. 21, 27). *Coconino ss.* is proposed for the cross-bedded gray to white ss. of Aubrey group, which is so conspicuous in walls of Grand Canyon. It underlies entire Coconino Plateau, as well as the extensive plateau country N. of Grand Canyon. Thickness 50 to 610± ft. Underlies Kaibab ("Aubrey") ls. and overlies Supai fm. It is upper part of "Aubrey ss. series" of early writers. [Subsequently the upper part of Supai fm. of Ariz. was separated from the Supai and named *Hermit sh.*, so that according to present definition the Coconino ss. rests on Hermit sh.]

Later repts have shown that Coconino ss. in parts of southern Utah greatly thickens and occupies the time interval of Kaibab ls. and part at least of Supai fm. See R. C. Moore and H. E. Gregory, 1931 (U. S. G. S. P. P. 164) and A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1413–1448).

Codell sandstone member (of Carlile shale).

Upper Cretaceous: Western Kansas and eastern Colorado.

N. W. Bass, 1926 (Kans. Geol. Surv. Bull. 11, pp. 28, 64). *Codell ss. bed.*—A sandy zone forming topmost 20 to 25 ft. of Blue Hill sh. memb. of Carlile sh. in western Kans. (Russell to Hamilton Counties). Named for excellent exposures in bluffs along Saline Valley in Ellis Co., Kans., 5 mi. S. and a little W. of Codell.

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B), applied *Codell ss. memb.* to topmost 3 to 20 ft. of Benton sh. in eastern Larimer Co., Colo., or to ss. called "Niobenton sand" by drillers.

C. H. Dane and W. G. Pierce, 1933 (U. S. G. S. Press Notice, June 8, "Geol. and oil and gas prospects in part of eastern Colo."), elevated *Codell ss.* to rank of a memb. at top of Carlile sh. and restricted Blue Hill sh. memb. to underlying part of the Blue Hill sh. of previous repts.

Codorus limestone.

Ordovician and Cambrian: Southeastern Pennsylvania (York County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, p. 454). The trap cuts *Codorus ls.* beds its whole visible length and throws a short branch SW., also in the ls. [On p. 167 mention is made of Codorus Creek, in York Co. On p. 473 he speaks of the white and blue lss. of Codorus Valley.]

Cody shale.

Upper Cretaceous: Northern Wyoming (Bighorn Basin).

C. T. Lupton, Jan. 21, 1916 (U. S. G. S. Bull. 621, pp. 166, 171, table, etc.). *Cody sh.*—Gray and dark sh., with 1 bed of ss. near base and several thin fossiliferous sss. near top. Thickness 3,360± ft. Includes Basin (Niobrara) sh. and overlying Pierre sh. of Hintze 1915 classification. Underlies Mesaverde fm. and overlies Frontier fm. Town of Cody is located on outcrop of this sh. near Shoshone River, where it is 2,150 ft. thick. [Detailed section of fm. given, and fossils listed.]

Coetas formation.

Pliocene: Panhandle of Texas.

L. T. Patton, 1923 (Univ. Tex. Bull. 2330, pp. 80–86). *Coetas fm.*—Slightly consolidated sand of gray to buff color, with 2 to 20 ft. of bedded somewhat sandy, flaggy ls. near top, which are known by their fossil content to be Plio. The fm. is quite calc. and contains many tabular calc. concretions. Thickness 150 to 200± ft. Overlies Potter fm. Is uncon. overlain by Quat. Contains Plio. vertebrate fossils. Well exposed on Coetas Creek, in E. part of Potter Co.

Is a part or all of Ogallala fm. (Plio.) of Texas Panhandle.

Coeur d'Alene series.

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and central western Montana.

D. F. MacDonald, 1906 (U. S. G. S. Bull. 285, pp. 42–43). *Coeur d'Alene series.*—All Algonkian rocks of Coeur d'Alene Mtns region, including (descending): Striped Peak fm. 1,000+ft.; Wallace fm. 4,000 ft.; St. Regis fm. 1,000 ft.; Revett qtzite 1,200 ft.; Burke fm. 2,000 ft.; Prichard sl. 8,000+ft.; a total of 17,200 ft. of rocks, overlying the Archean.

Is a local name for Belt series of present terminology.

oeymans limestone. (In Helderberg group.)

Lower Devonian: Eastern New York and Pennsylvania, western Maryland and Virginia, and northern West Virginia.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Coeymans ls.*, the Lower Pentamerus (Helderberg and Pentamerus lss.) of N. Y. geologists. Exposed at Coeymans, Albany Co. N. Y. Underlies New Scotland ls. and overlies Manlius ls. Basal fm. of Helderbergian group.

In subsequent N. Y. State repts this fm. was described as consisting of hard, massive, bluish gray ls., vertically jointed (see N. H. Darton, N. Y. State Mus. 47th Ann. Rept., 1894), and ranging in thickness from 30 to 100 ft.

In 1908 (Sci., n. s., vol. 28, pp. 346-348) G. H. Chadwick introduced *Kalkberg ls.* "to cover certain layers heretofore included variously by writers with the beds above (New Scotland) or below (Coeymans)," and carrying a mixed fauna, highly developed and excellently silicified on Catskill Creek [Greene Co., N. Y.], where the beds show numerous thin parallel seams of black flint nodules.

Chadwick's restricted definition of Coeymans ls. is generally accepted. Included in Helderberg group.

In central Pa. the Helderberg is treated as a fm. and these beds are designated *Coeymans ls. memb.* of Helderberg ls.

offee sand.

Upper Cretaceous: Western Tennessee and northeastern Mississippi.

J. M. Safford, 1864 (Am. Jour. Sci., 2d, vol. 37, pp. 361, 362–363). *Coffee sand.*—Mostly stratified sands, usually containing mica scales. Thin leaves of dark clay often interstratified with the sand, the clay leaves occasionally predominating. Sometimes beds of dark laminated or slaty clay 1 to 20 or more ft. thick are included. Thickness probably 200 ft. Northern extension of Tombigbee sand of Hilgard, which most likely ought to be included in his Eutaw group. Underlies Cret. Green sand or shell bed [Selma chalk of later repts.]. Is lowest Cret. fm. in western Tenn.

Above definition continued to be followed until 1911, when L. W. Stephenson (Ga. Geol. Surv. Bull. 26, pl. 5) divided the sands that had previously been called *Coffee sand* in Tenn. and *Tombigbee sand* in Miss. into 2 members, the upper being called *Coffee sand memb. of Eutaw fm.* and the lower being called *Tombigbee sand memb. of the Eutaw*, and he showed a considerable thickness of Eutaw deposits below the Tombigbee sand in Miss. He showed *Coffee sand memb.* as grading laterally into lower part of Selma chalk in Miss. and as also overlain by Selma chalk, but stated it is lithologically like Eutaw deposits and should therefore be treated as a memb. of Eutaw fm. (See L. W.

Stephenson, Wash. Acad. Sci. Jour., vol. 7, No. 9, 1917.) This sand is not present in Ala. The Coffee sand of early Ala. repts included Tombigbee sand memb. and underlying beds of Eutaw fm.

Further work led Stephenson (in March 1936) to belief *Coffee sand* should be treated as a distinct fm., instead of as a memb. of Eutaw fm. or a memb. of Selma chalk, into the lower part of which it grades laterally. The present classification of U. S. Geol. Survey treats Coffee sand as a distinct fm. and restricts Eutaw fm. to beds btw. top of Tombigbee sand memb. and top of underlying Tuscaloosa fm.

Named for exposures at Coffee Landing, Hardin Co., Tenn.

Coffee shale.

A color term applied by drillers to the Sunbury sh. of W. Va. oil fields.

†Coffee Mill Hammock marl.

Pleistocene: Southern Florida (De Soto County).

E. H. Sellards, 1919 (Fla. Geol. Surv. 12th Ann. Rept., pp. 73, 74). *Coffee Mill Hammock marl.*—Shell marl, 2 ft. max. thickness. Rests on fresh-water ls. at top of Fort Thompson beds. Although removed by erosion at the rapids this marl is very persistent. Is seen in place at Goodno's Landing, Fort Thompson, and at Coffee Mill Hammock [De Soto Co.], 12 mi. above Labelle. Predominating fossil is *Chione cancellata,* shells of which have been thrown out in great profusion by the dredge.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Deposits named "Coffee Mill Hammock marl" by Sellards are included in Fort Thompson fm., and name is considered unnecessary.

Coffee Ranch.

Pliocene: Texas Panhandle.

R. D. Reed, 1933 (Geol. of Calif., p. 303), listed, in his "standard section," the name *Coffee Ranch,* and placed it below Blanco beds, above Clarendon, and opp. Middle Etchegoin.

R. D. Reed, 1936 (letter dated May 18). The "Coffee Ranch" locality is in Hemphill Co., Tex., and has been described by Matthew and Stirton in papers of Univ. Calif. geol. series; also in a bull. on Hemphill Co. put out by Tex. Bur. Econ. Geol.

The compiler finds that Matthew and Stirton (in Univ. Calif. Dept. Geol. Sci. Bull., vol. 19, No. 7, 1930, pp. 171–216) described species of Plio. fossil mammals from Coffee Ranch, near town of Miami, Hemphill Co., Tex., but did not name the beds containing them. Also that Univ. Tex. Bull. 3231, 1932, describing the geol. of Hemphill Co., Tex., did not describe the Coffee Ranch locality, and named the Plio. deposits (all *lower* Plio.) of that Co. *Hemphill beds.* Therefore, *Coffee Ranch* as a geologic name appears to have no standing.

Coffeyville formation.

Pennsylvanian: Southeastern Kansas and northeastern and central Oklahoma.

F. C. Schrader and E. Haworth, 1905 (U. S. G. S. Bull. 260, p. 448). *Coffeyville fm.*—Series of lss. and shales, 250 ft. thick, underlying Drum fm. and overlying Parsons fm. Includes Cherryvale sh., Dennis [Winterset] ls., Galesburg sh., Mound Valley [Bethany Falls] ls., and Ladore-Dudley sh.

In NE. Okla. overlies Lenapah ls. and underlies Hogshooter ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 67). *Coffeyville fm.* of Schrader and Haworth includes beds btw. top of Lenapah ls. and base of true Drum ls.

Named for exposures at Coffeyville, Montgomery Co., Kans.

†Coffeyville limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1, p. 74). *Coffeyville ls.*—Overlies Walnut sh. and underlies Pleasanton shales.

Preoccupied. Same as Lenapah ls.

Named for Coffeyville, Montgomery Co.

Coffman conglomerate member (of Maroon formation).

Pennsylvanian (?): Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 971–1009). *Coffman cgl. memb. of Maroon fm.*—Arkosic cgl. with interbedded sh. and ss. Conformably underlies Chubb siltstone memb. and conformably overlies Weber (?) fm. in Salt Creek area, Park and Chaffee Counties. Thickness 20 to 1,000 ft. Named for Coffman Park, in SE. part of area. Type section is in unnamed valley in sec. 24, T. 13 S., R. 77 W., about 2 mi. N. of Coffman Park, where it is 615 ft. thick. Is 1,000 ft. thick about 1 mi. E. of type section, and only 20 ft. thick in Chubb Gulch. Assigned to Penn.(?).

Coggon limestone.

Middle Devonian: Central eastern Iowa.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, pp. 23, 24). *Coggon beds.*—Heavy-bedded dolomitic lss., probably of Sil. age. Underlie Otis beds.

In 1901 (Iowa Geol. Surv. vol. 11) Norton transferred his Coggon beds to Dev. and to Wapsipinicon ls., and they have since been included in that fm.

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, p. 374). *Coggon phase of Otis ls.*—Soft mag. ls., finely crystalline, granular, in some places earthy, varying in color from light-cream yellow to rather dark buff. Fossils prove it to be simply mag. basal portion of the Otis. Present in Linn, Scott, and Cedar Counties. Type exposures at Coggon, Linn Co., at crossing of Buffalo River by Illinois Central Ry., where Ashby's quarry shows 14 ft. of it. In Linn Co. the Coggon phase rests on Bertram beds; in N. part of county on Hopkinton ls.; in Cedar Co. it is in places uncon. on Leclaire beds of the Gower, and in places conformable on Anamosa beds.

M. A. Stainbrook, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 249–251), included Bertram beds in Otis and placed Coggon below Otis, as did the "Conf. classification," fig. 1.

Cohansey sand.

Tertiary (Miocene?): New Jersey.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 137). *Cohansey sand.*—Coarse quartz sand with occasional small pebbles; locally cemented into ss. Contains clay lenses 8 to 24 ft. thick. Rests on Shiloh marl [memb. of Kirkwood fm.]. Underlies Beacon Hill gravel. Was included in Beacon Hill of Salisbury.

Later repts give thickness as 0 to 450± ft.

Named for exposures along Cohansey Creek, Cumberland Co., N. J.

Coharie formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

L. W. Stephenson, 1912 (N. C. Geol. Surv. vol. 3, pp. 273–277). *Coharie fm.*—Sandy clays, sands, more or less argill. or arkosic, and gravels. Almost everywhere gravels or coarse sands constitute basal beds; these are irregularly bedded, and in many places exhibit cross bedding. In almost all sections the coarser materials at base grade up into unstratified argill. sands or sandy clays; and these in turn into a soil of gray sand or sandy or clayey loam. Over large areas the immediate surface materials, from a few inches to 2 or 3 ft. thick, consist of loose gray sands. Thickness of deposits 25 to 50 ft. Upper surface of Coharie deposits forms a terrace plain, more or less dissected, which slopes up from elevations of about 160 or 170 ft. along its SE. edge to about 230 or 235 ft. along foot of escarpment which separates it from the Lafayette belt. Oldest fm. of Columbia group in N. C. Named for Great Coharie Creek, a tributary of Black River in N. C. The terrace plain formed by surface of the fm. has a widespread development on either side of the narrow valley of this creek in N. half of Sampson Co.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, pp. 503–513), proposed to restrict Coharie fm. to the 215-foot level. The terrace fms. of Columbia group (including the Coharie) now recognized by Cooke from Del. to southern Ga. and probably into Fla., are enumerated herein under *Columbia group.*

Cohulta conglomerate.

Misprint (on p. 123 of U. S. G. S. Bull. 191) for *Cohutta cgl.*

Cohutta conglomerate.

Probably Lower Cambrian: Northwestern Georgia.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 3, pl. 3, p. 4). [Name appears in this rept at top of Hayes' Holly Creek section, in NW. Ga., but is not defined. The cgl. referred to is regarded by A. Keith as probably lower part of Great Smoky fm.]

Probably named for Cohutta Mtn, Gilmer and Fannin Counties.

Cojimar formation.

Oligocene or Miocene: Cuba.

R. H. Palmer, 1934 (Jour. Geol., vol. 42, No. 2, p. 134).

Colbert porphyry.

Pre-Cambrian: Central southern Oklahoma (Arbuckle Mountains).

C. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470–474, map). *Colbert porphyry.*—Pink porphyry dikes of pre-Camb. age.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 9–10). *Colbert porphyry.*—A mass rising in East Timbered Hills to highest point in Arbuckle Mtns, 1400± ft. altitude. Is largely pink feldspar phenocrysts in a reddish to gray groundmass, cut by numerous diabase dikes. Probably formed at less depth than Tishomingo granite. Lack of metamorphism in Colbert porphyry and Tishomingo granite suggests they are not older than Algonkian; may be as recent as Keweenawan or even Camb.

Derivation of name not stated.

Colbert sand.

A subsurface sand, of Penn. age, in Colbert pool, Okla. (T. 19 N., R. 12 E., W. part of Tulsa Co.), which according to F. Aurin (Okla. Geol. Surv. Bull. 19, pt. 2, chart opp. p. 526, 1917) correlates with Dutcher sand.

†Colchester formation.

Lower Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 110, 129). *Colchester fm.*—Differs from underlying fms. in that it contains numerous shaly and slaty beds; is interbedded with sss. and dolomites. Greater portion of fm. in northern sections is sh., which decreases to S., and beds of calc. ss. and sandy dol. become more numerous. The shales are usually dark or black, distinctly banded and much speckled with little scales of mica. The ss. is gray, in thin layers, locally argill., but in places calc. In Highgate and Swanton the fm. contains many non-banded massive layers, which weather light gray or white, and many very strongly bedded layers that are used for flagstones. A few layers of sandy dol. are present here and there. A notable feature of fm. is a peculiar tough, dark-gray dol. that weathers brick red, and which forms lenses as much as 5 ft. thick and 50 ft. long near base of fm. In Swanton they are numerous and prominent and closely associated with a peculiar cgl. of irregular dol. bowlders in a sl. matrix. The fm. also contains another set of lenses of massive blue marbleized ls., sharply separated from the sl. These are best shown 2 mi. SE. of Swanton, where 2 of them are surrounded by gray sl. The lenses measure 100 by 60 ft. and 105 by 75 ft. The fm. is uncon. overlain by Milton dol. and grades into underlying Mallett dol. Thickness 200 to 250 ft. to S. and 500± ft. at N. Named for good exposures 1 to 2 mi. N. of Colchester village in town of Colchester [Milton quad.], which borders Burlington on N. Extends from Canada to Monkton, where it is cut off by a thrust fault. South of Monkton its position in eastern sequence is taken by a fm. of similar aspect but with less sh. and more dol. The Colchester has furnished a large part of the Lower Camb. fossils from Vt., and most of them have come from Parker quarry (now Howard quarry), 2¼ mi. N. 60° W. of Georgia. May include some Middle Camb.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 371), renamed this fm. *Parker sl.,* and abandoned Colchester fm., because of poor exposures at that place.

Coldbrook group.

Pre-Cambrian or Cambrian: New Brunswick.

G. F. Matthew, 1863 (Canadian Nat., vol. 8, pp. 244, 246–247).

Cold Spring horizon.

Miocene or Pliocene: Eastern Texas (San Jacinto County).

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 468, 470, 472, 473, 476). Cold Springs, W. of Trinity River [San Jacinto Co.], is in midst of an important outcrop of the Fleming. In this region the Fleming brown and gray clay has a considerable portion of brown, buff, and white sand. Locally there are large boulders of grayish-brown soft ss., some of which are 10 to 12 ft. long. There are also a fine-grained, hard, brown claystone and numerous calc. nodules; locally crystals of selenite; also pure white sand with only a minor amount of clay. Vertebrates [listed by W. D. Matthew] were secured from *Cold Springs horizon,* which is above center of the series of deposits in Trinity drainage here referred to the Fleming. Matthew says they are not earlier than Middle Mio. nor younger than Lower Plio. The *Cold Springs horizon* is in upper half of Fleming. [In chart on p. 476 the *Cold Springs* is placed below the Burkville. On map (p. 448) the town is spelled *Cold Spring,* which is spelling given in latest P. O. Guide.]

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869, p. 237). *Cold Springs horizon* is much higher than the Burkeville, and is in upper half of Fleming clay.

Cold Springs granite.

Pre-Cambrian: Southwestern Oklahoma (Kiowa County).

C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). Finest-grained of Okla. granites. Is near a quartz monzonite. The only granite of commercial importance in Cold Springs area. Age relations to other granites of Wichita Mtns dist. cannot be stated with certainty. Appears to be older than Lugert granite.

Coldwater shale.

Mississippian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *Coldwater shales,* 667 to 1,000+ ft. thick, underlie Marshall ss. and overlie Richmondville or Berea ss.

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30, pp. 84–85). *Coldwater shales.*—In general composed of fine-grained, micaceous, bluish shales. Thickness 896 ft. Underlie Lower Marshall and overlie Berea black sh., 130 ft. thick.

C. H. Gordon, 1900 (Mich. Geol. Surv. vol. 7, pt. 3, pp. 1–20), divided *Coldwater shales* of Sanilac Co. into (descending): (1) Forestville shales, 100 to 200 ft.; (2) Richmondville ss., 50 to 80 ft.; (3) blue shales, 200 to 250 ft. Underlie Lower Marshall ss. and overlie Berea grit sh. (black shales 50 to 150 ft. thick).

A. C. Lane, 1902 (Mich. Geol. Surv. vol. 8, pt. 2, map at end), also 1909 (Mich. Geol. Surv. Rept. 1908) and later repts applied *Coldwater sh.* to all beds btw. Marshall ss. above and Berea grit below, including at base 25 to 55 ft. of black sh. called Sunbury or Berea sh.

This basal black sh. was included in Coldwater sh. in most subsequent repts, including: U. S. G. S. Ann Arbor folio, No. 155, 1908; W. H. Sherzer, 1913 (Mich. Geol. and Biol. Surv. Pub. 12); R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14); C. W. Cook, 1914 (Mich. Geol. and Biol. Surv. Pub. 15); the 1916 geol. map of Mich. (by R. C. Allen, R. A. Smith, and L. P. Barrett); R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21, map opp. p. 148); C. G. Carlson, 1927 (A. A. P. G. Bull., vol. 11, p. 959+). The following repts treated Sunbury sh. as a distinct fm., underlying Coldwater sh. (restricted): W. F. Cooper, 1909 (Mich. Miner, vol. 11, No. 6, p. 13); W. M. Gregory, 1912 (Mich. Geol. and Biol. Surv. Pub. 11); and R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38).

In 1932 the U. S. Geol. Survey adopted for its publications the restricted definition of Coldwater sh. and treated the subsurface Sunbury sh. as a distinct fm.

In some repts the so-called Huron gritstone has been included in overlying Marshall ss. and in other repts in Coldwater sh.

Named for exposures on Coldwater River, in Branch and Hillsdale Counties.

Coldwater group.

Oligocene: British Columbia.

G. M. Dawson, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 26B, 65B–66B, 68B–71B, 160B–164B). [Assigned to Olig. Most later Canada repts assign this group to Olig., but a few have assigned it to Eo. and some to *Tert.*]

Coldwater sandstone member. (In Tejon formation.)

Eocene: Southern California (Los Angeles and Ventura Counties).

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753). The top ss. of Tejon fm. in parts of Los Angeles Co. is locally known as "*Coldwater ss.*"

N. L. Taliaferro, 1924 (A. A. P. G. Bull., vol. 8, pp. 789–802). *Coldwater memb. of Tejon fm.*—West of Sespe Canyon, in heart of an anticline along Coldwater Creek, and again to N. along S. flank of Topatopa Mtns, there are 400 to 500 ft. of hard white sss. with intercalations of light-pink, pale-green, and grayish shales. The sss. carry a dwarfed estuarine fauna of Eocene age. These beds have heretofore been included with the Sespe, but since they are fossiliferous, and also differ lithologically from typical Sespe, they should be included in Tejon as *Coldwater memb.*

P. F. Kerr and H. G. Schenck, 1928 (Geol. Soc. Am. Bull., vol. 39, p. 1091). *Coldwater ss.*, top memb. of Tejon fm., is about 2,500 ft. thick near Matilija, Ventura Co. Is characterized by white friable arkose ss. interbedded with reddish sandy sh. and massive hard ledges composed of numerous shells of *Ostrea idriaensis* Gabb. Has been traced more than 40 mi. along Santa Ynez Range westward from type loc. in Coldwater Canyon.

Cole sand.

A subsurface producing sand in Fayette ss. (Eocene) of Driscoll pool, Duval Co., Tex. Lies higher than Mirando City sand.

Colebrooke schist.

Pre-Cretaceous: Southwestern Oregon (Port Orford quadrangle).

J. S. Diller, 1903 (U. S. G. S. Port Orford folio, No. 89). *Colebrooke schist.*—Completely metamorphosed sed. rocks, in part mica schists intermingled with slates in which cleavage is highly developed but without definite crystalline structure visible to unaided eye. Rocks always fine-grained, with decided schistose structure. Pre-Cret.; possibly pre-Dev. [Type loc. not stated, but Colebrooke Butte and surrounding country in Port Orford quad. are mapped as in this fm.]

G. M. Butler and G. J. Mitchell (1916) assigned this fm. to pre-Jurassic; W. D. Smith and E. L. Packard (1919) assigned it to pre-Camb.

†Cole Camp sandstone. (In Van Buren formation.)

Lower Ordovician (Beekmantown): Central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 364–369). *Cole Camp ss.*—White saccharoidal ss., 6 to 25 ft. thick, underlying Osage ls. and overlying Proctor ls.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, p. 42). *Cole Camp ss.* is same as Gunter ss. [memb. of Van Buren fm.].

E. R. Buckley, 1905 (Mo. Bur. Geol. and Mines vol. 3, 2d ser., pp. 3–9). The *ss. at Cole Camp* is not Gunter ss. but a ss. bed in St. Elizabeth [Roubidoux] fm.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12). *Cole Camp ss.* of Winslow belongs in Gasconade ls., which underlies St. Elizabeth fm. [Gasconade has been restricted to upper part of Gasconade of early repts, and lower part has been named *Van Buren fm.* Gunter ss. is basal memb. of the Van Buren.]

Named for outcrops on Cole Camp Creek, Cole Co.

Cole Canyon dolomite.

Cambrian (Middle?): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Cole Canyon dol.*—Alternating beds, 10 to 25 ft. thick, with nearly white and dark-gray weathered surfaces; some beds dense and finely banded, others finely crystalline. Thickness 500 to 510 ft. Underlies Opex dol. and overlies Bluebird dol. Scattered exposures occur along upper W. slope of Cole Canyon. Top and bottom drawn arbitrarily at lowest and highest light-colored bed.

Coleman limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Somerset County).

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, pp. 286, 292). *Coleman ls.* underlies Coleman coal, from which it is separated by 6 inches of slate, and lies 40 ft. above Philson or Rose coal in Somerset Co. [Probably same as Cambridge ls. memb.]

Probably named for exposures at or near Coleman, Somerset Co.

†Coleman division.

Permian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). *Coleman-Albany series.*—Shales, clays, and lss., barren of coal, overlying Waldrip-Cisco series and underlying Wichita beds.

R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 210–213). *Coleman div.*—Alternating lss., clays, shales, and sss. overlying Waldrip coal div. The ls. forming basal bed of Coleman div. is 25 to 100 ft. thick and not more than 100 ft. above the coal in Waldrip div.

Approx. same as Wichita fm.

Named for Coleman Co. and for occurrence near town of Coleman.

Coleman bed.
Coleman clay. } (In Admiral formation.)
Coleman limestone.

Permian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 424). *Coleman bed.*—To S. mostly marly yellowish clay with some thin beds of ls. To N. chiefly black or dark-gray sandy clay sh. with many white specks scattered through it. Thickness 50 to 100 ft. Memb. of Albany div. [Wichita group]. Overlies bed No. 5 (25 to 60 ft. of ls. with some marly clay) and underlies Elm Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, p. 193, pl. 11), divided their Admiral fm. (basal fm. of Wichita group) into (descending): Elm Creek ls., 20 to 50 ft.; "Coleman clay" (Drake), 148 ft.; *Coleman ls.*, 12 ft.; "Bed No. 5" of Drake, 3 ft.; Indian Creek sh., 105 ft.; Hordes Creek ls., 2 ft.; Lost Creek sh., 46 ft. They defined "Coleman clay" as consisting of (descending), grayish yellow sh. 22 ft.; yellow-gray ls. 2 ft.; black sh. 34 ft.; muddy brown ls. 1 ft.; dark gray sh. 17 ft.; gray ls. 1 ft.; sh. 11 ft.; sandy sh. 3 ft.; sh. 58 ft.; and defined *Coleman ls.* as consisting of 3 ft. of yellow gray ls. underlain by 9 ft. of yellow sh.

Named for Coleman, Coleman Co.

Coleman Junction limestone member (of Putnam formation).

Permian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, p. 421). *Coleman Junction bed.*—In descending order: Yellowish friable ls., 8 to 10 ft.; clay, 10 ft.; massive, hard, brittle, yellowish brown, slightly cherty ls., 20 ft. Basal memb. of Albany div. Overlies Santa Anna Branch bed of Cisco div.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 40). *Coleman Junction ls. memb.*—Upper memb. of Putnam fm., which is top fm. of Cisco group. Assigned to Penn. Overlies Santa Anna Branch sh. (lower memb. of the Putnam). Named for Coleman Junction, Coleman Co.

Putnam fm. was transferred to Perm. Wichita group in 1933.

Coles Brook limestone.

Pre-Cambrian: Western Massachusetts (Berkshire County).

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 27–28). *Coles Brook ls.*—More or less crystalline, white, impure mag. ls. Exposed at mouth of Coles Brook and 1 mi. to E.

B. K. Emerson, 1899 (U. S. G. S. Bull. 159, pp. 41–43). *Coles Brook ls.*—A remarkable linear outcrop of Hinsdale ls. 7 mi. long, which has cut through the Camb. gneisses like a knife, from Factory Hollow, in Middlefield, to S. part of Becket. Best exposed a mi. NW. of Bancroft Station, in Middlefield, where Boston and Albany R. R. cuts off a loop of Westfield River and Coles Brook enters this loop from N. South from Coles Brook the ls. rises in a great hill S. of Middlefield R. R. station, where it is 330 ft. thick.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 20–22 and map). *Coles Brook ls.*—Coarse, highly crystalline, mag. ls., locally white and pure, generally graphitic and greatly changed to a mass of silicates—chondrodite, wollastonite, wernerite, hypersthene, pyroxene, amphibole, titanite, adularia, pericline, and others. In southern part of State is largely changed to pyrrhotite. Thickness 600 ft. max. Lies in upper part of Hinsdale gneiss.

Colesburg dolomite.

Silurian (Niagaran): Central eastern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 149, 150). *Colesburg terrane.*—Dol., 30 ft. thick, comprising next to bottom fm. of Niagaran series. Overlies Sabula dol., of Niagaran, and underlies Hartwick dol., also of Niagaran. Separated from Hartwick and Sabula by fauna.

C. [R.] Keyes, 1932 (Pan-Am. Geol., vol. 58, No. 5, p. 377). Is same as Waucoma ls. and has priority.

Named for Colesburg, Delaware Co.

Colfax formation.

Upper Jurassic: Northern California (Gold Belt region).

J. P. Smith, 1910 (Jour. Geol., vol. 18, charts opp. pp. 217, 221). *Colfax fm.*—Tuffs and shales of Gold Belt with *Perisphinctes colfaxi*. Of Portland (Upper Jurassic) age. Overlies Mariposa fm. [restriction of Mariposa] and is older than Knoxville fm.

R. W. Goranson, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 162). Mariposa fm. (of Auriferous slates) of Sierra Nevada is divided into two parts, the lower part being Mariposa sl., and the upper the *Colfax series* of the Gold Belt. The tuff beds of Colfax contain *Perisphinctes colfaxi*, and the same beds near Nashville, Amador Co., contain *Simbirskites* sp.

Is upper part of Mariposa sl. as used by U. S. Geol. Survey.

Colgate member (of Fox Hills sandstone).

Upper Cretaceous: Eastern Montana (Dawson County) and southwestern North Dakota.

W. R. Calvert, 1912 (U. S. G. S. Bull. 471, pp. 189–198). *Colgate ss. memb. of Lance fm.*—White and yellowish ss., 185 ft. thick, forming basal memb. of Lance fm. as here interpreted. Exposed on both sides of Cedar Creek anticline. In vicinity of Iron Bluff, in NE. part of T. 14 N., R. 55 E., it consists of following beds (descending): (1) Massive white ss., most prominent stratum in region, 35 ft.; (2) brown ss. 75 ft.; fossil leaves in bottom part; forms summit of Iron Bluff; (3) sh. and ss., 75 ft., fossil leaves in upper 20 ft. Overlies Pierre sh. and underlies, with only local unconformities, 500±ft. of somber colored clay and lenticular sss. containing a few lignite beds, which compose upper part of Lance. Although in Iron Bluff section there is an appearance of transition btw. Colgate ss. and Pierre sh., which suggests the ss. occupies the strat. position of the Fox Hills, the evidence of fossil leaves indicates that much if not all of it is of later age. Lower part may be Fox Hills, but if flora collected 70 ft. above base is found to continue to base of Colgate, then it should be considered merely as a memb. of Lance fm. Named for prominent development in vicinity of Colgate station, on Northern Pacific Railway.

W. T. Thom, Jr., and C. E. Dobbin, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 484–497). *Colgate ss. memb.* is here redefined and name is applied to the conspicuous white upper ss. of the Fox Hills, typically developed btw. Colgate station and

Glendive, Mont., and extensively exposed along Cedar Creek anticline and elsewhere in eastern Mont. The 35-foot white ss. is the upper (Colgate) memb. of the Fox Hills and forms top part of the lower 75-foot ss. of Iron Bluff, its white color being masked in the Iron Bluff exposure by ferruginous matter leached from the overlying brown ss. of the Lance. In addition to fossil leaves the Colgate ss. as here redefined contains abundant casts of *Halymenites major* in exposure along Cedar Creek anticline, and is gradational into underlying marine strata on Little Beaver Creek, S. of Baker. The Colgate is strikingly developed along the Missouri btw. Hell Creek and Musselshell River, consisting of 15 to 50 ft. of white ss. resembling its type development. That the fluviatile basal ss. of Lance in central Mont. is=Colgate ss. and upper white ss. of type Fox Hills the writers feel confident, although this has not been conclusively demonstrated by continuous tracing.

C. J. Hares, 1928 (U. S. G. S. Bull. 775), identified 17 to 40 ft. of Colgate ss. memb. in top of Fox Hills ss. of Marmouth lignite field, N. Dak.

Colgate member. (In Skaneateles shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th. vol. 19, pp. 219, 221, etc.). *Colgate memb. of Skaneateles fm.*—Fine-grained, thin-bedded, cross-bedded ss. and bluish gray aren. sh. exposed on campus of Colgate Univ., Hamilton. Stratigraphically it lies at top of Berwyn memb. and is transitional with it. Upper part consists of 20 ft. of coarse aren. sh. capped by 1½ ft. of crinoidal ls. containing *Spirifer divaricatus*, which is characteristic of Centerfield ls., basal memb. of overlying Ludlowville fm. Best exposures of this upper sh. are at top of Univ. Quarry and in falls and quarry behind the buildings of Hatch's Red Gate stock farm. The Colgate is not known W. of E. margin of Cazenovia quad., and E. of type section it was but imperfectly identified in upper part of Gould's gully, Unadilla Valley, where the upper sh. has disappeared. But the memb. is prominent in Chenango Valley and is noted for its fine fossils. [Although this memb. is included in Skaneateles fm., diagram on p. 219 shows it to be E. equiv. of Centerfield ls. memb. of Ludlowville fm.]

Collazo shale.

Tertiary: Puerto Rico.

C. A. Reeds, 1916 (N. Y. Acad. Sci. Annals, vol. 26, p. 437).

College Hill limestone.

Upper Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., p. 276). *College Hill ls.*—Dark blue, highly fossiliferous, coarsely crystalline and roughly stratified ls., with more or less of its laminae shaly. Generally weathers into rough, flaggy lss., and shaly matter interstratified, often liberating multitudes of fossils, especially small corals; some of ls. layers are made up wholly of corals and shells. Thickness 120 ft. Well exposed on College Hill, Nashville. Lowest layers are at top of bluff at Wire Bridge. Top div. of Nashville fm. Overlies *Cyrtodonta* bed, a remarkable bed of coarsely crystalline, ashen-gray or light yellowish gray ls., in great part made up of valves of several species [enumerated] of fossils.

College Point stage.

Pleistocene: Southeastern New York (Long Island).

J. B. Woodworth, 1901 (N. Y. State Mus. Bull. 48, pp. 621-663). *College Point delta* and *College Point stage* included in Wisconsin epoch of Nassau Co. and Borough of Queens, Long Island.

Collier shale.

Cambrian: Southwestern Arkansas and southeastern Oklahoma (McCurtain County).

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557; Slates of Arkansas, Ark. Geol. Surv., pp. 30, 31). *Collier sh.*—Dark, soft, graphitic, clay sh., containing widely separated thin beds of dense, black, and intensely fractured chert. As result of squeezing and shearing practically all traces of bedding have disappeared. In places slaty cleavage is visible. Upper 100 ft. or more is calc.; ls. occurring in dark-colored crystalline lenses and layers and in beds several ft. thick.

Upper part of ls. is conglomeratic. Thickness several hundred ft.; only upper 200 ft. exposed. Age unknown. Underlies, probably uncon., Crystal Mtn ss.

Named for Collier Creek, Montgomery Co., Ark.

Collingsworth gypsum member (of Blaine gypsum).

Permian: Central northern Texas, Texas Panhandle, and southwestern Oklahoma.

F. W. Cragin, 1897 (Am. Geol., vol. 19, p. 356, footnote). *Collingsworth gyp. fm.*—A higher gyp. than Quanah gyp. May represent Cave Creek fm.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., p. 56). *Collingsworth gyp.*—Massive white gyp., 0 to 20 ft. thick, composing upper gyp. ledge of Greer div. In Okla. separated from overlying Delphi dol. [now known as Mangum dol.] by 20 ft. of red clay, and from underlying Cedartop gyp. by red clay sh. Named for exposures in Collingsworth Co., Tex.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324–341). Collingsworth gyp. memb. is provisionally considered = Shimer gyp. memb.

On 1926 geol. map of Okla (by H. D. Miser) this gyp. was included in *Blaine gyp.*, and the equiv. Greer fm. was abandoned.

Collingwood formation.

Middle Ordovician: Ontario (Manitoulin Island) and Michigan.

P. E. Raymond, 1912 (Canada Geol. Surv. Summ. Rept. for 1911, p. 354). *Lower Utica* (*Collingwood fm.*).—A thin fm. of layers of fine-grained rather pure blue ls. alternating with thick beds of soft brown sh. Thickness not known but appears to be less than 50 ft. Fauna, which is well developed at Collingwood, Ont., differs from that of typical Utica in many respects. Overlain by darker shales containing typical Utica fauna, and underlain by Trenton ls.

E. O. Ulrich, 1913 (12th Int. Geol. Cong. chart), placed *Collingwood sh.* in upper Trenton.

C. Schuchert, 1915 (Textbook geol., p. 629 and index). [*Collingwood fm.* is shown in table as top of Middle Ord., as overlying Trenton, and as underlying Utica and Eden.]

R. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2), placed *Collingwood* in upper Trenton.

W. Malcolm, 1915 (Canada Geol. Surv. Mem. 81, p. 23), included this fm. in Utica.

R. Ruedemann and G. M. Ehlers, 1924 (Geol. Soc. Am. Bull., vol. 35, p. 186), identified it in Mich. and assigned it to upper Utica, as did A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, table opp. p. 58).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 62, 64, 149), placed *Collingwood sh.* below Gloucester sh. and above Cobourg ls. and assigned all 3 to Utica. He stated the deposits reached N. Y. "only in traces."

W. A. Parks, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 229). If *Collingwood black sh.* is to be defined by presence of *Ogygites canadensis* it must include not only the black sh. with ls. beds but also many ft. of upper Trenton.

G. M. Kay, 1933 (Am. Jour. Sci., 5th, vol. 26, No. 151, p. 2), and 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 227–228) included *Collingwood* in Trenton group.

Collinsville limestone.

Pennsylvanian: Southwestern Illinois (Madison County).

A. H. Worthen, 1873 (Ill. Geol. Surv., vol. 5, p. 315). *Collinsville ls.*—Fossiliferous ls., in upper div. of Coal Measures near Collinsville, Madison Co., lying about 115 ft. above the coal seam mined at that point, which is probably No. 5. Regarded same as Rock Creek ls. [Later studies by E. W. Shaw indicate that this ls. is probably older than Carlinville ls. and is the ls. in lower part of McLeansboro fm. that is known among mining men as the "top ls.," which lies 100 to 130 ft. above Herrin or No. 6 coal.]

Collinsville granite gneiss.

Ordovician (?): Northern central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 105–107 and map). *Collinsville granite gneiss.*—Two types appear intermingled without order: (1) a light-gray, heavy-bedded, finely crystalline rock, grading into massive granite; and (2) a very dark gray to black variety which grades by imperceptible stages into even-banded hornblende gneiss and, rarely, into schistose phases. The darker varieties are produced by greater development of biotite in bands and patches, and the rock splits readily into even slabs from 1 inch to 10 inches thick. Dikes and veins of fine-grained granite and coarser pegmatite occur in Collinsville granite gneiss. Hornblende and plagioclase are so abundant in parts of the Collinsville that the whole fm. might be called a granodiorite gneiss. Well exposed at Collinsville.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 34). The *Collinsville granite gneiss* was originally granite and diorite intruded into Hartland [Hoosac] schist.

Collores limestone.

Age (?): Puerto Rico.

C. R. Fettke, 1924 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 2, p. 149).

†Collozoic age.

A time term that has been applied to all post-Keewatin pre-Camb. time. For definition see U. S. G. S. Bull. 769, pp. 26–27.

Colmar shales.

Upper Ordovician: Iowa.

C. [R.] Keyes, 1931 (Pan-Am. Geol., vol. 55, pp. 217-222), introduced this name to replace Clermont of Calvin.

†Colob sandstone.

Jurassic (?): Southwestern Utah (Washington County).

E. Huntington and J. W. Goldthwait, 1903 (Jour. Geol., vol. 11, pp. 46–63). *Colob ss.*—White ss. (Jurassic of Dutton) underlying Cretaceous sss. and sh. and overlying Kanab ss. (Triassic of Dutton). [*In* 1904 (Harvard Coll. Mus. Comp. Zool. Bull., geol. ser., vol. 6, p. 203, pl. 7) they called the rocks Colob fm., and described them as hard, white, cross-bedded ss. Name apparently derived from Colob Creek on Colob Plateau (spelled Kolob on some maps), Washington Co.]

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr. (U. S. G. S. P. P. 183, chart opp. p. 33), Colob ss. of Huntington and Goldthwait's 1904 rept. is=upper part of Navajo ss.

Colony sand.

A prolific subsurface gas sand, 100 ft. thick, opened at Colony, T. 19 S., R. 23 E., Kans., and traced 15+ mi.

Coloradan series.

A term employed by C. R. Keyes instead of *Colorado group.*

†Colorado conglomerate.

Term applied by J. F. Carll (2d Pa. Geol. Surv. Rept. I, pp. 38–40, 48, 1875) to the coarse cgl. in hill-tops at Colorado, Warren Co., NW. Pa. Probably same as Olean cgl. memb. of Pottsville fm. (Penn.).

Colorado group. (**Colorado shale** or **Colorado formation** where undivided.)

Upper Cretaceous: Colorado, Wyoming, Montana, Idaho, North Dakota, South Dakota, northeastern New Mexico, Nebraska, Iowa.

F. V. Hayden, 1876 (U. S. Geol. and Geog. Surv. Terr. 8th Ann. Rept., p. 45). Numbers 2, 3, and 4 of the Cret., or the Fort Benton, Niobrara, and Fort Pierre divisions, may be regarded as one group, under the name of *Colorado group*, as adopted on Clarence King's beautiful geol. map of Green River basin. Underlain by Dakota group and overlain by Fox Hills group. *Exposed along E. base of Front or Colorado Range.*

C. King, 1876 (U. S. Geol. Expl. 40th Par., Atlas, map 1). *Colorado* includes [descending] Fort Pierre, Niobrara, and Fort Benton. Overlies Dakota and underlies Fox Hill.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 298, 305). The name *Colorado group was suggested by Hayden at my request, for the marine deposits* conformably underlying Fox Hills group and conformably overlying the Dakota.

C. A. White, 1878 (U. S. Geol. and Geog. Surv. Terr. 10th Ann. Rept., pp. 21, 22, 30). While adopting the name *Colorado group* of Mr. King, I, for paleontological reasons chiefly, so restrict its application as to include only what I understand to be equiv. with Nos. 2 (Fort Benton) and 3 (Niobrara) of Meek and Hayden's original section, leaving the equiv. of No. 4 (or Fort Pierre group) to be included with the strata of Fox Hills group, instead of with Colorado group, as Mr. King has done. Mr. Meek, who studied the paleontology of these groups so carefully, has shown in his works that while the paleontological affinities btw. the Fort Benton and Niobrara groups, and the Fort Pierre and Fox Hills groups, respectively, are very close, they are comparatively very slight btw. the two former and two latter groups, respectively.

The generally accepted definition of Colorado group includes only Benton and Niobrara and their equivalents.

Named for exposures at E. base of Colorado or Front Range, Colo.

†Colorado series.

Upper Cretaceous.

Name proposed by G. H. Ashley (Eng. and Min. Jour.-Press, vol. 115, No. 25, pp. 1106–1108, 1923) to include Colorado group and underlying Dakota ss.

Colquitt formation.

Upper Cretaceous (Gulf series): Southwestern Texas (Brewster County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 271, 441, 452). From Val Verde to Terrell Counties westward to beyond Terlingua, the Austin consists of thin ls. flags, chalkier to E., more crystalline to W. Near Terlingua these are thin and are interbedded with much marly material, so as to weather down to flats. To NW. the fm. becomes more marly, until at Chispa Summit it consists of marl with thin subordinate amounts of marly and platy ls. flags. This facies is here called *Colquitt fm.* Thickness 1,200± ft. Overlies Chispa Summit fm. (Eagle Ford) and underlies Taylor clays. Type loc. is on Colquitt ranch below Chispa Summit, western Jeff Davis Co.

Colquitz gneiss.

Jurassic: British Columbia.

C. H. Clapp, 1913 (Canada Geol. Surv. Mem. 36, p. 57).

Columbia group.

Pleistocene: Atlantic Coastal Plain from Delaware to **Florida.**

W J McGee, 1886 (Rept. Health Office D. C. for 1885, p. 20; also Am. Jour. Sci., 3d, vol. 31, p. 473). Washington is located in a depression, or amphitheater, rising 20 to 80 ft. above tide, bounded on E., N., and SW. by bluffs rising 150 to 300 ft. in altitude and traversed by Potomac River and Eastern Branch. Within this amphitheater, and rising above its periphery to an altitude of something over 100 ft., is a well-defined Quat. deposit to which the name *Columbia fm.* is applied by U. S. Geol. Survey. It consists of loam or brick clay above, and sand, gravel, or both combined, below. Thickness varies considerably, the upper memb. ranging from almost nothing to perhaps 20 to 30 ft., and the lower from perhaps 1 to 20 ft. The fm. is more or less distinctly stratified throughout, particularly in its lower div., and at base it often becomes a simple bed of bowlders and gravel without considerable admixture of finely comminuted materials. In some places it rests on gneissoid, schistose, and greenstone rocks. The entire fm. appears to represent a subaqueous delta of Potomac River, formed when the sea rose far above its present level and fashioned the marine terraces exhibited in the bluffs. Overlies Potomac fm. In places rests on gneiss.

W J McGee, 1888 (Am. Jour. Sci. 3d, vol. 35, pp. 126–143, 367–388, 448–466; also Am. Ass. Adv. Sci. Proc., vol. 36, pp. 221–222). *Columbia fm.* consists of a series of subestuarine and submarine deltas and associated littoral deposits, occupying entire Coastal Plain of Middle Atlantic slope up to altitudes ranging from about 100 ft. to S. to over 400 ft. to N. Occurs from Long Island to Ga. Rests uncon. on the various known Tert. and Quat. deposits of the region, and has therefore been inferred to be Quat. The fm. was named for District of Columbia.

W J McGee, 1893 (Cong. Géol. Int. Compte rendu, 5th sess., pp. 231–239). The *Columbia fm.* has been traced throughout greater part of Coastal Plain from mouth of Hudson to beyond the Mississippi, or over an area of more than 200,000 sq. mi., its thickness and composition varying from place to place with the volumes of rivers and with character of sediments transported by them. Traced northward the fm. is found to pass under the terminal moraine and the drift sheet it fringes.

In N. J. the *Columbia group*, as the deposits are now called, is divided into (descending) Cape May, Pensauken, and Bridgeton fms. In the Atlantic Coastal Plain from Del. to Fla. it is now divided by C. W. Cooke into following terrace fms. (youngest to oldest): Pamlico fm. (at 25 ft. elev.), Talbot fm., restricted (at 42 ft. elev.), Penholoway fm. (at 70 ft. elev.), Wicomico fm. (at 100 ft. elev.), Sunderland fm. (at 170 ft. elev.), Coharie fm. (at 215 ft. elev.), and Brandywine fm. (at 270 ft. elev.). (See Int. Geol. Cong., 16th, Guidebooks Nos. 5 and 12, 1933.) Cooke stated (Guidebook No. 12, p. 8): The division into fms. is based chiefly upon geomorphology, the fill corresponding to each Pleist. terrace being considered a separate fm. and bearing the same name as the terrace. Cooke regards all of the fms. as chiefly or wholly marine, but some geologists—especially M. R. Campbell (Geol. Soc. Am. Bull., vol. 42, pp. 825–832, 1931) and C. K. Wentworth (Va. Geol. Surv. Bull. 32, 1930)—do not recognize any marine terraces above the 100-foot Wicomico terrace. All of the fms. enumerated above are present in Dist. of Columbia, the type loc. of the group. Cooke does not recognize the Princess Anne terrace (and fm.), which has been assigned to 12-foot elev.

†Columbia granite.

Pre-Cambrian: Central Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Columbia granite.*—Biotite quartz monzonite. Intrusive into Glenarm series. Mapped at and around Columbia, Fluvanna Co. Is pre-Camb.

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 18–23, map). *Columbia granite* (pre-Camb.) ranges in composition from quartz monzonite to granodiorite. It was named for its occurrence at Columbia, on Fluvanna-Goochland Co. line, N. of James River. Intrudes Wissahickon fm. and the hornblende gneiss. Mylonitized granite, the *Shelton granite gneiss facies of Columbia granite,* occurs in 2 zones [described]. The freshest and largest exposures of Columbia granite are in Cowherd quarries at Columbia, on N. side of James River, near highway 60.

This name conflicts with Columbia group (Pleist.) of same State.

†Columbia lava.

See *Columbia River basalt.*

Columbia Ford limestone.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). [No definition except that it is included in Humphrey shale. Derivation of name not stated. If it occurs in Humphrey sh. it is probably Wakarusa ls.]

Columbia Hill oil rock.

Drillers' term for a bed in basal part of Venango oil sand group of NW. Pa.

Columbian marble.

Trade name for a marble of Ord. age in western Vt. Derivation of name not known.

Columbia River basalt.

Tertiary (Eocene, Miocene, and Pliocene?): Oregon, Washington, and northern Idaho.

I. C. Russell, 1893 (U. S. G. S. Bull. 108, map. and pp. 20–22). Resting uncon. on Kittitas system and overlapping it to N., there is a great series of lava sheets, composed principally of basaltic rocks, which extend with unbroken continuity, not only over whole of Douglas Co., but larger part of Yakima and Kittitas Counties, Wash., and besides are known to pass southward beyond boundaries of Wash. Although this great series of lava sheets is irregular in many ways and of an entirely different origin from the sediments above and below it, yet it forms the most important geological series in the Northwest. As region it occupies is drained almost entirely by Columbia River, I venture to name it *Columbia lava*. So far as known this is most extensive fm. of its kind in the world. It is known to occupy large portions of Oregon and Idaho and to extend into northern Calif. Its estimated area is 200,000± sq. mi. It is traversed by Snake River throughout its entire course, and by the Columbia from near mouth of Spokane River to where the Columbia breaks through Cascade Mtns, a distance of 800 mi. The streams tributary to the Columbia from the S., below mouth of the Snake, also drain the same great lava field. The Columbia lava is not one vast flow, but is composed of many separate flows, sometimes separated by land surfaces, which frequently contain the stumps of large trees, or by sheets of lapilli. The sheets of which it is composed overlap and supplement each other, so as to form one continuous but highly compound system. No single sheet can be traced over entire field, but in sides of deep canyons that have been eroded in its surface individual flows may be followed continuously for a score or more of miles. The entire series varies in thickness from 300 or 400 ft. or less along rim of canyon of Columbia, on NW. border of Douglas Co., to 3,700 ft., according to Le Conte, in Cascade Mtns at the Dalles. Its average thickness is probably about 2,000 ft. In the best sections of Columbia lava exposed in coulees or canyons is Douglas Co. and the remarkable gates eroded by Yakima River through ridges of same material there are frequently 6 or 8 distinct layers of basalt exposed, from 50 to 150 ft. thick. The rock is usually a compact bluish black basalt, with frequently a well-defined columnar structure, but it is also at times vesicular and scoriaceous, especially on surfaces of the sheets. Near upper surface of Columbia lava in Yakima region there is a thin layer of clay formed as a sediment in a Tert. lake and later covered by a lava flow 100 ft. thick. Above this bed of basalt and resting evenly on its surface are gravels and fine, evenly bedded lacustral sediments 125 ft. thick. Then comes a sheet of columnar basalt 40 to 100 ft. thick, which can be traced from the hills about Ellensburg eastward to Columbia River and appears again in E. part of Saddle Mtn. Above this layer are the lacustral deposits of John Day system. The presence of Mio. lake beds on the surface of Columbia lava and the occurrence of Kittitas system of probable Eocene age below it, show that the volcanic outbursts belong somewhere near middle of Tert. [The map accompanying this rept. covers Yakima, Kittitas, Okanogan, and Douglas Counties and parts of counties adjacent on the E.]

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pl. 9), mapped the Tert. rocks of Mount Stuart quad., Wash., and to N. and E., as follows (descending): Ellensburg ss., Columbia lava, Roslyn ss., Swauk ss., and andesite, and made the following statements (pp. 118–134): In U. S. G. S. Bull. 108 the author proposed term *"Kittitas system"* for the fms. here named *Roslyn* and *Swauk sss.* It has been thought best to abandon the provisional name first used. [p. 118, footnote.] The Columbia lava, in common with Swauk and Roslyn sss., has been upraised, and removal of upper part of these elevations has left exposed the edges of 4 distinct lava sheets. The lowest sheet in Mount Stuart quad. lies conformably on Swauk ss. (which contains Eocene plants) and is separated from second or Table Mtn sheet (which is of very wide extent) by Roslyn ss. (which also contains Eocene plants and is 200 to 3,500 or more ft. thick), with which it also appears to be conformable. The second sheet is of very wide extent. The third sheet is 300 to 350 ft. thick. The Ellensburg ss. contains plants identified by Knowlton as upper Mio. The Roslyn ss. is separated from Ellensburg ss., which occurs stratigraphically above it, by the several later sheets of Columbia lava and their associated tuffs. The number of separate overflows in entire Columbia system is not known, but is certainly a score or more. They are sometimes separated by sediments. The best exposures of Columbia lava occur in Snake River Canyon, where a vertical thickness of 4,000 ft. can be seen in a single escarpment.

I. C. Russell, 1901 (U. S. G. S. W. S. P. 53, p. 28, footnote). *Columbia River lava.*—In previous repts this fm. has been termed *Columbia lava*, but to avoid confusion with Columbia fm. of Atlantic States it has been thought best to change name to *Columbia River lava*.

J. C. Merriam, 1901 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9). *Columbia lava.*—The name given to the lava fm. above the John Day was first used by Russell (U. S. G. S. Bull. 108, p. 20), who applied it to the series of eruptives which forms such a prominent feature of geology of area drained by Columbia River. In region discussed by Russell there are several distinct horizons of Columbia lava, separated by important fms. belonging to different geological periods. Obviously only one of them can retain the name, if it is to be used as a series or fm. name in geological classification. This one should be the horizon which is most prominent along Columbia River, as it was this fm. which suggested the name. In John Day basin it is found that the lavas of the Columbia form a well-defined series which lies btw. the John Day [upper and middle Olig. and Mio.] and Mascall [middle Mio.] fms. This series is the one of the several to which the name is applied which has the greatest lateral extent, forming probably the largest lava field in world and one of most important fms. on continent. It would seem advisable to restrict the name *Columbia* to this horizon. The lava series is composed of a large number of basalt flows which are sometimes separated by beds of tuff. At Turtle Cove 23 flows were counted in the bluff.

G. O. Smith, 1901 (U. S. G. S. W. S. P. 55), applied *Yakima basalt* to the Mio. part of Columbia River basalt, which he stated included basalts of Eocene, Mio., and post-Tert. age.

G. O. Smith (U. S. G. S. Ellensburg folio, No. 86, 1903, and Mount Stuart folio, No. 106, 1904) applied the name *Teanaway basalt* to the pre-Roslyn (Eocene) basalt flow, and the name *Yakima basalt* to the Mio. (pre-Ellensburg) basalt flow (2,000± ft. thick), and stated: In the reconn. surveys of central and SE. Wash. by Russell and others the names *Columbia lava* and *Columbia River lava* have been used, including not only basalts of Eocene, Mio., and possibly Plio. age, but also hypersthene andesite of Pleist. age. In detailed areal mapping igneous rocks of different ages must necessarily be separated, and therefore the name *Teanaway* has been applied to this fm., which includes only the basalt flows and interbedded basaltic pyroclastics of Eocene age, and which constitutes a series that can be taken as a unit. [He also applied the name *Wenas basalt* to a younger flow, 20 to 200 ft. thick, interbedded in the Ellensburg fm. (Mio.).]

J. P. Buwalda, 1923 (Idaho Bur. Mines and Geol. Pam. No. 5). *Columbia River basalts* are generally assigned to Mio. In SW. Idaho they lie on granite or on early phases of Payette fm. and are intercalated with it. They appear to be continuous with the great Columbia River basalt flows of Wash., Oreg., and central Idaho.

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 201–239). *Columbia River basalt* (Mio.) discon. underlies Idaho fm. in Idaho, and includes, 300 to 1,000 ft. below its top, the 1,000± ft. of terrestrial deposits and lake beds known as Payette fm., which carry a Mio. flora.

The U. S. Geol. Survey at present recognizes *Columbia River basalt* as a convenient blanket term, covering basalts of Eo., Mio., and Plio.(?) age in the broad region described by Russell. Some geologists restrict the name to the Mio. basalt (Yakima basalt).

See also *Snake River basalt* and *Yakima basalt*.

Columbus limestone.

Middle Devonian: Ohio.

W. W. Mather, 1859 (Rept. State House Artesian Well at Columbus, Ohio, p. 25). *Columbus ls.*, 138½ ft. thick, underlies 15 ft. of Dev. sl. and overlies 2 ft. of gritty hard rocks. [As thus defined included at top Delaware ls.]

J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, pt. 1, p. 89). *Columbus ls.*—Very light-colored ls., containing balls of chert. Forms lower part of Corniferous ls., while Sandusky ls. forms upper part of Corniferous.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3). *Columbus ls.*—White and buff lss., 45 ft. thick, underlying the bone bed [6 to 8 ft. thick] or basal bed of Delaware ls., and overlying Waterlime group or Lower Helderberg ls. Includes "Delhi stone" near top. Is lower part of Corniferous ls., the Delaware ls. being upper part of Corniferous.

E. Orton, 1890 (Ohio Geol. Surv., 3d ser., 1st Ann. Rept.), included the "bone bed" in Columbus ls., and it has been thus included in subsequent repts of all other geologists.

J. A. Bownocker, 1915 (Ohio Geol. Surv., 4th ser., Bull. 18), describes lower part of Columbus ls. as gray and upper part as usually buff.

Named for exposures at Columbus.

†Columbus sandstone. (In Cherokee shale.)

Pennsylvanian: Southeastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 106). *Columbus ss.*—The most extensive ss. system in Cherokee shales. Lies more than 200 ft. above base of Cherokee and in places divides it into two parts. Named for outcrops along Brush Creek, E. of Columbus, Cherokee Co.

W. G. Pierce and W. H. Courtier (unpublished mss.). The term "Columbus ss." was proposed by Haworth and Kirk for the ss. exposed SE. of Columbus, but was rather loosely defined and would probably include both Little Cabin and Bluejacket ss. members of Cherokee sh.

†Columbus sand.

Upper Cretaceous: New Jersey.

G. N. Knapp, as reported by R. D. Salisbury, 1899 (N. J. Geol. Surv. Ann. Rept. State Geol. 1898, pp. 35, 36). *Columbus bed.*—Sand underlying Marshalltown bed and overlying Woodbury bed. All included in Clay marl series [Matawan group].

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 156). *Columbus sand.*—White or yellow quartz sand marked by delicate lines of red. Thickness 20 to 100 ft. Overlies Woodbury clay and underlies Marshalltown clay marl.

Preoccupied. Replaced by Englishtown sand.

Named for occurrence at Columbus, Burlington Co.

†Columbus marl.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

See explanation under *Marlbrook marl.*

Named for Columbus, Hempstead Co.

Columbus quartzite.

Pennsylvanian: Central northern Utah (central Wasatch Mountains).

L. A. Palmer, 1906 (Mines and Min., vol. 26, pp. 438–439), in a description of rocks of Alta, divided the Carbf. rocks into: (1) upper lss., 1,000+ ft.; (2) *Columbus qtzite* (or upper qtzite), some hundreds of ft. ("corresponds in geologic age to Ontario qtzite of Park City"); (3) lower lime. The qtzite appears to be named for Columbus Consolidated Mine.

Same as Weber qtzite.

†Colville series.

Upper Cretaceous and Pliocene: Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 248). *Colville series.*—Chiefly heavy-bedded, partly consolidated silts or mud rock, with intercalated harder layers of soft ss., ls., sh., lignite, and unconsolidated silts. Thickness 500 to 600 ft. Of Plio. and Olig. age. The supposed Olig. part is best exposed along Colville River near mouth of the Anaktoovuk, where it comprises lower 150 ft. of section.

Later work proved Upper Cret. age of lower part of this "series" and Plio. age of upper part.

Colville granite.

Colville granodiorite.

Mesozoic (probably Cretaceous): Northeastern Washington.

J. T. Pardee, 1918 (U. S. G. S. Bull. 677). [The granite and granodiorite that compose Colville batholith, in Colville Indian Res., are, for brevity, called *Colville granite* and *Colville granodiorite* in this rept. They intrude Covada group.]

Colville quartzite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 68; map). *Colville qtzite.*—More homogeneous than Addy qtzite. Ranges from a pure light-colored massive rock, composed almost entirely of quartz grains, to a fine-grained pebbly or cgl. qtzite, pebbles usually less than ⅛-inch diam. Locally the belts become schistose and even argill. South of Kettle Falls along Columbia River they grade into schists and argillites and are difficult to distinguish from the younger Mission argillite. Thickness 5,000± ft. Rests with apparent conformity on Old Dominion ls. and underlies Mission argillite and Clugston ls. [Mapped close to town of Colville.]

Colvin limestone member (of Washington formation).

Permian: Southwestern Pennsylvania (Greene County) and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 23, 39). *Colvin's Run ls.*—Buffish ls., 0 to 10 ft. thick. Named for Colvin's Run, Greene Co. Lies 0 to 1 ft. above Waynesburg "A" coal and 30 to 35 ft. below Waynesburg "B" coal. Included in Dunkard Creek series [Dunkard group]. Seldom seen S. of Pa. line.

In several subsequent repts by Pa. Geol. Survey this ls. was called *Calvin Run ls.*, upon the misapprehension that the stream for which it was named (in Greene Co.) was correctly spelled *Calvin*, as on the topog. maps. Later the Pa. Geol. Survey changed the name of the ls. to *Colvin Run*. In explanation, G. H. Ashley, State Geol., stated (letter dated Sept. 4, 1931) that according to the postmasters at Mount Morris and Kirby the name is correctly spelled *Colvin Run*.

In 1910 the U. S. Geol. Survey adopted *Colvin ls. memb.* (of Washington fm.) as the name of this ls.

Colvin sand.

A subsurface sand of late Chester (Miss.) age in Ind. that has been correlated with Tar Springs ss.

†Colvins Run limestone member.

See *Colvin ls. memb.*

Colwood sands and gravels.

Pleistocene: British Columbia.

C. H. Clapp, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 294; Canada Geol. Surv. Mem. 36, p. 112); 1914 (Canada Geol. Surv. Mem. 51, p. 85; Canada Geol. Surv. Summ. Rept. 1912, p. 51); and 1917 (Canada Geol. Surv. Mem. 96, p. 345). *Colwood sands and gravels*, Pleistocene, British Columbia.

Colwood formation.

Recent: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2). *Colwood fm.*, post-Vashon alluvium, deposited since retreat of last glacier. Thickness 0 to 50 ft. [Assigned to Recent.]

Comanchan series.

Comanchan system.

Terms applied by some geologists to *Comanche series* of U. S. Geol. Survey and other geologists.

Comanche series (or **epoch**).

The provincial series of marine Lower Cretaceous rocks present in Southwestern States and the time during which they were deposited. **For definition see U. S. G. S. Bull. 769, pp. 59–61.**

†Comanchean system.

Name introduced by T. C. Chamberlin and R. D. Salisbury in 1906 (Geology, vol. 3, pp. 107–137), for major part of Comanche series, but excluding at top the rocks of Albian and Cenomanian age, which they included in overlying "system," to which they restricted the name *Cretaceous*. See U. S. G. S. Bull. 769, p. 60.

Comanche Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 385). *Comanche Creek bed.*—Clays, 300 ft. thick, divided into three parts by 8 to 10 ft. of hard, massive ss. associated with 10 to 15 ft. of shaly friable ss. and clay. Memb. of Strawn div. Underlies Antelope Creek bed and overlies Wilbarger Creek bed.

Named for Comanche Creek, Mills Co.

†Comanche Peak group.

Lower Cretaceous (Comanche series): Central Texas.

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, pp. 583, 584). *Comanche Peak group.*—Fossiliferous, soft, yellowish and whitish chalky ls. and buff and cream-colored lss. of greater or less compactness. Thickness 300 to 400 ft. Underlies Caprina ls. [Shumard's section of this "group" at Shovel Mtn, Burnet Co., shows it included Comanche Peak ls., Walnut clay, and at least larger part of Trinity fm. Name was later used by R. T. Hill in same sense as Fredericksburg group.]

Named for Comanche Peak, Hood Co.

Comanche Peak limestone. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Eastern Texas.

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, pp. xiv, xvii–xix). *Comanche Peak chalk bed.*—Persistent, fossiliferous, white chalky ls., composing middle fm. of Fredericksburg div. [group]. Conformably underlies Caprina chalk and chalky ls. [Edwards ls.] and overlies *Exogyra texana* beds [Walnut clay].

Named for Comanche Peak, Hood Co.

See also under *Fredericksburg group.*

Comanchian series.

Comanchian system.

Terms applied by some geologists to Comanche series.

†Combahee shale.

Miocene (lower and upper): Southern South Carolina (Colleton County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, name only, not defined); and 1908 (S. C. Geol. Surv., ser. 4, Bull 2, pp. 435, 464, 465). *Combahee phase.*—Poorly stratified gray and yellow sh. with occasional pockets of glauconite, and enclosing casts and moulds of shells and, along its littoral margin, impressions of the dwarf palmetto. Overlain by Parachucla marl.

According to C. W. Cooke (personal communication, 1935) Combahee sh. of Sloan included Hawthorn fm. (lower Mio.) and Raysor marl (upper Mio.).

Appears to be named for exposures on Combahee River.

Combe sandstone.

Upper Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81), divided the Jurassic rocks of Mount Jura into following fms. (descending), but did not define any of them:

Upper Jurassic: *Combe ss.*, Trail tuffs and cgls., Lucky S argillite, Cooks Canyon aggl., Forman argillite, North Ridge aggl., Hinchman arkose.

Middle Jurassic: Hull aggl., Moonshine cgl., Mormon ss., Thompson red sh., Fant volcanics, Hardgrave tuff.

Lower Jurassic: Lilac argillite.

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 896, 903). *Combe fm.*—Calc. marine ss. and cgl. containing cobbles from the mid Upper Jurassic quartz porphyry and from granitic plutonics. Thickness 550 ft. Rich but ill-preserved fauna. Of late Upper Jurassic age. Overlies Trail tuff and cgl. Type loc., Combe Canyon, N. of Mount Jura.

Combined Metals bed.

A name locally applied to 40 or 50 ft. of ls. in Pioche sh. of Pioche dist., Nev., which is the productive horizon (silver, lead, and zinc) of the Combined Metals mine. (See U. S. G. S. P. P. 171, pp. 54–55, 1932.)

Combs limestone.

Upper Devonian: Eureka district, Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 78). *Combs lss.*—1,200 ft. thick, form top fm. of Nevadan series [Nevada ls.] in Nev. Named for Combs Peak, in neighborhood of Eureka.

Comerio beds.

Early Cretaceous (?): Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

Comet Creek bed.

Lower Cretaceous: Western Oklahoma (Custer County).

R. T. Hill, 1895 (Am. Jour. Sci., 3d, vol. 50, p. 228). *Comet Creek bed.*—Isolated remnant of Cret. at Comet Creek, G Co., Okla., described by Prof. Jules Marcou as a single stratum of Gryphaeate ls., 5 ft. thick, containing one fossil speciès, the *G. pitcheri* of Marcou. Probably part of same general fm. as those nearby at Camp Supply and Belvidere. [Marcou located Comet Creek at lat. 35°32′21″ and long. 99°14′40″.]

Commerce sandstone.

Tertiary: Southeastern Missouri (Scott County).

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines, vol. 15, 2d ser., p. 191). *Commerce ss.*—Prominent ss. that outcrops at and near Commerce, Scott Co. Best exposures in cuts of St. Louis & San Francisco R. R. in and just N. of Commerce. Rock moderately fine-grained, buff to pink, and varies from loose friable ss. to vitreous qtzite. About 20 to 30 ft. is exposed in R. R. cuts. Has been referred to Cret. by some of earlier writers, but Marbut classifies it as a more indurated phase of the Tert. Similar sands and qtzites of Tert. age, underlain by unconsolidated Tert. clays, are reported from many points on Crowley's Ridge, Ark.

Commercial limestone member (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 40, map, sections). *Commercial ls. memb. of Bingham qtzite.*—Most extensive ls. body of Bingham region. Commonest strata are blue lss. and altered white marbles, with here and there beds of light-blue, gray, dark-blue, and black ls.—precisely the same kinds of rock as in Jordan ls., which lies a considerable distance below it. Thickness 0 to 200 ft. May possibly be same as Yampa ls. lentil and Jordan ls. may possibly be same as Highland Boy ls. memb. [Evidently named for Commercial mine.]

Commonwealth ore formation.

Age (?): Northern Michigan.

C. L. Rominger, 1881 (Geol. Surv. Mich., vol. 4, pt. 2, p. 223). *Commonwealth ore fm.*—The ore fm. of Commonwealth Mine, Menominee iron region, which I place below Quinnesec ore fm. of Quinnesec mining dist.

†Como beds.

Name applied by W. B. Scott in 1897 (Introduction to geol., pp. 477, 491) to the beds in southern Wyo. and Colo. which were named *Morrison fm.* by G. H. Eldridge in 1896. In 1907 Scott adopted *Morrison fm.*, and

Como beds (from Como, Wyo.) is no longer used. W. C. Knight, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 377–388), called these beds *Como stage*. They have also been called "*Atlantosaurus* beds" (paleontologic name). The Morrison fm. is now classified as Upper Jurassic.

Comondu formation.

Tertiary: Mexico (Lower California).

A. Heim, 1922 (Geol. Mag., vol. 59, p. 542).

Comox formation.

Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 105). [Age not assigned; but MacKenzie, 1922 (Can. Inst. Min. and Met., Mon. Bull. No. 122, p. 674), assigned it to Cret.]

Compton limestone.

Mississippian (Kinderhook): Southwestern Missouri.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 60, 108–109, 111, 118–122, 131, 158). *Compton ls.*—Light bluish-drab or grayish-blue compact ls., very fine grained and breaking with conchoidal fracture; occurs in beds averaging 6 to 8 inches in thickness but in places as much as 2 ft. thick. Thickness 0 to 25 ft. Conformably overlain by (merges with) Northview fm. Rests uncon. on Sylamore ss. in some places, but usually lies on Ord. Contains a typical Chouteau fauna, and it seems best to regard it as a thin extension of a part of Chouteau ls. of central Mo. It is certainly not=Louisiana ls., although in most previous repts it has been called Louisiana. In some repts it has been included as a calc. facies of Northview fm. Cannot be correlated directly with previously recognized strat. units, and therefore the name *Compton ls.* is proposed. Named for exposures along James River in vicinity of Compton, near W. line of Webster Co., where 22 ft. is exposed.

Compton formation.

Ordovician: Southeastern Quebec (Mount Megantic region).

H. W. McGerrigle, 1935 (Quebec Bur. Mines Ann. Rept. 1934, French ed., pt. B, p. 78).

H. W. McGerrigle, 1935 (Quebec Bur. Mines, Rept. Minister Mines 1934–35, pt. D, pp. 71–73). Sss. and slates, granitic and gabbroic sills at base. Widely developed in Compton Co.

†Conanicut granite.

A name that has been casually applied in some repts (for example, L. V. Pirsson, Am. Jour. Sci., 3d, vol. 46, p. 363, 1893) to the granite described as *granite of Conanicut Island*, southern Rhode Island, which is now considered to be same as Sterling granite gneiss. (See B. K. Emerson, U. S. G. S. Bull. 597, p. 171 and map, 1917.)

Conanicut arkose.

Carboniferous: Southern Rhode Island (Conanicut Island).

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, p. 380). *Conanicut arkose.*—Evidently composed of detrital material derived from the granite. Occurs on E. side of Mackerel Cove, Conanicut. Thickness may reach 100 ft. Possibly contemp. with part of Aquidneck shales.

A part of either Rhode Island fm. or Wamsutta fm. as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

Conasauga shale, also **Conasauga limestone.**

Upper and Middle Cambrian: Northwestern Georgia, northern Alabama, and eastern Tennessee.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 143, 144–148). *Conasauga sh.*—Alternating beds of ls. and calc. sh., 1,600 to 2,000 ft. thick. Underlies Knox dol. and overlies Rome ss. Same as Knox sh. of E. A. Smith and J. M. Safford.

C. W. Hayes, 1891 (U. S. G. S. Bull. 81, p. 304). In section from Rome, Ga., to Gadsden, Ala., *Connasauga sh.* is 1,600 to 2,000 ft. thick, and consists of (descending): Thin-bedded seamy ls., sometimes blue and massive; yellow calc. shales grading into seamy ls.; earthy ls. interbedded with shales, often wanting and locally carrying nodules of chert; yellow shales; oolitic ls. and thin beds of light-green or yellow shales; variegated sandy shales, purple, green, brown, etc. Overlies Rome ss.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2). *Connasauga sh.*—At base thin lss., in part oolitic, interbedded with shales; in middle yellow or greenish clay shales; at top blue seamy ls. or calc. shales. Where the oolitic ls. is absent bdy btw. Connasauga and underlying Rome fm. becomes very indefinite. The same is true when upper part of the Rome contains lss. Thickness probably 1,500 to 2,500 ft.

C. W. Hayes, 1902 (U. S. G. S. Rome folio, No. 78). *Conasauga fm.* presents several widely different phases in this quad. At type loc. (in Dalton quad., to NE.) it consists of great thickness of fine clay sh. with occasional beds of rather pure blue ls. from a few inches to several hundred ft. thick. Near Rome and to NE. it consists at base of several hundred ft. of fine olive clay sh., then beds of oolitic ls., and finally of 1,000 ft. or more of calc. shales interbedded toward top with blue lss. To S. of Rome the lss. increase. In Coosa Valley the fm. can be divided into 3 rather distinct phases: The upper part consisting of characteristic greenish siliceous shales, in some places replaced by greenish micaceous ss. To NW. the siliceous beds are replaced by fine olive-green shales, and throughout central part of valley this division is represented by olive shales containing many flat concretions of gray siliceous rock intermediate btw. qtzite and chert. The intermediate div. of the Conasauga in Coosa Valley is clay sh. containing varying amounts of ls. The lower part of fm. is wholly fine clay or slightly sandy sh.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, p. 69, etc.). *Conasauga ("Coosa") fm.*—Made up of ls., dol., and sh. of varying proportions in different areas; in places it is chiefly ls., in other places chiefly sh. Thickness ranges from 500 to possibly 3,600 ft. Overlies Rome fm. and underlies Brierfield dol. and younger fms. into which Knox dol. has been divided in this region.

Named for exposures in Conasauga Valley, Dalton quad., NW. Ga.

Conception slate.

Pre-Cambrian: Newfoundland.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 220).

Conchos gravels.

Age(?): Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 327).

Concord granite.

Late Paleozoic(?): Central southern New Hampshire.

C. H. Hitchcock, 1873 (Rept. Geol. Surv. N. H. 1872, pp. 9, 12). Of the specific members of White Mtn series that known as "*Concord granite*" has been traced irregularly from Concord to Fitzwilliam. [p. 12. On p. 9 he calls it the *celebrated Concord granite.*]

C. H. Hitchcock, 1877 (Geol. N. H. pt. 2). A not less important variety of Montalban group is a granitic gneiss with very different degrees of crystalline coarseness. The finer grained rock often displays no visible marks of stratification, though there is no reason to doubt its sed. origin, and, for convenience, this is designated *Concord granite.* It is usually incoherent, tender, and quite friable after decomposition has commenced, and is distinguished from Lake granitic gneiss by its fineness of texture.

G. W. Hawes, 1881 (Am. Jour. Sci., 3d, vol. 21). Origin of *Concord granite* is open to question. [He mapped it.]

C. H. Hitchcock, 1884 (Bull. Am. Mus. Nat. Hist., vol. 1, No. 5, pl. 16, pp. 178–179), placed *Concord granite* below Montalban.

W. O. Crosby and M. L. Fuller, 1896 (Tech. Quart., vol. 9, p. 330). Montalban gneiss seems to be merely a more gneissoid phase of *Concord granite.* They are youngest and most acidic of entire granite series of the region. Intrusions of normal Concord granite occur chiefly in more massive fms. (Winnipesaukee gneiss, porphyritic gneiss, etc.).

M. Billings, 1935 (letter dated Aug. 27). I have never studied *Concord granite* in the field, but would tentatively assign it to New Hampshire magma series [late Dev. or late Carbf.] from description I have read.

Concord formation.

Oligocene: Western California (San Francisco Bay region).

B. L. Clark, 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, pp. 54-111). *Concord fm.*—Chiefly fine grayish ss., becoming finer and more shaly near top, and including at base a thin layer (6 inches) of cgl. the boulders of which are composed mainly if not entirely of tuff, ss., and sh. apparently derived from immediately underlying Olig. beds. Thickness about 250 ft. On S. side of Sobrante anticline, in Concord quad., it discon. overlies Kirker tuff and uncon. underlies Sobrante ss. [restricted definition, and only upper part of Lawson's Sobrante ss.] of Monterey group. Included in San Lorenzo series. Is lower part of Sobrante ss. as defined by Lawson, the name *Sobrante* being restricted by author to upper 80 to 100 ft. of Lawson's Sobrante.

Concreto shale.

Pennsylvanian: Southeastern Kansas.

G. I. Adams, 1904 (U. S. G. S. Bull. 238, p. 20). *Concreto sh.*—Clay sh., 75 ft. thick, overlying Iola ls. and underlying Allen [Plattsburg] ls.

According to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), this is same as Lane sh., but according to N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 56), and R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), it includes true Lane sh. and 2 overlying fms. (Wyandotte ls. and Bonner Springs sh. of present Kans. Geol. Surv.) up to base of Plattsburg ls. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.) Newell says (p. 56 cited above): Concreto may properly be used for beds btw. top of Iola ls. and base of Plattsburg ls.; but it seems preferable to indicate the combined Lane and Bonner Springs sh. by hyphenated term *Lane-Bonner Springs sh.*, where intervening Wyandotte ls. disappears, thus avoiding using a geographic name that gives no indication of its strat. relation to correlative units, and the introduction of a different name where separating lss. thin out.

Named for Concreto, Allen Co.

Condon erosion surface (Oregon).

See under *Ochoco erosion surface*.

Conecuh sands.

Pleistocene: Southeastern Alabama.

See under †*Ozark sands*.

Probably named for Conecuh River.

Conejo volcanics.

Miocene: Southern California (western end of Santa Monica Mountains).

N. L. Taliaferro, 1924 (A. A. P. G. Bull., vol. 8, pp. 800-801). One of most important centers of Mio. volcanism in the State lies in W. end of Santa Monica Mtns. This region is often referred to as Conejo Mtns, and name *Conejo volcanics* is here applied to all volcanic and intrusive rocks occurring in that region. These volcanic rocks and the interbedded Mio. sediments probably aggregate 15,000 ft in thickness.

Conejos andesite. (Of Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 38-39). *Conejos fm.*—Dark-colored andesite of compact texture and similar in appearance to Summitville andesite. Presumably an augite andesite. Basal fm. of Potosi volcanic series ih Platoro-Summitville quad. Underlies Treasure Mtn latite. In field we called this fm. *Palisade andesite*. [Palisade is preoccupied.]

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Conejos fm.* is 0 to 3,000+ ft. thick in Platoro-Summitville dist. Named for exposures along Conejos River.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Conejos fm.* is an extremely variable volcanic aggl. with intervening flows of andesite. In places in Summitville quad. a considerable thickness of it consists of stream-laid gravels and bowlders.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843). *Conejos andesite.*—In nearly all large exposures of this fm. tuff breccia is in greater amount than massive rock. In central and thickest part of the Conejos volcanic pile, in Summitville, Conejos, and Del Norte quads., massive rock makes up considerable part of fm., but near borders, to W., in San Cristobal quad., and to N., in N. part of Del Norte quad. and S. part of Cochetopa and Saguache quads., massive rock is very subordinate and tuff breccia, much of it rather well bedded, makes up most of fm. To S., in Tusas quad., N. Mex., beginning not far S. of State line, the fm. is made up mostly of several hundred ft. of sands and gravels, composed chiefly of volcanic rocks, with some layers of pyroclastic beds or flows. Farther S. the fm. becomes thinner and grades into sands and gravels composed chiefly of pre-Camb. rocks. In S. slopes of the mtns a variable thickness of soft bedded sands and gravels made up of volcanic material underlies the normal Conejos andesite. It has been included in the Conejos although it may be older. It is commonly very poorly exposed. Is well developed in drainage of Chama River in SE. part of Summitville quad. and N. and E. of Quien Sabe Mtn, in NW. part of Summitville quad. and adjoining part of Pagosa Springs quad., where it overlies Blanco Basin fm. The greater part of the rocks of Conejos fm. are andesitic.

Conemaugh formation.

Pennsylvanian: Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, p. 8). *Conemaugh series* underlies Pittsburg coal bed, basal bed of Monongahela series, and overlies Allegheny series, which includes Upper Freeport coal at top. The Conemaugh includes Middle Barren Measures and underlying Mahoning ss. [This definition accords with current definition of Conemaugh fm. except that the thin clay underlying the Pittsburg coal has for many years been included in Monongahela fm.]

The present Pa. Geol. Survey classifies the Conemaugh as a *group*.

Named for exposures along Conemaugh River, Pa.

Conestoga limestone.

Ordovician (Lower) and Cambrian(?): Southeastern Pennsylvania.

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 359, 365–366). *Conestoga ls.*—Dark slaty ls., coarse ls. and marble cgl., thin-bedded granular blue ls. and thin graphitic sl. Overlaps southeastward on all fms. from Ledger dol. to Harpers schist. Probably older than or in part=Cocalico sh. and probably of Chazy age.

E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 55). *Conestoga ls.*—Strongly crumpled, gray to blue, crystalline ls. with partings of black graphitic sl. Is gashed by numerous veinlets of coarsely crystalline white calcite. To S. around Mine Ridge Hill it is gray or blue, micaceous, banded ls. In some places it comprises massive beds of white marble speckled with phlogopite. Near base are lentils of coarse ls. cgl., which are now regarded as basal cgls. in a transgressive series of probably Chazy age. Edgewise cgls. occur near base in some places. Named for outcrops along Conestoga Creek S. of Lancaster.

G. W. Stose and A. I. Jonas, 1923 (Geol. Soc. Am. Bull., vol. 34, pp. 507–524). [Detailed description.]

G. W. Stose and A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 524–526). *Conestoga ls.*—Extends from NE. of Phila. along Chester and Quarryville valleys to Lancaster, thence across Lancaster, York, and Hanover valleys to Md. line. Rests uncon. on fms. from Beekmantown ls. to Harpers schist (Lower Camb.). Probably of Chazy or Black River age.

This fm. is now classified by U. S. Geol. Survey as of Beekmantown age in Chester Valley and as Lower Ord. or Camb. at type loc. It has yielded very few fossils.

Conewago group.

Upper Triassic: Central southern Pennsylvania (Dauphin and York Counties).

G. H. Ashley, 1931 (Topog. and Geol. Surv. Pa. Bull. G_1, p. 77). *Conewago group*.—Alternating hard, purplish, or pinkish red ss. and red sh., 8,000 ft. thick, underlying Lewisburg group and overlying Manchester group, all Upper Tr. [Credited to [M. H.] Bissell. When the Triassic of New Cumberland quad. (in which occur the geographic features indicated) was differentiated for 1931 geol. map of Pa., these rocks were included in Gettysburg sh., and the underlying "Manchester group" was mapped as New Oxford fm., of which it is a westward continuation.]

Conewango formation.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

C. Butts, 1908 (Pa. Topog. and Geol. Surv. Rept. 1906–08, pp. 191, 198) and 1910 (U. S. G. S. Warren folio, No. 172). *Conewango fm*.—Greenish sandy sh. with thin layers of very fine-grained greenish, micaceous, and argill. sss. and cgls. Thickness 550 ft. Underlies Knapp fm. and overlies Chemung fm. Includes Salamanca cgl. memb. near middle. Marked change in fossils at Conewango-Chemung bdy. Assigned to Devono-Carboniferous. Is=Oswayo and Cattaraugus fms. of Olean and Salamanca quads., N. Y., which can not be differentiated in Warren Co. because of absence of red beds above Salamanca cgl. Represents upper part of Catskill fm. but differs from it in lithologic and paleontologic character. At base of the Conewango in Olean region, N. Y., is Wolf Creek cgl., which appears to lie at about same horizon as Panama cgl. The fm. is named for fact the beds make most of valley walls and uplands bordering Conewango Creek S. of N. Y. bdy.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 157), correlated Conewango fm. with Riceville sh. and underlying beds, called Venango, shown as extending to base of LeBoeuf ss. (Panama cgl.). He repeated this correlation in 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 195). Chadwick classified the beds as post-Chautauquan and assigned them to "Bradfordian" (Upper Dev.). On p. 10 of this Pan-Am. paper he stated that what has been called Oswayo in Tioga Co., Pa., is Cattaraugus or older.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203), assigned ***Oswayo sh. memb.*** to his Riceville fm. (restricted to lower part of Riceville of previous repts), and named the upper part of the Riceville of previous repts the ***Smethport sh. memb. of Knapp fm.*** He assigned his Smethport to Miss. and Oswayo to Upper Dev.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71), applied *"Conewango series"* to beds extending from top of Riceville restricted down to base of Panama cgl. He included typical Oswayo sh. of Olean quad., N. Y., in his Riceville stage (Riceville monothem), assigned the Conewango to Dev. and discarded "Bradfordian," which he stated included definitely Miss. and definitely Dev. beds. On p. 47 he restricted Riceville to "Dev. part" of Riceville of previous usage, and named the "Miss. part" ***Kushequa sh.*** (to replace his Smethport sh.).

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 332). If, and writer is not averse to this, to succeeding Cussewago or Knapp group is transferred top 40 ft. of original Conewango at Warren, Pa., the Smethport (subsequently Kushequa) sh. of Caster, carrying therewith the corresponding upper part of the Riceville, and also the Devil's Den (Leptodesma) ss. near Smethport, then some of the Miss. element (so called) is subtracted and the case for Dev. age of the Conewango is by thus much strengthened. [Fossils listed and discussed pp. 328–333.]

The U. S. Geol. Survey at present classifies Conewango fm. as *Dev. or Carbf.*

Conewango clay.

Pleistocene: Northwestern Pennsylvania (Warren County).

See under *Clarendon gravel.*

Named for Conewango Creek, Warren Co.

Conewango series.

See 1934 entry under *Conewango fm.*

Coney limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 379). *Coney ls.*—Greenish yellow, shaly; occasional marine fossils. Thickness 0 to 4 ft. Top memb. of Bluefield group [fm.]. Overlies Coney sh. and underlies Stony Gap ss. Type loc. in vicinity of Avis, just opposite Coney Island, Summers Co.

Coney shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 380). *Coney sh.*—Red, variegated, and sandy; marine fossils, also a persistent plant zone; streaks of ss. or ls.; 40 to 95 ft. thick. Underlies Coney ls. and overlies Clayton ss.; all members of Bluefield group [fm.]. Type loc. on E. side of New River, just E. of Avis and just opposite Coney Island, Summers Co. Also exposed in Mercer and Monroe Counties, W. Va., and in Giles and Tazewell Counties, Va.

Confederate limestone member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 15). *Confederate ls. memb.*, basal memb. of Hoxbar fm., reaches max. thickness of 60± ft. at its westernmost outcrop, NW. of Ardmore. Elsewhere it contains cgl. streaks, with chert and ls. pebbles.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 39–40). *Confederate ls. memb.*, basal memb. of Hoxbar fm.; consists of two resistant ledges, each 15–20 ft. thick, of coarsely granular, semi-crystalline gray to buff ls., sparingly fossiliferous, separated by a 30-foot interval of weaker material, part of which is also ls. Thins in general to SE. and thickens to NW. Lies 400± ft. below Union Dairy memb. of Hoxbar. Named because well exposed and has been quarried a short distance back (W.) of Oklahoma Confederate Veterans' Home, in SE¼ sec. 36, T. 4 S., R. 1 E., on SW. outskirts of Ardmore.

C. W. Tomlinson, 1934 (A. A. P. G. Bull., vol. 18, No. 8, p. 1085). According to revised mapping *Confederate ls. memb.* has been traced SE. *into*, instead of *below*, Westheimer memb. as mapped W. of Hoxbar, near S. line of Carter Co. *Westheimer ls.* can now be dropped and *Confederate*, geographically preferable, be substituted. This places base of Hoxbar fm. slightly higher than base as originally mapped by Goldston (1922). However, as this memb. is in that area the lowest of the conspicuous lss. which here constitute the most essential distinguishing characteristic of Hoxbar fm. as compared to the fms. above and below it, and also includes the lowest ls. cgl. (possibly intraformational) above Bostwick memb. of Dornick Hills fm., it appears most appropriate to continue to regard base of Hoxbar as coincident with base of Confederate ls. memb.

†Congaree shales (also †Congaree phase).

Eocene (lower and middle): Central South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 16). *Congaree shales.*—The *Congaree phase* exhibits its littoral line in Aiken Co. along Hollow Creek, near Savannah River, and extends easterly with occasional tongues forming shore line indicated for Tertiary. It is delimited on S. by a line extending from mouth of Hollow Creek (Aiken Co.) along Tinkers Creek N. of Kennedy's Bluff by Binnaker's Bridge (South Fork Edisto River), by Springfield, by Orangeburg, by Jenkins Hill, by Warley Hill, and by Fullers Earth Creek. From this point the fm. apparently constitutes narrow bands whose respective lines around the Carolina Ridge and by Catchall and Naked Creek probably follow the littoral line indicated for the Tert. in general description. The Congaree shales in some localities grade upward to a pea-green marl (Kennedy's Bluff on Tinkers Creek; Binnakers Bridge on Edisto River; Wannamakers Kiln on Caw Caw Swamp; and to a limited extent at Warleys Hill). The materials consist of buhrstone and sands, shales, and marl. Named for exposures on western scarp of Congaree River and the embayments of its tributaries to Lang Syne and Warley Hill, Orangeburg Co. [On p. 449 of Bull. 2 cited above Sloan showed *Congaree* as consisting of (descending) buhrstone, sands, and shales, underlying Caw Caw shales and marls (basal part of his Warley Hill phase) and overlying Black Mingo "phase."]

C. W. Cooke and H. K. Shearer, 1918. (See 1918 entry under †*Congaree clay memb.*)

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Fossils from Congaree phase of Sloan show that it included part of Black Mingo fm. (of Wilcox age) and lower part of McBean fm. (of Claiborne age), and it is abandoned. Its type loc. appears to be on Elmore Williams' place at head of First Creek, 0.8 mi. W. of Gaston, Lexington Co.

†Congaree clay member.

Eocene (upper): Eastern Georgia.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull, 26, p. 267), and 1915 (U. S. G. S. W. S. P. 341, pp. 77, 268). *Congaree clay memb. of McBean fm.*—Principally fullers' earth and drab or greenish sandy clays. Fossiliferous. Its name is adopted from S. C., where Sloan has described its distribution [under name *Congaree shales*]. In Ga. it lies at base of Claiborne group and of McBean fm., resting uncon. on Lower Cret. Thickness at least 100 ft. [Named for Congaree, Richland Co., S. C.]

C. W. Cooke and H. K. Shearer, 1918 (U. S. G. S. P. P. 120C). The beds called *Congaree clay memb. of McBean fm.* by Veatch and Stephenson are of Jackson age and much younger than "Congaree shales" of Sloan, which are of Wilcox age. The rest of McBean fm. contains Claiborne fossils. McBean fm. is therefore here restricted to beds of Claiborne age, and the "Congaree" clay memb., which is of Jackson age, is here transferred to Barnwell sand and renamed *Twiggs clay memb. of Barnwell fm.* Twiggs clay memb. thins out in Ga., near Savannah River and is absent in S. C. [See also C. W. Cooke, 1936 (U. S. G. S. Bull. 867, on S. C.).]

Congdon Hill moraine.

Pleistocene (Wisconsin stage): Rhode Island (Narragansett Bay region).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, table opp. p. 988).

Conglomerate series.

Conglomerate group.

Conglomerate measures.

Names applied in early repts to Pottsville group of Appalachian region.

Connasauga shale.

See *Conasauga sh.*

Connaughtic.

A term introduced by C. [R.] Keyes for a pre-Camb. epoch, separating his Anianic from his Nisconlithic. (See Pan-Am. Geol., vol. 55, pl. 8, p. 132, 1931.)

Conneaut group.

Upper Devonian: Northwestern Pennsylvania and northeastern Ohio.

Am. Jour. Sci., 5th, vol. 27, p. 471, June, 1934. *Note. A new stratigraphic name.*—In a paper by George H. Chadwick accepted for publication in this Journal, the new name *"Conneaut group"* (footnote: Caster, K. E., Bulls. Am. Pal., No. 71, now issuing) is employed to embrace the Upper Dev. Girard and Chadakoin shales of NW. Pa., or lower Chagrin of Ohio.

K. E. Caster, June 9, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 136, footnote). The substitution of *French Creek ls.* for *Conneaut ls.*, proposed in earlier parts of this paper for same memb., is at request of G. H. Chadwick, so that *Conneaut* may be used as a group name in his forthcoming revision of the "Portage" and "Chemung." The name *Conneaut* is especially fitting for the unit to which he is applying it, and "French Creek" is equally appropriate for the Miss. ls. of this paper. The name *Conneaut* is introduced to embrace Girard and Chadakoin stages of Upper Dev. in NW. Pa. and also the underlying Cuba ss. farther east. The wording in Chadwick's ms. is as follows: To these pseudo-Chemung beds, from base of the Dunkirk to base of Cuba ss., I am proposing to apply the substitute and distinctive name *Canadaway group,* and to those from base of Cuba ss.

to base of Wolf Creek (Panama) cgl., in which the fauna has been modified by loss of *Delthyris mesacostalis* and accession of *Camarotoechia(?) duplicata,* the name *Conneaut group.*

G. H. Chadwick, Feb. 28, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 351). [See this entry under *Canadaway group.*]

G. H. Chadwick, Nov., 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 860, 862). *Conneaut group* (or lower Chagrin) named for exposures on Conneaut Creek, in O. and Pa., which crosses the 2 members of the group present on Lake Erie, viz, Girard sh. below and Chadakoin beds (I. C. White's "Chemung") above.

†Conneaut limestone member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, June 9, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61), proposed *Conneaut ls. memb.* to replace *upper Meadville ls.* of early repts on NW. Pa. On p. 136 of same book he substituted *French Creek ls.,* for his proposed Conneaut ls. memb., at request of G. H. Chadwick, who desired to apply "Conneaut" to a Dev. unit in the same region.

†Connecticut shales, sandstone, and conglomerate.

†Connecticut sandstone group.

†Connecticut River sandstone.

Names applied in early Conn. and Mass. repts to sed. part of Newark group as developed in valley of Connecticut River. The interbedded igneous *flows* are treated as part of Newark group, the name now universally applied to these rocks. Has also been called *"Otozoum beds,"* because the rocks contain footprints of *Otozoum moodii,* a sp. of batrachian.

Connellsville sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

F. Platt, 1876 (2d Pa. Geol. Surv. Rept. L) *Connellsville ss.*—Coarse, gray, diagonally bedded ss., 65 ft. thick. [Called also *Ligonier ss.* on pp. 17, 19, 20.] Caps highest hills in Ligonier Valley, SW. Pa., and town of Connellsville, Pa., is built on it. Lies about 25 ft. below Pittsburg ls. and about 40 ft. above Pittsburg (Morgantown?) ss. [The Pittsburgh ss. is a much younger bed than Morgantown or Connellsville sss. The Morgantown is considerably older than the Connellsville, according to generally accepted classifications.]

Connellsville red bed. (In Conemaugh formation.)

Pennsylvanian: Southeastern Ohio, western Pennsylvania, and northern West Virginia.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied name *Connellsville red bed* to beds immediately underlying Summerfield ls. in Muskingum Co., Ohio; to beds lying a short distance below Lower Pittsburgh ss. at Wheeling, W. Va.; to beds overlying Little Clarksburg coal and = Connellsville ss. at Pittsburgh, Pa.; to beds overlying Connellsville ss. and underlying Little Pittsburgh coal in Preston Co., W. Va.; and to a red bed in midst of Connellsville ss. at Latrobe, Pa.

Connellsville member. (In Conemaugh formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa., No. 27, Pittsburgh quad., p. 31, 1929) to include Connellsville ss. and Franklin coal.

Connelly conglomerate. (In Oriskany group.)

Lower Devonian: Southeastern New York.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). *Connelly cgl.*—Pebble beds, 18 to 20 ft. thick, typically exposed on hill above South Rondout (Connelly P. O.) [Ulster Co.] and in creek bank opposite. Included in Oriskanian. Underlies Glenerie ls. and overlies Port Ewen ("Kingston").

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 370), assigned this cgl. to Oriskany.

Connoquenessing sandstone member (of Pottsville formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Connoquenessing ss. (Lower Homewood).*—Consists of (descending): Very massive, hard white ss. 40 to 50 ft.; darkish sandy shales, generally containing iron ore at top and in some places a thin coal below, 40 to 50 ft.; hard, massive, grayish brown ss. 20 to 25 ft. Overlies Sharon shales. Lies 20 to 80 ft. below Upper Homewood [Homewood] ss.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q_2), applied following names in Lawrence Co, Pa. (descending): Lower Mercer iron shales, 5–10 ft.; *Upper Connoquenessing ss.*, 45 ft.; Quakertown coal, 0 to 3 ft.; Quakertown iron shales, 40 ft.; *Lower Connoquenessing ss.*, 25 to 50 ft.; Sharon iron shales, 0 to 25 ft.; Sharon coal, 0 to 3 ft. The *Upper Connoquenessing ss.* forms upper cliff along Connoquenessing Creek btw. its mouth and Slippery Rock, and *Lower Connoquenessing ss.* is frequently seen along bed of Connoquenessing Creek [Lawrence Co., Pa.].

H. M. Chance, 1879 (2d Pa. Geol. Surv. Rept. V, pp. 221–226). *Connoquenessing ss. group.*—Underlies Mercer group and overlies Sharon group in western Pa. Thickness 140–180 ft. Divided by Mr. White into an Upper and a Lower Connoquenessing ss., but it could be readily subdivided into Upper, Middle, and Lower, or even into 4 divisions. As these rocks are very variable in thickness and character, being often nearly or wholly replaced by sh. and sl., they may be called the "*Connoquenessing ss. group.*"

Conococheague limestone.

Cambrian (Upper): Central southern Pennsylvania, western Maryland, and northwestern Virginia.

G. W. Stose, 1908 (Jour. Geol., vol. 16, p. 701). *Conococheague ls.*—Closely banded dark-blue ls., characterized by beds containing thin sandy laminae and quartz grains that weather into hard sh. fragments and thin slabby sss. Base marked by siliceous beds and cgls. of two kinds.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170), gave 1,635 ft. as thickness of Conococheague ls.

Named for Conococheague Creek in Scotland, Franklin Co., Pa. Underlies Beekmantown ls. and overlies Elbrook fm.

Conover slate.

Pre-Cambrian (upper Huronian): Northeastern Wisconsin (Vilas County).

R. C. Allen and L. P. Barrett, 1915 (Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, pp. 123–129). *Conover slates.*—Soft red, gray, or black slates containing seams of ferruginous chert and abundant iron carbonate. Probably continuous eastward with sl.-iron fm. series of Iron River dist., Mich., of which it is regarded as a tongue. Underlie eastern three-fourths of Conover dist.

Conroe sand.

A subsurface sand, 250 ft. thick, in Montgomery Co., Tex. According to A. Deussen and E. W. K. Andrau (A. A. P. G. Bull. vol. 20, No. 5, 1936, p. 540) it lies in upper part of Yegua fm. in Conroe dist. (5 mi. SE. of Conroe, Montgomery Co.), at about horizon of Tuleta sand of Pettus dist. (See F. W. Michaux, Jr., and E. O. Buck, A. A. P. G. Bull., vol. 20, No. 6, pp. 736–779, for description of Conroe oil field.)

Conshohocken clay.

Cretaceous? or Ordovician?: Southeastern Pennsylvania (Montgomery County).

T. C. Hopkins, 1899 (Am. Geol., vol. 23, p. 102; and Sci. n. s., vol. 9, p. 139) and 1900 (Geol. Soc. Am. Bull., vol. 10, pp 480–482; also Pa. State Coll. Ann. Rept. 1899–1900). *Conshohocken clays.*—Tough, plastic, refractory clays, 30 to 60 ft. thick. Rest on blue ls. (in places white and blue) of supposed Trenton age. No fossils except lignite. Occur on hill N. of Conshohocken. Resemble plastic clays of N. J., Long Island, and Marthas Vineyard.

Contention series.

Mesozoic (Lower Cretaceous?) : Southeastern Arizona (Tombstone district).

W. P. Blake, 1902 (Tombstone and its mines). *Contention and Toughnut series, of* Tombstone dist., consists of (descending) shales, blue ls., and qtzite. It overlies, uncon. (?), the Manganiferous or Luck-Sure series of massive, thick-bedded lss. [Derivation of name not stated.]

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Contention sh. series.*—Contains a heavy bed of qtzite, many thin lss. and thin qtzites. Regarded as a single composite memb. Thickness 700 ft. Top div. of Toughnut series. Overlies Blue lime.

F. L. Ransome, 1920 (U. S. G. S. Bull. 710D). Contention sh. series of Church is Mesozoic, probably Comanche (Lower Cret.).

†Contra Costa lake bed.

Pliocene: Western California (San Francisco Bay region).

J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 169). *Contra Costa lake bed.*—Lies chiefly on NE. slope of hills W. of San Pablo Creek, forming bdy btw. Contra Costa and Alameda Counties in that part of its course about 4½ mi. NE. of State University.

Contra Costa County Miocene.

A term applied in earlier literature to the Mio. deposits of Contra Costa Co., Calif., which are now divided into several named fms.

Conway granite.

Late Devonian or late Carboniferous: White Mountains and northwestern New Hampshire.

C. H. Hitchcock, 1874 (Geol. N. H. pt. 1, btw. pp. 508 and 545). *Granite of Conway,* so called since most of town is underlaid by it. Carries much quartz. Is pre-Camb.

C. H. Hitchcock, 1877 (Geol. N. H. pt. 2, many pp.). *Conway granite.*—Contains quartz, feldspar, and mica. Thickness 600 ft. The typical rock known as the "Conway" is best example of a real granite in N. H. Older than Albany granite. [Assigned to pre-Camb. in this and subsequent repts of Hitchcock and others.]

M. Billings, 1928 (Proc. Am. Acad. Arts and Sci., vol. 63, No. 3, map and pp. 67–137). *Conway group (Dev. ?).*—Chiefly biotite granite. Is=Conway granite of Hitchcock. At least 6 distinct phases in North Conway quad., some of which are segregation phases and others distinct intrusives: (1) Red phase (coarse biotite granite); (2) Green phase (relatively coarse hastingsite granite); (3) *Baldface phase* (medium-textured biotite granite low in dark minerals); (4) *Diana phase* (porphyritic biotite granite); (5) *Black Cap phase* (fine-grained pink biotite granite typically exposed on SE. slope of Black Cap, where it is shattered by Conway granite; is of either Conway or pre-Conway age); (6) contact phases.

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., map), assigned *Conway granite* to late Dev. or late Carbf., and to their White Mtn magma series.

Conway schist.

Silurian(?): Western Massachusetts, southeastern Vermont, and southwestern New Hampshire.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Conway schist.*—Rusty, contorted, muscovite schist. Underlies Leyden phyllite and overlies Goshen schist. The Conway and Goshen comprise Calciferous mica schist of Hitchcock.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 183–225). *Conway schist.*—Dark graphitic mica schist, with biotite, garnet, staurolite, zoisite, and many beds of dark impure ls. and sandy qtzite. Thickness 5,000 (?) ft. Probably=Amherst schist to E. Underlies Leyden argillite [in Mass. and Vt.; absent in N. H.] and overlies Goshen schist. [See also B. K. Emerson, U. S. G. S. Bull. 597, 1917, pp. 46–47, and map, in which Amherst schist is assigned to Carbf. and Conway schist to Sil.(?).]

Named for development along the rivers in Conway and Deerfield, Franklin Co., Mass.

Coody sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Coata ss. memb.*—Massive ss., medium to coarse-grained; large pebbles of quartz and chert near base; light to dark brown; fossiliferous. Thickness 40 ft. Basal memb. of Atoka fm. in Muskogee-Porum dist. Separated from overlying Pope Chapel ss. memb. by 150 to 220 ft. of sh. Named for exposure along Coata Creek in secs. 34 and 35, T. 15 N., R. 19 E.

R. H. Dott, 1936 (letter dated June 12). One mi. S. of Muskogee is a stream called *Coody Creek,* named for one of the old families in the area. An oil field has been named for it, and this name is universally applied. The topog. map shows it as "Coata." Since "Coata" is meaningless to anyone living or working in the area, I believe this usage should be corrected to *Coody*.

Cook sand.

A subsurface sand, of Penn. age, in Cook and Engle fields, Shackelford Co., north-central Tex., lying at 1,170 to 1,200 ft. depth.

Cooke granite.

Pre-Cambrian: Central southern Montana (Park County).

T. S. Lovering, 1930 (U. S. G. S. Bull. 811A, p. 17). Medium-grained pink granite, chiefly quartz and pink orthoclase. Cuts Goose Creek granite. Well exposed near Cooke [in SE. corner of Park Co.].

Cook Inlet gravels.

Pleistocene: Central southern Alaska (Cook Inlet region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 174–175). *Cook Inlet gravels.*—Pleist. marine gravels, extending from Cook Inlet along drainage basin of Skwentna River as far as Tordrillo Mtns. Thickness 40 to 100 ft.

Cook Mountain formation. (In Claiborne group.)

Eocene (middle): Southern and eastern Texas and northwestern Louisiana.

W. Kennedy, 1892 (Tex. Geol. Surv. 3rd Ann. Rept., pp. 54–57). *Cook's Mtn series.*—Extensive series of marine beds, prevailingly greensands, but including greensand marls, altered greensand with thin strata of carbonate of iron, indurated altered fossiliferous greensand, green fossiliferous clays, glauconitic sss. and clays, stratified black and gray sandy clays, brown fossiliferous sands, black or yellow clays with limy concretions, and occasionally local deposits of black sand with gyp. crystals. Thickness 390 ft. Underlies Yegua div. and overlies Mount Selman div.

Sparta sand was for many years treated as basal memb. of Cook Mtn fm., but it is now treated as a distinct fm.

Named for Cook Mtn, Houston Co., Tex.

Cook Ranch formation.

Oligocene (middle): Southwestern Montana (Beaverhead County).

A. E. Wood, 1933 (Jour. Mammalogy, vol. 14, No. 2, May 1933, pp. 134–135). A small collection of Middle Olig. fossils [listed] was found by A. E., F. D., and H. E. Wood, and R. Dowden in a butte immediately W. of road opposite (W. of) front entrance to buildings of Cook Sheep Co. Home Ranch, 8.1 mi. by road N. and E. of Dell railroad station, T. 12 S., R. 33 E., secs. 27 and 34. This butte forms W. (right) wall of valley of Sage Creek, in that part of its course which flows S. The fossils were in 3 small pockets, at essentially same strat. level, either just above, or just below, a prominent ss. lens. As these beds are definitely of a different age from those described by Douglass as the Sage Creek beds, a new fm. name is required, and *Cook Ranch* is elsewhere proposed (H. E. Wood, Bull. Am. Mus. Nat. Hist., in press). Sage Creek fauna is middle and upper Eocene, according to determinations by H. E. Wood and others. The Cook Ranch resembles Brule of Big Badlands in composition and erosion forms. Most of exposure is gray clay, but there are intercalated sss., a foot or less thick, resembling the *Metamynodon* sss. Thickness exposed estimated at 125 ft. At top of bluff is a coarse gravel (age undet.) lying horizontally and uncon. above Cook Ranch beds. Similar gravels occur at a considerably lower altitude a short distance to N. [See also H. E. Wood, 2nd, 1934 (Am. Mus. Nat. Hist. Bull., vol. 67, art. 5, pp. 250–255, 277), where practically same description as above is given, and where he stated *Cook Ranch fm.* (Middle Olig [illegible] rests uncon. on *Sage Creek fm.* (Eocene), and is overlain uncon. by [illegible] of upper Olig. (?) or Mio. (?) age.]

Cooks Canyon agglomerate.

Upper Jurassic: Northern California (Monni Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. [illegible]: 81. [See under *Combe ss.*]

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 896, [illegible]). *Cooks Canyon fm.*—At type loc. (ridge btw. Cooks Canyon and Lights Creek) mostly red aggls. containing here and there fossil charcoal of coniferous wood and angular fragments from the mid Upper Jurassic intrusive quartz porphyry. In Forman Ravine and neighborhood it is mostly coarse, water-laid, clastic sediment of volcanic origin, gray to green color, containing here and there fossil charcoal of coniferous wood. Thickness 1,900 ft. at Cooks Canyon, 900 ft. at Forman Ravine. No fossils. Of middle Upper Jurassic age. Underlies Lucky S argillite and overlies Forman argillite.

Cool Creek formation.

Ordovician: Southern Oklahoma.

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 105). The upper part of Simpson group of Okla. includes a widely distributed and clearly distinguishable strat. unit of formational rank, previously neglected. The name *Cool Creek fm.* is applied to this unit. [All of definition. The fm. seems to overlie Tulip Creek fm. and to underlie Criner fm., but he does not say so.]

C. E. Decker, 1933. See *this entry under Simpson fm.*

Above are only recorded uses of this name.

Cooledge chalk.

Upper Cretaceous: Eastern Texas (Leon, Freestone, and Limestone Counties).

J. A. Waters and W. A. Reiter, 1930 (A. A. P. G. Bull., vol. 14, pp. 322–323). The highest chalk in Taylor fm. in wells and outcrops in Leon, Limestone, and Freestone Counties. Well exposed 3 mi. NW. of Cooledge, on main road to Hubbard, Limestone Co., where it consists of white marl. Lies at top of Taylor fm.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, p. 466). *Cooledge chalk* is a higher Taylor chalk than Marlin chalk.

L. W. Stephenson, 1934 (letter dated Feb. 3), stated that this bed is not chalk and that it is merely a part of Neylandville marl, the basal fm. of Navarro group.

Coombs limestone member (of Islesboro formation).

Cambrian (?): Central southern Maine. (Penobscot Bay quadrangle).

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, pp. 2–3). *Coombs ls. memb.*—Chiefly shaly or qtzitic ls., but in three localities it is represented by fairly pure ls. Thickness 7 to 100 ft. Top memb. of Islesboro fm. Underlies Battie qtzite. Is assigned to Camb(?). Named for exposures near Coombs Point, on NE. shore of Islesboro, Waldo Co.

On 1933 geol. map of Maine, by A. Keith, the Islesboro fm. is included in the Camb. and Ord. block.

Coon Creek tongue (of Ripley formation).

Upper Cretaceous: Western Tennessee, southern Kentucky (?), southern Illinois (?), and northern Mississippi (?).

B. Wade, 1917 (Johns Hopkins Univ. Circ., n. s., No. 3, Whole No. 293, pp. 74, 101). *Coon Creek horizon or memb.*—Variable sediments, ranging from local lenses of impure ls. through very fossiliferous marls to glauconitic sands and gypsiferous clays poor in fossils. The sediments containing Coon Creek fauna are dark bluish green and gray clayey sands at base of Ripley fm., a thickness of more than 30 ft. of which is exposed along banks of Coon Creek, McNairy Co., Tenn. Overlies Selma chalk and is separated from overlying McNairy sand memb. of Ripley by 100 ft. of sparsely fossiliferous ferruginous clay.

B. Wade, 1926 (U. S. G. S. P. P. 137), defined *Coon Creek tongue of Ripley fm.* as underlying McNairy sand memb. and overlying Selma fm., and included in it at top the 100 ft. of ferruginous clay which was originally excluded from it. This is present approved definition of Coon Creek.

Cooney quartz latite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). Alternating brick-red quartz latite flows and beds of tuff, with a few lenses of red, purple, and, more rarely, green ss. Thickness 700 to 1,400 ft. Older than Pacific quartz latite and younger than Whitewater Creek rhyolite.

Named for exposures in canyon of Mineral Creek near old mining camp of Cooney.

Coon Mountain sandstone member (of Pueblo formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 417). *Coon Mtn bed.*—Ss. and cgl., 0 to 75 ft. thick. Memb. of Cisco div. Underlies Stockwether bed and overlies Camp Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, footnote on p. 172 and charts). Detailed mapping of W. part of Brown Co. has shown that Coon Mtn ss. bed (No. 11 of Drake's section) is largely Cret. sands overlapping several Penn. beds. Named for Coon Mtn, Brown Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), recognized Coon Mtn ss. of Drake as underlying Stockwether ls. and overlying Camp Creek sh.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), ignored Coon Mtn ss., and redefined Camp Creek sh. memb. to include all beds in McCulloch Co. beneath Stockwether ls. and above Saddle Creek sh.

C. O. Nickell (Univ. Tex. Bull. soon to be published). *Coon Mtn ss. memb.* of Pueblo fm. underlies Stockwether ls. and overlies Camp Creek sh. memb. [This is adopted definition of U. S. Geol. Survey.]

Cooper marl.

Eocene (Jackson): Southern South Carolina (west of Santee River).

M. Tuomey, 1848 (Agr. Surv. S. C. 1st Rept., pp. 162–169, 190, 211). *Ashley and Cooper beds, the newest Eocene beds of the State.*—The marl of these beds is characterized by its dark gray color and granular texture, while the remains of fishes and Mammalia give its fossil remains a peculiar character, and leave no doubt of position assigned it, at the top of the Eocene series. These, together with the Santee beds, must amount, at least, to a thickness of 600 or 700 ft. Overlie Coralline marl (Eocene) and uncon. underlie Plio. [Mio.]. Exposed along Ashley and Cooper Rivers, S. C. [In text of above rept the beds along Ashley River are called *Ashley marl* and *Ashley beds* (pp. 162, 164), and the beds along Cooper River are called *Ashley and Cooper beds* and (p. 139) *Cooper River marls.* Page 165 states that many of the fossils of the Ashley are found on the Cooper.]

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2), defined Cooper marl as underlying †Ashley marl.

T. W. Vaughan, 1912 (U. S. G. S. P. P. 71, p. 739). The beds called *Ashley-Cooper marl* by Sloan are referable to Jackson group.

G. S. Rogers, 1914 (U. S. G. S. Bull. 580, pp. 186–187). *Cooper marl* consists of over 100 ft. of grayish-green marl. The lower part (Cooper marl of Sloan) is greenish drab, somewhat plastic when wet, but lighter-colored and fairly hard when dry. The upper part (Ashley marl of Sloan) is dull olive green and semi-plastic when wet and drab when dry. Uncon. underlies Edisto marl and conformably overlies Barnwell sand.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Small phosphatic lumps are locally abundant in Cooper marl. The extent of phosphatization the rock has undergone was used by Sloan as principal criterion in distinguishing btw. his Ashley marl and his Cooper marl, the greater amount of phosphate being characteristic of his Ashley. His Ashley marl included in part Hawthorn fm. (lower Mio.).

Cooper limestone.

Middle Devonian (Onondaga): Central Missouri.

G. C. Swallow, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pt. 1, pp. 108, 196). *Cooper marble.*—Upper part bluish drab compact ls. containing cavities filled with yellowish green substance which gives rock a fine mottled appearance; lower part bluish compact beds containing numerous small crystals of calc spar. Thickness 20 to 60 ft. in Cooper Co. No fossils, but on lithology and strat. position referred to Onondaga.

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Cooper ls.* is discon. overlain by Callaway ls. Contemp. with Grand Tower ls., but deposited in separate sea, which came from Arctic ocean and did not connect with Grand Tower sea.

E. B. Branson, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 267–276). *Cooper ls.* occurs in patches. Is contemp. with Mineola ls. Rests uncon. on Jefferson City dol. in most places, but in a few places on St. Peter ss.

D. K. Greger, 1920 (Am. Jour. Sci., 4th, vol. 50, pp. 20–24). *Cooper ls.* of Moniteau, Cooper, and Pettis Counties contains at base a sandy cgl. 2 to 14 ft. thick. Fossils found are chiefly new and undescribed sp. In all exposures studied in Marion Co. the Cooper is uncon. overlain by Saverton sh.

E. B. Branson, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 35). The Cooper and Mineola seas were in part contemp., but Cooper sea withdrew before close of Mineola time, and Mineola spread so as to overlap part of Cooper.

The 1922 geol map of Mo. by Mo. Geol. Surv. placed *Cooper* above Grand Tower and below Beauvais ss.

E. B. Branson, 1923 (Mo. Geol. and Nat. Hist. Surv. vol. 17, 2d ser., pp 8-24). *Cooper ls.* is contemp. with Mineola ls., but deposited in separate sea or bay, and faunas, although related, are distinct.

Named for exposures in Cooper Co.

Cooper sand.

Drillers' term for sand in Bradford oil sand group (Upper Dev.) of NW. Pa. The name has also been applied to a Miss. sand in Wayne Co., Ky.

†Cooper-Ashley beds.
†Cooper River beds.
†Cooper River marl.

Eocene (upper): Southern South Carolina.

Terms used in early repts on geology of S. C. Now replaced by *Cooper marl* (of Jackson age), which is exposed along Ashley and Cooper Rivers.

Coopers Lake limestone member.

Middle Devonian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 43 and passim). *Coopers Lake ls. memb.*—Underlies Lone Butte ls. and overlies Glen Creek sh., all members of Jefferson ls. Thickest (508 ft.) in Dearborn section and thinnest (225 ft.) in Wall Creek-Juliet Creek Ridge section. Probably most striking feature is great number of organisms it contains. One of best exposures is in SW. part of White Ridge, where it consists of (descending): (1) Thick-bedded, massive, chocolate to tan, fine-grained ls. containing numerous Jefferson fossils, 132 ft.; (2) thick-bedded to shaly tan-gray ls. carrying rich Jefferson fauna, 157 ft.; (3) massive, friable, brown, thick-bedded, aren. ls. which in some beds becomes essentially a calc. ss., interbedded with thin bands of buff sh., 48 ft. Named for fact it forms a large part of Jefferson ls. over NE. part of Coopers Lake quad., especially in Powell Co., Mont. Type loc. on SE. slope of SW. peak of White Ridge, in SW¼ sec. 16, T. 22 N., R. 11 W.

Coos group.

Paleozoic (?): Northern New Hampshire (Coos County).

C. H. Hitchcock, 1870 (2d Ann. Rept. Geol. and Min. N. H., map and p. 34). *Coos group.*—Under this appellation are included the argill. schists, whetstone mica schists, grits, etc. of northern Coos Co., as explored by J. H. Huntington, the similar and associated rocks in Barford, Hereford, Auckland, etc., P. Q., and Essex Co., Vt., the qtzites, staurolite rocks, micaceous schists, hornblende schists, perhaps green, protogene and other rocks W. of White Mtn series and E. of Conn. River, along whole of western N. H., but excluding the calciferous mica schist. The unity of the series, its age, thickness, and relations to Quebec group, calciferous mica schist, and the clay slates remain to be defined. It appears clearly to overlie White Mtn series uncon. [Mapped over large part of Coos Co. and southwestward across W. part of N. H. to Mass. line. On 1932 geol. map of U. S. these rocks are mapped as pre-Camb.]

C. H. Hitchcock, 1870 (Am. Nat., vol. 4, p. 568). *Coos group.*—Qtzite and ls. with staurolite slates and schists. Characterized by presence of silicates of alumina destitute of alkalies; minerals are staurolite, andalusite, and kyanite. Is Sil. or older. Thickness 10,000 ft. in White Mtns. Younger than White Mtn series.

C. H. Hitchcock, 1871 (Geol. Surv. N. H. Rept. for 1870). Sections of *Coos group* measured at Hanover, Lyme, Orford, and Lisbon give following composite section: Hornblende schist, 2,300 ft.; gneiss; clay slates, 1,500 ft.; green schists, 4,200 ft.; clay slates, 2,400 to 4,500 ft.; staurolite schist or mica schist, 1,500 to 2,100 ft.; granitic gneiss, 1,700 ft.; qtzite and ls., 800 to 2,200 ft.; gneiss. Uncon. overlies White Mtn series. Named for northern part of Coos Co.

C. H. Hitchcock, 1873 (Boston Soc. Nat. Hist. Proc., vol. 15, pp. 304–309). *Coos group.*—Embraces "calciferous mica schist" of eastern Vt., the hard mica schist of Essex Co., Vt., the softer slates of northern Coos Co., N. H., together with the various slates and schists holding staurolite as far as Mass. and adjoining Conn. River, and various patches of andalusite sl. on Mount Washington, Mount Monadnock, Mount Kearsarge, in Warner, Rochester, etc. Older than the clay slates and younger than Merrimac group of qtzites and fine-grained mica schist. [All included under "mostly Cambrian (?)."]

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, pp. 508–545). *Coos group* of N. H. consists of qtzite, mica schist, slates full of staurolite and garnet. Overlies clay slates (Camb.) and Merrimack group, and is older than lss. of Helderberg age.

C. H. Hitchcock, 1874 (Am. Jour. Sci., 3d, vol. 7, pp. 468–476). *Coos group.*—Qtzites, mica schist, argill. schist, clay slates, possibly phyllite, calc. mica schist, hornblende rocks, and various sss. Thickness 10,000 ft. The ls. and gneiss heretofore included in this group must be eliminated; they underlie Coos group. The group may embrace "calciferous mica schist" of Vt. The original definition of this group expressely excluded latter rock. The Coos group has been erroneously confounded with White Mtn series in Swiftwater-Littleton area. The White Mtn series may be pre-Camb. Coos group can not be older than Camb. and Dana thinks it is all of Helderberg age. T. Sterry Hunt included both Coos group and White Mtn series in his Montalban, and originally he included them in his Terranovan.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 348–408), divided rocks of Conn. Valley into: Calciferous mica schist, *Coos slates and schists, Coos qtzite,* Camb. clay sl. and older rocks, and stated: I am sometimes disposed to maintain that the two [calciferous mica schist and Coos slates and schists] were synchronous. Also: The Coos qtzite is grouped with Coos slates on account of their proximity and intimate association. On pp. 658 to 675 he divided the Paleozoic rocks of N. H. into: Upper Helderberg (Vermont), 200 ft.; Lower Helderberg, 500 ft.; calciferous mica schist, 4,800 ft.; *Coos group,* consisting of staurolite sl., 3,000 ft.; mica schist, often stauroliferous, 3,300 ft.; and qtzite, 1,000 ft., overlying Camb. slates of Conn. Valley.

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 178–179, pls. 16, 17). Calciferous mica schist and *Coos group* are essentially same series, and underlie Niagara group and overlie Kearsarge group.

C. H. Hitchcock, 1896 (Jour. Geol., vol. 4, pp. 44–62), divided Paleozoic rocks of northern N. H. into: Argillite (perhaps Dev.); Lower Helderberg; Niagara lss., slates, and sss.; calciferous mica-schist with Trenton to Utica graptolites; *Coos group* (several thousand ft. of slates, staurolite mica schists, hornblende schists, mica schists, and basal qtzite); and Camb. slates.

C. H. Hitchcock, 1905 (Geol. of Littleton, N. H.), assigned *Coos group* (mica schist and qtzite) of Littleton area to Sil., and placed these rocks below his Swiftwater schist series (Sil.) and above his hydro-mica schist group (Lower Sil. or Camb.).

C. H. Hitchcock, 1912 (Vt. State Geol. 8th Ann. Rept., pl. 46, pp. 139–145), assigned the rocks that he called *Coos group* in Hanover and Lebanon region, N. H., to Dev., and stated that they are=Bernardston fm.

M. Billings, 1934 (Sci., vol. 79, No. 2038, pp. 55–56), divided the rocks of Littleton and Ammonoosuc region, N. H., into: Littleton fm. (Lower Dev.); Fitch fm. (middle Sil.); Clough cgl. (lower ? Sil.); and Partridge sl., Ammonoosuc volcanics, and Albee qtzite, all of Upper Ord. (?) age.

The age and strat. position of the typical Coos group of Hitchcock (which he stated is in N. part of Coos Co.) appears to be undet. On 1932 geol. map of U. S. these typical rocks are mapped as pre-Camb., but Billings (1934) suggests the possibility that there are no pre-Camb. rocks in N. H.

M. Billings, 1935 (letter dated Aug. 27). *Coos qtzite* of Hitchcock is our *Clough cgl.*

Coos quartzite.

See 1877 entry under *Coos group* and 1935 entry under *Clough cgl.*

Coos conglomerate.

Pliocene: Southwestern Oregon (Coos Bay region).

W. H. Dall, 1897 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 336–343). *Coos cgl.*—A singular fm. at Fossil Point, Coos Bay, Oreg. Consists of Mio. fossils, small water-worn chert pebbles, sand, and a few fossil forms still living in vicinity, cemented into hard cgl. Rests on eroded surface of Empire fm. Only fragments of original deposit remain, the rest having been eroded, though originally some 10 ft. thick. The Mio. fossils are from Empire beds; source of chert unknown. The only part of the cgl. that may be regarded as strictly contemp. with its deposition comprises the rather small proportion of Pleist. fossils and sand which is intermixed with the rehandled older material.

J. S. Diller, 1901 (U. S. G. S. Coos Bay folio, No. 73). *Coos cgl.*, named by Dr. Dall, consists of 30 ft. of consolidated cgl., cross-bedded, generally known as "Fossil Rock," on account of large number of conspicuous fossil shells it contains, some of which represent living species, but larger part were derived by erosion directly from underlying fossiliferous Empire beds. Dall says probably Pleist. Exposed extent covers about 1 acre.

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., vol. 3, No. 1, pp. 6–7), assigned *Coos cgl.* to upper Plio., and stated that it contains a mixed fauna of living, Plio., and Mio. fossils. H. V. Howe, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 147), also assigned the cgl. to Plio.

H. V. Howe, 1922 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 14, No. 3, pp. 86–91). *Coos cgl.* is an integral part of Plio. series of South Slough syncline. That it represents a time break is evident from its composition, but that this break is not great enough to bridge remainder of Plio. is seen both by its fauna and strat. position. The fauna listed by Dall contains only 3 sp. not contained in beds below. To Merriam and Lawson should go credit of first correctly determining Plio. age of Coos cgl. It is not Pleist., as assigned by Dall. Uncon. overlies Empire fm. and uncon. underlies massive unfossiliferous sss. of Pleist. age.

W. D. Smith, 1924 (Univ. Oreg. Commonwealth Rev., vol. 6, No. 4, p. 73), assigned Coos cgl. to Plio., as did L. G. Hertlein and C. H. Crickmay, 1924 (Am. Phil. Soc. Proc., vol. 64, No. 2).

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 264–270). *Coos cgl.* appears to be without doubt Plio. [Gives résumé of literature.]

†Coosa shale.

Upper and Middle Cambrian: Western Georgia and eastern Alabama.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 148, map, and structure section opp. p. 162). *Coosa shales* on p. 148, *Flatwoods shales* on map legend, and *Coosa Valley or Flatwoods shaly lss.* on structure section.—Shaly lss. which give rise to the "Flatwoods." Underlie Montevallo shales.

Owing to faulting in dist., for many years the relations of †Coosa sh. to Conasauga sh. and Rome fm. were misunderstood. The †Coosa sh. is now, however, known to be same as Conasauga sh. and to overlie Rome fm., now known to be same as †Montevallo shale. *Coosa sh.* is now replaced by *Conasauga sh.*, better established name. Underlies Knox dol., or Brierfield dol., or Ketona dol., and overlies Rome fm.

Named for Coosa Valley, btw. Rome, Ga., and Gadsden, Ala.

†Coosa Valley.

Upper, Middle, and Lower Cambrian: Eastern Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). *Coosa Valley* (*Knox*).—Sh. above; ss. below. Underlies Knox dol. and overlies Ladiga (Potsdam) ss. [Only definition is on map legend. See also under †*Coosa sh.*]

Probably includes Conasauga (†Coosa) sh., Rome (†Montevallo) fm. and Shady (†Beaver) ls.

Named for Coosa Valley.

Copake limestone.

Lower Ordovician (Beekmantown): Southeastern New York (Dutchess County).

J. D. Dana, 1879 (Am. Jour. Sci., 3d, vol. 1, pp. 376–383), described the ls. of Copake, in two places on p. 382 called it *Copake ls.*, and stated that "the Wappinger Valley ls. is not the only southern extension of the Copake ls."

E. B. Knopf, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 429–458). *Copake ls.*—Mainly mottled gray and white ls. carrying *Ophileta* sp., with some white ls. and a gray aren. dol. that weathers to a deep sandy surface, which is riddled with *Scolithus* borings and contains a large *Ophileta*. Thickness 0 to 400 ft. Overlies, probably conformably, Rochdale ls., of Beekmantown age. Ulrich considers Copake fauna to be=upper part (divisions D and E) of Beekmantown of Lake Champlain dist. Named for extensive development in neighborhood of Copake, N. Y. Overlain by lss. of early Trenton and Black River age. [This fm. was included in Rochdale group of Dwight, 1887.]

Copan formation.

Pennsylvanian: Northeastern and central Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 29). *Copan memb.*—Shales, heavy-bedded sss., and ls. lentils, 250 ft. thick, forming middle memb. of Wann fm. Underlies Stanton ls. memb. and overlies Hogshooter ls. memb. Includes Avant and Dewey ls. lentils.

A. E. Fath, 1925 (U. S. G. S. Bull. 759, pp. 13, 16). *Copan fm.* (*restricted*).—The Copan as defined by Ohern in 1910 included all beds btw. base of Stanton ls. above and top of Hogshooter ls. below. The Stanton ls. thins out a few mi. S. of Kans. line, and the next logical fm. bdy is base of Tiger Creek ss., which persists from Nowata quad. through Bristow quad. The adoption of that bdy line, however, throws into Bristow fm. some rocks included in Copan fm. as originally defined by Ohern, but this slight restriction of Copan is believed to be justified, as it will make the Copan a map unit over a large area and prevent the introduction of a new name for rocks=major part of Ohern's Copan. The Hogshooter ls. is thought by writer to be same as "Layton lime" of Bristow quad. Thickness of Copan fm. in Bristow quad. 600–700 ft.; divided into (descending): (1) Upper sh., 150 ft.; (2) upper ss. and interbedded sh., including a lenticular ls. and Dewey ls. memb., 85–250 ft.; (3) middle sh. 100 to 125 ft.; (4) lower ss. with interbedded sh., 100 to 150 ft.; (5) lower sh., 100 to 200 ft.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 76). *Copan fm.*—Named by D. W. Ohern, 1910. Consists of ss. and gray sh., and in its upper part includes Dewey [Avant] ls. memb. Thickness 600 to 700 ft. Includes lower part of Ochelata fm., the underlying Dewey ls., and the Nellie Bly fm. Named for Copan, Washington Co.

Copeland moraine.

Pleistocene (Wisconsin stage): Northern Colorado.

W. T. Lee, 1917 (The geol. story of Rocky Mtn Nat. Park, p. 82).

Coplay limestone.

Lower Ordovician: Southeastern Pennsylvania (Lehigh Valley district).

E. T. Wherry, 1909 (Sci., n. s., vol. 30, p. 416). *Coplay ls.* (*Beekmantown*).—Dark gray, shaly, with mottled crystalline layers and many fossils; 1,500 ft. thick. Uncon. underlies Nisky fm. and overlies Allentown ls.

Probably named for occurrence at or near Coplay, Lehigh Co.

Btw. 1910 and 1927 this name was used in several Pa. Geol. Survey and other repts. In 1928 (letter dated March 26) B. L. Miller stated: "The names Nisky, Nazareth, and Coplay were tentatively used in this region by us some years ago. We finally dropped the term *Coplay* when we were convinced that this limestone was the same as the Beekmantown. For Nisky and Nazareth combined, we have accepted the term *Jacksonburg;* the Nisky representing the high calcareous layers at the base and the Nazareth the upper and major portion of the formation. We are not now separating the Jacksonburg, inasmuch as in many localities the distinction between the lower and upper portions cannot be definitely recognized."

Copley meta-andesite.

Devonian or older: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Copley meta-andesite.*—Includes a great mass of lava made up of many separate volcanic flows of considerable variety and sheets of tuffs more or less distinctly bedded but generally so compressed as to develop slaty cleavage. Is generally pale green on weathered surface, but darker green and compact on fresh, somewhat shaly fracture. Thickness 1,000± ft. Is overlain by Kennett ls. (Middle Dev.), and is oldest fm. exposed in Redding quad. In places Bragdom fm. rests on it. Named for occurrence in vicinity of Copley.

Copperas Creek. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Copperas Creek sh. and ss.* to that part of McLeansboro fm. in Fulton Co. lying beneath his Rolls Ford sh. and above his Brereton ls. Thickness and derivation of name not stated, but probably is Copperas Creek, NE. of Canton, Fulton Co., which flows across Edington quad.

Copper Cliff arkose.

Pre-Cambrian: Ontario.

A. P. Coleman, 1913 (12th Int. Geol. Cong. Guidebook 7, p. 13).

Copper Creek beds.

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Douglas County).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, pp. 42, 43, 44, 67). *Copper Creek beds.*—White and pink fine-grained ss., with magnetite and mica grains and a few ripple marks. Thickness 75 to 100 ft. Included in Orienta ss., which see for overlying and underlying beds. Named for exposures on Copper Creek, Douglas Co.

Copper Harbor group.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 690). *Copper Harbor cgls.*—The cgls. N. of Eagle River group were grouped together by Douglass Houghton, who considered the Lake Shore traps as intrusive dikes. When these were understood to be interbedded flows the cgl. was divided into the Great and Outer, respectively, below and above the Lake Shore traps. Hubbard's studies around Copper Harbor have shown that there are at least three heavy cgls. It is not probable that the lines btw. the Great Cgl., Lake Shore Trap, and Outer Cgl. can be drawn at all consistently. Together they cover the period of decadent vulcanism, and it is not at all likely that the flows from these last expiring throes filled the whole basin, but more likely they occur irregularly in the cgl. series. It therefore seems fitting to give a local term to whole assemblage, treating the Lake Shore traps as a lentil or lentils in the same. Underlies Nonesuch sh. and overlies Eagle River group. Thickness 1,740 to 7,500 ft.

Named for exposures around Copper Harbor, Keweenaw Co.

Coppermine series.

Age (?): Canada.

A. Sandberg, 1914 (In Lands Forlorn, by G. M. Douglas, p. 280, N. Y.).

Coppermine River series.

Pre-Cambrian: Arctic Canada.

J. J. O'Neill, 1924 (Canadian Arctic Expedition, 1913–18, Rept., vol. 11, pt. A, pp. 23, 57).

†Copper Mountain porphyry.

Eocene: Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48), applied *Copper Mountain porphyry* to the mass of Elk Mtn porphyry on Copper Mtn.

Copper Mountain greenstone or amphibolite schist.

Age (?): Alaska (Prince William Sound region).

F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 414–415). *Copper Mtn greenstone or amphibolite schist.*—Constitutes almost entire mass of Copper Mtn. Is totally different from either Orca or Valdez series, and seems to be much older.

Copper Queen intrusion.

Age (?): Mexico.

J. E. Spurr and G. H. Garrey, 1908 (Econ. Geol., vol. 3, p. 694).

Copper Queen limestone.

Upper Cambrian: Southeastern Arizona (Bisbee-Tucson region).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 469–471, 480–482). *Copper Queen ls.*—White-gray granular and algal ls. with *Idahoia, Irvingella,* and *Maladia;* cliff-forming in lower part; at top Parting qtzite memb., 8 ft. thick; at base thinner bedded gray ls. with *Billingsella coloradoensis.* Thickness 81 ft. Overlies Abrigo fm. [here restricted to middle part of Abrigo ls. of previous repts] and underlies Martin ls. (Dev.). Is youngest Camb. fm. in Bisbee dist., and is Upper Camb. Named for Copper Queen mining area of Bisbee, where it is good horizon. Correlated with Rincon ls. (new) of Whetstone Mtns, and with Peppersauce Canyon ss. of Santa Catalina Mtns. [See last sentence under *Peppersauce Canyon ss.*]

Copper Ridge dolomite.

Upper Cambrian: Eastern Tennessee, southwestern Virginia, and Alabama.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 548, 635–636, pl. 27). In Knox Co., Tenn., where the fm. was first studied and from which it was named, the Knox consists mainly of a characteristically and profusely cherty middle div. to which I am applying the name *Copper Ridge chert.* This is flanked above and beneath by much thinner and very sparingly cherty members, for which no names have been proposed. [Page 548.] [In chart, pl. 27, the subdivisions of the Knox in Knoxville trough are called *Upper Knox, Copper Ridge,* and *Lower Knox.*] Occasionally, as in River Ridge, 3 mi. NW. of Morristown, Tenn., the Copper Ridge chert rests on the Nolichucky. More commonly the Knox begins with an older div., 300 to 700 ft. thick, while in vicinity of Montevallo, Ala., three still older fms. [Bibb, Ketona, and Brierfield], aggregating something near 2,500 ft. of dol., intervene btw. base of typical Knox and top of the Conasauga. [Page 628.] *Basal div. of Knox dol. (s. st.).*—Rather generally in eastern Tenn. and SW. Va. grayish dol. and ls., practically free of chert, constitute lower part of Knox proper. So far as known, this lower div., which I formerly thought to represent the Ketona but now believe to be a younger and quite distinct fm., does not occur on W. side of Murphrees Valley, Ala., nor has it been recognized in Cahaba Valley. Even in Tenn. basin it varies considerably in thickness, possibly being absent altogether locally, as in River Ridge N. of Norristown, while in other places it seems to exceed 600 or 700 ft. The latter figure is attained btw. Clinchport and Speers Ferry, Va. The fm., which for present remains unnamed, was recognized at Knoxville; hence it is a part of typical Knox dol. of Safford. In Tenn. and SW. Va., where the Brierfield, Ketona, and Potosi fms. have not been detected, the Knox rests on upper Camb. fms., either the Nolichucky or the Conasauga sh. When present the lower memb. of the Knox is readily distinguished by its more calc. and much thicker beds. Most of its beds are mag., but few, if any, are dol. Many contain so little magnesia that they may justly be called ls. The latter are fine-grained and not infrequently contain more or less shaly layers. Chert is very sparingly developed, not only in the unweathered rock but also in the residual-clays of the surface. The practical absence or scarcity of chert and the presence of nearly pure and often shaly ls. distinguishes this lower memb. of the Knox from the profusely cherty main mass of the fm. which overlies it and for which the name *Copper Ridge chert* is proposed. [Page 635.] *Copper Ridge chert (new).*—Of the three divisions commonly recognizable in the Knox, the highly cherty ridge-making middle div. is most persistent and by far the greatest. This middle div., for which term *Copper Ridge chert* is here proposed, is readily distinguished from the lower and upper div. by the hard white or gray chert which is developed by segregation and liberated under the slow process of subaerial decomposition of the dolomitic matrix. The resistant character and finally great abundance of this chert almost invariably gives rise to broad and long ridges, among which that known as Copper

Ridge, in NE. Tenn., is the excellent example chosen to supply the name and type of the memb. or fm. As a fm. the Copper Ridge chert is best displayed, and probably also best developed, in middle and western parts of Appalachian Valley in Tenn. and Ala. Here its average thickness is nearly 2,000 ft., and it rarely falls under 1,200 ft., except along the Rome barrier, where, as btw. Birmingham and Gadsden, it was greatly reduced locally by pre-Ord. erosion. Max. thickness observed is in Chestnut Ridge S. of Sneedville, Tenn. Here, deducting some 600 to 700 ft. apparently repeated by faulting, an estimate based on dip and width of outcrop indicated a thickness of 2,800± ft. Both the lower and upper members of the Knox are relatively thin in Chestnut Ridge, the former being 360 ft., the latter only 200± ft. [Pages 635–636.]

In 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 549, 638, 639, and pl. 27) Ulrich introduced *Chepultepec chert fm.* for rocks in Murphrees Valley, Ala., which he then considered to be younger than his so-called *Upper Knox* of Tenn. But in 1915 (U. S. Nat. Mus. Bull. 92, vol. 1, p. vii, and vol. 2, pls. 1 and 2) R. S. Bassler, who collaborated with Ulrich, redefined Chepultepec dol. as resting on Copper Ridge chert and as synonymous with so-called *Upper Knox*, but he still defined Copper Ridge chert as resting on *Lower Knox*, which he showed to be younger than Bibb dol. In 1924, however (Tenn. Dept. Ed., Div. Geol., Bull. 28, p. 34, and Bull. 31, p. 16), Ulrich redefined the Copper Ridge so as to include all of the pre-Chepultepec part of Knox dol. in Knoxville trough and W. part of Valley in Tenn., or the *Lower Knox* or the *Knox proper* of his previous publications, while to the still older rocks in Athens trough of Tenn. (which according to his charts are absent in Knoxville trough, and which it is understood he regards as=in whole or part to the Bibb, Ketona, and Brierfield dolomites of Ala.) he applied the new name *Greenville dol.* The present definition of Copper Ridge dol. therefore applies to all beds btw. Chepultepec dol. above and Bibb dol. below, with both of which fms. it is conformable.

C. Butts has extended the name as far N. as Newcastle, Craig Co., Va.

Named for Copper Ridge, NE. of Knoxville, Tenn., which is composed of this fm.

Copper River silts and gravels.

Pleistocene: Alaska (Copper River region).

F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 410–412). *Copper River silts and gravels,* 0 to 1,000± ft. thick, form bluffs and terraces all along Copper River above Taral and on tributaries of that part of river.

Copps group.

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Gogebic Range).

R. C. Allen and L. P. Barrett, 1915 (Jour. Geol., vol. 23, p. 697). *Copps group.*—Great thickness of graywacke sl., highly ferruginous in W. half of its area (E. part of Gogebic Range) and associated in certain horizons, especially the lower ones, with considerable nonclastic chert and here and there jasper. At base a true basal cgl. Uncon. overlies Presque Isle granite and Animikie, and uncon. underlies Keweenawan series. [R. C. Allen, Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, 1915, gave thickness of *Copps fm.* as 2,300 ft., and stated that it was named for Copps mine.]

Coqui limestone.

Age (?): Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 29).

Coquihalla series.

Tertiary: British Columbia.

C. E. Cairnes, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, p. 99).

†Coral limestone.

Descriptive term applied in early Ala. repts to Glendon ls.

†Coralline limestone.

A descriptive term applied in early N. Y. repts to ls. later named *Cobleskill ls.*, also to ls. later named *Wilbur ls. memb. of Salina fm.*, and to a ls. in Niagara group.

Coralline Falls limestone.

Devonian: Kentucky.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pp. 95–97). *Gray Coralline Falls lss.* include the Devonian lss. underlying the Dev. black Lingula shales in Ky.

Coralville limestone.

Upper Devonian: Central eastern Iowa.

C. Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, p. 149) and 1913 (Iowa Acad. Sci. Proc., vol. 20, pp. 205, 206). *Coralville terrane.*—Lss. included in upper part of Cedar Valley ls., consisting of (descending) 2 ft. of gray, fine-grained ls. containing *Idiostroma;* 6 ft. of gray earthy ls; 10 ft. of gray, massively bedded ls. containing *Acervularia* and sponges; and 8 ft. of bluish, thin-bedded, shaly, unfossiliferous ls. Underlies Lucas ls. and overlies Rapid ls. Included in Senecan.

See 1935 entry under *Cedar Valley ls.*, of which it is a memb. In this 1935 rept the underlying beds are named *Littleton memb.* (of Cedar Valley ls.).

Named for Coralville, Johnson Co. Typically exposed in quarries 1± mi. NE. of Coralville.

Corbin conglomerate lentil.

Pennsylvanian: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 3). *Corbin cgl. lentil.*—Coarse pink ss. or cgl., 90 ft. thick, forming topmost memb. of Lee fm. in Richmond quad. Overlain by Irvine fm. (Neocene?).

Later studies by D. White show that top of Lee fm. properly belongs at top of Rockcastle cgl. memb., and that Corbin cgl. lentil and the shales separating the Corbin and Rockcastle properly belong to horizon of Sewell fm. and are probably to be correlated with Sharon cgl. memb. of Pottsville fm.

Named for Corbin, Whitley Co.

Corbin granite.

Pre-Cambrian: Northwestern Georgia (Cartersville district).

C. W. Hayes, 1901 (Am. Inst. Min. Engrs. Trans., vol. 30, pp. 406–410). *Corbin granite.*—Chiefly massive, coarse-grained rock, with large porphyritic crystals of microcline in large groundmass of plagioclase feldspar, muscovite mica, and blue quartz. Some portions of rock have undergone considerable alteration, being converted into augen gneiss. Probably Archean.

Named for development around Corbin, Bartow Co.

Corbin City limestone.

Pennsylvanian: Eastern Kansas (Montgomery County) and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). It is proposed to use *Drum ls.* as a fm. name, and to recognize the light-blue [nonoolitic] lower bed as *Cement City memb.* and the upper bed of oolitic ls. as *Corbin City memb.* The Corbin City (named for a locality just S. of Cherryvale [Montgomery Co.]), is very local in development, but appears to be represented in Kansas City section by a thin bed of granular fossiliferous ls. separated by a few inches of sh. from main body of Cement City ls.

N. D. Newell, 1935. See 1935 entry under *Cement City ls.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 106–107). *Corbin City ls. memb. of Drum ls.* rests discon. on Cement City ls. memb. in southern Kans. To SW., W., and NW. of Coffeyville it is represented by ls. cgl. Thickness of the memb. ranges from feather edge to 50± ft. Near Kansas City, Mo., a ls. 1 ft. or less thick, separated from Cement City ls. by a few inches of fossiliferous sh., is thought to represent Corbin City memb.

Cordell member.

Silurian (Niagaran) : Northern Michigan.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 23, 37). G. M. Ehlers (unpublished ms.) has divided Manistique fm., of Niagaran age, into the *Cordell* and *Schoolcraft members*. [In table on p. 23 the Cordell is placed above the Schoolcraft. No description nor thicknesses of the members given.]

Corder "sand".

Drillers' name for a subsurface ls. in New Providence fm. (Miss.) of eastern Ky.

Cordilleran formation.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 224).

Cordilleran system.

Name proposed by G. H. Ashley (Eng. and Min. Jour.-Press, vol. 115, No. 25, pp. 1106–1108, 1923) "to designate the time and the rocks from the end of Comanchian to beginning of Eogene." Corresponds to Upper Cret. series of U. S. Geol. Survey.

Cordova sands and gravels.

Pleistocene: British Columbia.

C. H. Clapp, 1913 (Canada Geol. Surv. Mem. 36, p. 110).

Corey limestone.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6).

Coriba formation.

Tertiary (Miocene) : Central northern Oregon and southern Washington.

E. T. Hodge, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 991, footnote). Basalt in this paper refers to Columbia River basalt fm. (*Coriba fm.*), of Mio. age.

E. T. Hodge, 1933 (Northwest Sci., vol. 7, No. 2, p. 35). *Coriba fm.*, "a mnemonic expression proposed for the cumbersome name Columbia River Basalt fm."

Coriba erosion surface.

Late Pliocene: Central northern Oregon.

E. T. Hodge, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 157). [See under *Rhododendron fm.*]

Corinth sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties) and northern West Virginia.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 574). *Corinth ss.*—Underlies Irondale ls. and overlies Thornton clay; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 57–58, pl. 6). *Corinth ss.* occurs a short distance below Brush Creek coal at many places. Named for exposures at E. end of cut on B. & O. R. R. at Corinth, W. Va.

Corliss conglomerate.

Lower Ordovician (Beekmantown): Northwestern Vermont (Franklin County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 377). *Corliss cgl.*—Rests uncon. on Highgate sl. (Upper Camb.) and forms a series of lenticular deposits btw. the Highgate and the overlying Georgia sl. (of Beekmantown age) at intervals from Canada to their end, 5 mi. S. of St. Albans. Consists mainly of pebbles and boulders of various lss., marbles, and dolomites, mostly ls. The thin slabs of fossiliferous Upper Camb. ls. derived from Mill River cgl. (which underlies Highgate sl. and is of Upper Camb. age) are numerous and conspicuous in the Corliss, which also contains fossiliferous pebbles of Lower Camb. age and others of Williston (Upper Camb.) age. In Burlington region the Corliss overlies Williston ls. Strongly resembles Mill River cgl., but lies higher in section. Assigned to early Beekmantown. In original description of this region by writer the Mill River and Corliss cgls. were included in what writer called "Swanton cgl." [now abandoned]. Later detailed mapping and study showed that there are 2 cgls., and that the Mill River (the older) was placed by thrust faulting S. of Highgate Center in position of the Corliss, on top of Highgate sl., thus causing the confusion. Exposed at Corliss Ledge, 5 mi. NE. of St. Albans. [Not on map, but probably in St. Albans quad.]

Cornell member.

Upper Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 10, 57–62), removed *Spirifer* (*Reticularia*) *laevis* zone from top of Sherburne memb. of the Portage and named it *Cornell memb.*, from outcrops at foot of Ithaca falls, near mouth of Fall Creek gorge, at Ithaca. Type loc. on S. side of gorge, not far from Cornell Univ. campus. Overlain by Ithaca memb. of the Portage. He made the following statements: As writer interprets Kindle's lists of fossils, there are 25 definitely recognized species in Cornell memb. of Ithaca region. Of these, 12 are not found in underlying Sherburne but do occur in overlying Ithaca memb.; 8 occur in both Sherburne and Ithaca; 1 sp. appears to be confined to Cornell memb.; and 4 sp. seem doubtful or inadequate. Except in deference to historical precedent there is no particular reason for retaining the Cornell in the Sherburne. In fact, Kindle's figures and a number of other considerations argue for its transfer to the Ithaca. Although very thin, it is a tangible and fairly widespread zone (of flags and shaly flags, some barren and some fossiliferous). [Further along, on p. 59, he stated *Spirifer laevis* bed is definitely known from but few localities and upper limit of Sherburne memb. has been drawn arbitrarily. On p. 63 he stated that he had tentatively included the *Spirifer laevis* bed at Barber Point in Ithaca memb., and that *Spirifer laevis* has been reported from beds below his Cornell memb.]

Cornfield Harbor clays.

Pleistocene: Eastern Maryland.

W. H. Dall, 1897 (55th Cong., 2d sess., H. Doc. 5), also 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 336 and table opp. p. 334). *Cornfield Harbor clays.*—These beds on Cornfield Harbor, near Federalsburg [Caroline Co.], Md., contain interesting marine fauna. Have generally been referred to Pleist. but may prove to be upper Plio.

G. B. Shattuck, W. B. Clark et al., 1906 (Md. Geol. Surv. Pliocene and Pleistocene vol.), assigned the beds at Cornfield Harbor (Wailes Bluff) to Pleistocene Talbot fm. The Pleist. age of the fossils contained in these beds was also verified by W. C. Mansfield in 1928 (U. S. G. S. P. P. 150, pp. 130, 136–140).

Cornfield Springs formation.

Middle Cambrian and later (?): Southeastern California (San Bernardino County).

J. C. Hazzard and J. F. Mason, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 2, pp. 229–240). *Cornfield Springs fm.*—Medium to coarse-grained sandy dol. with interbedded fine-grained shales; Middle Camb. fossils; thickness 50 ft. To this fm. there is tentatively added 700 ft. of overlying nonfossiliferous beds consisting of alternating dark smoky-gray and light-gray to light-buff dolomites, with some sandy beds. Top limit of fm. as thus tentatively defined is the base of 50 to 100 ft. of somewhat massive, nearly black dol. that is tentatively correlated with Ironside dol., the basal memb. of Sultan ls. (Dev.) of Goodsprings quad., Nev. Overlies Bonanza King fm. (Middle Camb.). Named for good exposures E. of Cornfield Springs, Providence Mtns.

Cornfields series.

Tertiary or Pleistocene: Northeastern Arizona. See 1932 entry under *Bidahochi fm.*

†Corniferous ls.

†Corniferous fm.

†Corniferous group.

Descriptive terms applied in early geologic repts on Eastern States to a ls. or dol. of Dev. age. In N. Y. applied to Onondaga ls.; in Ind. and Ky. to Sellersburg and Jeffersonville lss., also to Jeffersonville ls. alone; in

Ohio to Delaware and Columbus lss.; in Mich. to Dundee ls. The name was derived from the balls of hornstone contained in the rock.

†Corniferous period.

A term used by some early geologists to include Onondaga ls., Schoharie grit, and Esopus grit, being the same sense in which "Upper Helderberg" was commonly applied in early repts.

Corning Creek zone. (In Negaunee formation.)

Pre-Cambrian (middle Huronian): Northern Michigan (Marquette County).

J. L. Adler, 1935 (Jour. Geol., vol. 43, No. 2, pp. 113-132). *Corning Creek zone of Negaunee fm.*—Wavy-bedded (characteristic feature), dense to granular, gray to pink chert with interbedded red and blue hematite and locally some martite. Contains some straight-bedded and concretionary parts. Generally thicker-bedded than the other zones of Negaunee fm. Thickness 470 ft. Grades into underlying North Lake zone. Overlain by dolerite ("diorite") sill, or, where that is missing, uncon. overlain by Goodrich qtzite. In places Jasper Knob zone of the Negaunee may rest directly on Corning Creek zone. [Type loc. not stated, but his map shows Corning Creek and West Corning Creek.]

Cornish sandstone member.

Permian: Central southern Oklahoma (Carter and Jefferson Counties).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 18). *Cornish ss. memb.*—One of highest members of Cisco (?) [Clear Fork ?] red beds of Carter Co. Consists of a white, massive, cross-bedded ss. which forms a scarp NE. along SW. side of Healdton field, and underlies gentle dip slopes extending from the scarp to SW. corner of Co., interrupted by valleys and ravines which have cut to lower strata. Immediately underlies city of Ringling and village of Cornish, just over the line in Jefferson Co. Assigned to Perm.

Cornishville limestone member (of Perryville formation).

Middle Ordovician: Central Kentucky.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17, pp. 23, 31, 33, 36, 132, 133). *Cornishville ls.*—Fossiliferous coarse-grained ls. underlying Greendale memb. of Catheys fm., overlying Perryville memb., and forming top memb. of Lexington ls.

A. F. Foerste, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 377-385). *Cornishville bed* [of central Ky.] consists of 5 to 6 ft. of granular ls. containing a typical Trenton fauna. Top memb. of Perryville fm. Overlies Salvisa horizon of Perryville.

See further explanation under *Perryville fm.*

Named for Cornishville, Mercer Co.

†Cornitiferous limerock.

A descriptive term used in early N. Y. repts. According to L. Vanuxem (N. Y. Geol. Surv. 3d Rept., 1839), the "cornitiferous rock" of Amos Eaton (1824), who probably originated the term, is middle part of Onondaga ls. Named for presence of balls of hornstone.

Cornmeal sand.

Drillers' term for a sand in Pottsville fm. (Penn.) of Butler Co., Pa., lying lower than Homewood ss. memb. (See J. P. Lesley, 1878, 2d Pa. Geol. Surv. Rept. Q. pp. 303-305.)

†Cornwall slates.

Upper Cambrian: Southeastern Pennsylvania (Lebanon County).

J. P. Lesley and E. V. d'Invilliers, 1886 (2d Pa. Geol. Surv. Ann. Rept. 1885, p. 526). *Cornwall slates.*—Lime slates, occupying an area about 4 mi. long and ⅔ mi. wide at Cornwall [Lebanon Co.]. Hold important relations to Cornwall ore mass. Age and position in Paleozoic have been much debated. Uncertain whether they underlie or overlie Lebanon Valley ls. fm., but probably overlie it. Exposed in R. R. cut at Cornwall Station.

According to G. W. Stose (personal communication Dec. 1936) the rock exposed in R. R. cut at Cornwall Station is metamorphosed Conococheague ls.

†Cornwall limestones.

Devonian and Silurian: Southeastern New York.

E. C. Eckel, 1902 (N. Y. State Geol. 20th Ann. Rept., p. r148). A series of thin beds of ls. overlies Longwood shales at several points in Orange Co. Beds carry fossils which correlate them with Lower Helderberg and Waterlime farther W. The term "Cornwall lss." is not here proposed as a fm. name, but is used merely as a convenient designation for the series till further field work shall have decided the extent to which subdivision can be carried.

Range in age from Decker ls. to New Scotland ls., according to Hartnagel (Hdb. 19, 1912).

Name apparently taken from some one of the places in Orange Co. that bear the name Cornwall.

Cornwall shale.

Middle Devonian: Southeastern New York and northern New Jersey.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 107, pp. 39–54). *Cornwall sh.* replaces *Monroe shales* of Darton, because that name is preoccupied in Mich. Consists of 200 ft. of dark-gray slaty shales; in places pronounced slaty cleavage is shown. Of Hamilton age. Rests on Oriskany qtzite in N. Y., the relations of which to Newfoundland grit (which underlies the Monroe shales in N. J.) is not yet established. [This underlying fm. is now called *Kanouse ss.*, in both N. Y. and N. J.] Named for occurrence at Cornwall, Orange Co., N. Y. Eckel's use of *Cornwall lss.* not considered valid.

In N. J. the name "Monroe shales" was replaced by *Pequanac sh.* in 1908 (U. S. G. S. Franklin Furnace folio, No. 161), but *Pequanac* was discarded in 1914 (Raritan folio, No. 191), in favor of the older name *Cornwall sh.*

Cornwall formation.

Jurassic: British Columbia.

C. H. Crickmay, 1930 (Calif. Univ., Dept. Geol. Sci. Bull., vol. 19, No. 2, p. 33).

Coronach shale.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 296, 300). *Coronach sh.*—Black sh. and interbedded ls.; 600 ft. thick. Type locality on road a mi. S. of Disaster Point. Named for Coronach Creek, across the Athabaska. Naples fauna. Overlies Boule dolomitic ls. and underlies Fiddle ls.

Coronado quartzite.

Upper Cambrian: Central eastern Arizona (Greenlee County).

W. Lindgren, 1905 (U. S. G. S. P. P. 43, p. 59). *Coronado qtzite.*—Chiefly heavy beds of brown, pink, or maroon qtzitic sss., usually characteristically jointed. Lowest memb., which is missing in many sections, is qtzite cgl. up to 50 ft. thick. Thickness of fm. 100 to 250± ft. Rests uncon. on granite basement. Conformably underlies Longfellow lss. Several areas of this fm. crown summit and westerly slope of Coronado Mtn, N. W. of Morenci, Greenlee Co.

Upper Camb. fossils have been found 25 ft. below top.

Corozal limestone.

Cretaceous (?): Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 23).

†Corral sandstone. (In Cheyenne sandstone.)

Lower Cretaceous (Comanche): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 366). *Corral ss.*—Ss., 30 to 50 ft. thick; lower part white; upper part often beautifully variegated with bright reds mingled with yellow, purple, and brown. Basal part of Cheyenne ss. Overlain by Elk Creek beds (upper part of Cheyenne).

Named for the Natural corral, a short box canyon on Lanphier claim, in SE. corner of Kiowa Co., long known under that name by the settlers.

This name was discarded by U. S. Geol. Survey in 1921, the bed being simply a local facies of Cheyenne ss. and without strat. value; and the name seems to have been discarded by Kans. Geol. Survey. (See last entry under *Cheyenne ss.*)

Corral formation.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289), applied the name "(Hector) Corral" to, apparently, all pre-Camb. rocks of Alberta, consisting of (descending order) slates 4,600 ft., qtzites 1,200 ft., and cgls. 100 ft.; which are, apparently, the same rocks that were called "Hector fm." in earlier repts.

Derivation of name not stated.

Corral Creek formation.

Pre-Cambrian: Alberta and British Columbia.

C. D. Walcott, 1910 (Smithsonian Misc. Coll., vol. 53, No. 7, p. 428).

Corral Hollow shales.

Jurassic (?): Western California (Alameda County).

C. F. Tolman, Jr., 1915 (Nature and science on Pacific coast, p. 45, San Francisco, Elder & Co.). *Corral Hollow shales.*—A subdivision of Franciscan series. Contain massive beds of crumpled and folded cherts, and, especially in vicinity of serpentine intrusions, lawsonite, chlorite, and glaucophane-bearing schists that seem to be peculiar to Franciscan series. Older than Oakridge ss., and underlain by dense blue ss. of the Franciscan.

†Corrigan formation.

Lower Devonian: Western Maryland.

A. W. Grabau, 1910 (Mich. Geol. and Biol. Surv. Pub. 2, geol. ser. 1, pp. 231, 234). *Corrigan fm.*—The succeeding "Manlius" exposed at Keyser, W. Va. (110 ft.), has recently been made subject of a careful and detailed faunal study by Dr. Poole Maynard of Johns Hopkins Univ. The series has been named [unpublished] *Corrigan fm.*, and in outline presented before Geol. Soc. Am. at Cambridge meeting, 1909–10, it was shown that the fauna was a unit and of Upper Siluric (Cobleskill-Manlius) type. A comparison of the fossils with those of Upper Monroe fm. of Mich. has convinced both Mr. Maynard and author of the relationship of the faunas, some of the characteristic Mich. species, such as * * *, being present in the Corrigan. Thus the Corrigan of Md. (Manlius of Schuchert, Helderbergian of O'Harra's Potomac section) must be regarded as representative of the Upper Monroe.

C. K. Swartz et al, 1913 (Md. Geol. Surv. Lower Dev. vol., p. 97). In 1908–9 [T. P.] Maynard (Dissert. presented for degree Ph. D. in Johns Hopkins Univ. 1909) studied the beds termed *Manlius fm.* by Schuchert, comprising most of [lower or] *Chonetes jerseyensis* zone of Keyser memb. of Helderberg fm. He named them [unpublished ms.] *Corrigan fm.* and correlated them with Cobleskill, Rondout, and Manlius fms. of N. Y., and Decker Ferry, Rondout, and Manlius fms. of N. J., believing these units are undiff. in Md.

The rocks at Corriganville, Md., are now assigned to Helderberg fm. (Lower Dev.).

Named for occurrence at Corriganville, Allegany Co.

Corrigan formation.

Miocene? (lower Miocene?): Eastern Texas (Polk County).

E. T. Dumble, 1911 (Tex. Acad. Sci., vol. 11, p. 51). The *Corrigan beds*, as Kennedy called [where?] the sands which overlie the Frio as now determined, are therefore later than any previously recognized Eocene deposits. Referred to Jackson by Prof. Harris.

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 465). *Corrigan sands.*—Coarse "rice" sands and sss. at base, overlain by finer sands and by yellowish green clay and claystones with plant remains. The clays and claystones carry pyritic nodules and streaks of lignite and weather yellow to cream color. Local unconformities btw.

sands and clays. Occasionally cross bedded. Mapped [p. 448]. Assigned to Olig. *Named for town in Polk Co.* "It is here proposed to use Kennedy's older term *Corrigan sands* for the group of deposits lying between the known Jackson and the Fleming, which while forming the only mappable unit, probably includes beds of later age than the Catahoula of Veatch, which name should be retained for that portion of the Corrigan to which it strictly applies."

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869). *Corrigan fm.*—We will use Kennedy's older name *Corrigan* for entire group of non-marine deposits which lie btw. the Jackson and the Fleming and together constitute our only mappable unit. They are supposedly for most part of upper Olig. age.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 715, 717), replaced *Corrigan* in narrow sense by *Chita sand memb.*, and *Corrigan* in broad sense by *Catahoula fm.* (See under *Chita sand memb.*)

Named for Corrigan, Polk Co.

Corry sandstone.

Mississippian: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 92–94). *Corry ss.*—Yellowish white or buff gray ss., compact, fine-grained, at one or two places some pebbles. Thickness 20 ft. Quarried about 1 mi. S. of Corry, Erie Co. Top fm. of Oil Lake group. Overlies Cussewago Upper Shales and underlies Orangeville sh. Corry and Cussewago probably = Berea ss. of Ohio.

H. P. Cushing (1888) and E. Orton (1893) correlated Corry alone with Berea ss.; J. J. Stevenson (1903) correlated Cussewago and Corry with Berea.

G. H. Girty, 1905 (Wash. Acad. Sci. Proc., vol. 7, p. 6). Berea grit of Ohio is White's Cussewago ss. together with probably the Cussewago flags and Corry ss. It initiates the Miss.

C. Butts, 1910 (U. S. G. S. Warren folio, No. 172), used *Berea ss.* in this quad., and stated: Berea ss. has been traced eastward from Ohio by Girty and found to be same as "Corry" ss. at Corry, Pa. Identifying it by its abundant and highly characteristic fauna he was able to follow it still farther E. into this quad.

C. S. Prosser, 1912 (Ohio Geol. Surv. Bull. 15, p. 395), correlated Cussewago and Corry with Berea.

W. A. VerWiebe, 1916 (Am. Jour. Sci., 4th, vol. 42, p. 46), and 1917 (vol. 43 of same journal, pp. 301–318). Berea fm. is represented in Pa. by Corry ss. and Cussewago sh. and ss. of I. C. White, and should be considered base of Miss.

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 455–464), correlated Berea ss. with Corry ss. only, but used Corry ss. in Pa.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 49–52, table opp. p. 61, pp. 122–128 and later pp.). Strat. position is substantial proof of equivalence of Corry ss. and some part of Berea ss. The detailed sections of Prosser's voluminous rept establish that fact. Also, the Corry fauna occurs in upper Berea of Ohio. [p. 49.] The Corry is of remarkable lithic similarity to Berea ss. of Williamsford P. O., Ohio. [p. 51.] The lower Berea seems to be identical with Cussewago ss. (and sh.?). [p. 52.] "Berea stage" is a new stage created to include Corry ss. only. [p. 52.] There is reasonable certainty Corry is eastward continuation of upper Berea ss. of Ohio. [p. 52.] [Fauna listed on pp. 123–124.] [In table opp. p. 61 he used *Berea stage* to include *Corry ss. memb.* only. On p. 122 he correlated Berea ss. of Ohio with Cussewago ss. and Corry ss. of Pa., and stated that Corry is "correlated with Upper true Berea ss. of Ohio." Fossils listed. On p. 126: "The relation of the Corry ss. to the true Berea grit of Ohio is as yet obscure. It would appear that the upper Berea ss. of Ohio is continuous with the Corry ss."]

K. E. Caster, 1935 (A. A. P. G. Bull., vol. 19, No. 6, p. 913). Corry ss. (possibly of Berea age) occurs in upper part of Oil Lake series in western Pa. The Corry fauna is of a characteristic Kinderhook aspect.

The U. S. Geol. Survey classifies Berea ss. as of Kinderhook age, and for many years discarded Corry, regarding it as a synonym of Berea; but in view of doubt that now exists as to exact equivalency of the two, *Corry* has been restored to good standing.

Corryville shale member (of McMillan formation).

Upper Ordovician: Southeastern Indiana and southwestern Ohio.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, pp. 75, 83). *Corryville or Chiloporella nicholsoni beds.*—About 60 ft. of thin ls. and yellowish, also blue, sh. interbedded. Overlain by Mount Auburn or *Platystrophia lynx* beds and underlain by Bellevue or *Monticulipora molesta* beds.

Middle memb. of McMillan fm.

Named for Corryville, near Cincinnati.

Corsicana marl. (In Navarro group.)

Upper Cretaceous (Gulf series): Northeastern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 342–343). *Corsicana beds.*—Fine, brown, sandy marl, with occasional bands of hard calc. ss. in upper part. Included in upper part of Navarro fm. Underlies Kemp clay bed of Navarro fm. Extends from Sulphur River, Delta Co., to the Brazos. [According to L. W. Stephenson (Univ. Tex. Bull. 3232, p. 516, 1933) this unit probably included (ascending) *Exogyra cancellata* zone (Neylandville marl of Stephenson), Nacatoch sand, and the chalky marl (*Corsicana marl restricted* of Stephenson).]

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 488, 516). *Corsicana fm. (restricted).*—Dr. L. W. Stephenson suggests that the basal Navarro clays (*Exogyra cancellata* zone) below the Nacatoch be called *Neylandville fm.*, and that if the name *Kemp beds* of Hill is retained, as in this paper, for the portion of the Navarro above Nacatoch sand, the lower part (chalky marl) of the Kemp be separated as the *Corsicana fm. (restricted)*. It appears from Hill's description that he included in his "Corsicana beds" the Navarro clays below the Nacatoch, the Nacatoch, and a portion at least of the chalky marl. Dr. Stephenson says (personal communication, March 6, 1933): [See Stephenson 1933 entry.] Although not entirely satisfactory, it is considered best here to *restrict and redefine "Corsicana"* of Hill to include all beds in Navarro Co. section above top of Nacatoch sand and below base of upper clay or "chalk marl" of Stephenson. The beds (of Navarro age) btw. top of the Taylor and base of the Nacatoch are here called *Neylandville fm.*, as suggested by L. W. Stephenson.

L. W. Stephenson, 1933 (Univ. Tex. Bull. 3232, p. 516). *Neylandville* would be appropriate name for unit I have heretofore called *Exogyra cancellata* zone, which includes all beds btw. Taylor marl below and Nacatoch sand above. Exposures occur in washes in a field just S. of fair grounds at SE. edge of Greenville, and in ditches along Dixon road for a mi. or more SE. of fair grounds. Type exposures occur along Bankhead highway btw. Liberty School and Neylandville, 3 to 6 mi. in air line NE. of Greenville, and in first cut of Texas Midland Ry. W. of Neylandville Station. *Kemp fm.* as used by Bur. Econ. Geol. in this rept. includes the units which I have called chalky marl memb. and upper clay memb. Since the chalky marl memb. underlies city of Corsicana, it would be appropriate to *restrict Corsicana* to it. As Hill originally used "Corsicana" it probably included *Exogyra cancellata* zone, Nacatoch sand, and the chalky marl. The pit of Corsicana Brick Co. 2 mi. S. of court house at Corsicana, might appropriately be regarded as type loc. If *Kemp* is retained it should be restricted to the upper clay memb., but exposures of this are rare in vicinity of Kemp, and desirability of applying the name to this unit has not been fully considered. The names *Neylandville* and *Corsicana restricted* have not yet been formally adopted by U. S. Geol. Survey. [They were later adopted.]

See U. S. G. S. 1937 geol. map of Tex., where Navarro group is divided into (ascending) Neylandville marl, Nacatoch sand, *Corsicana marl (restricted)*, and Kemp clay (restricted). This is present approved classification.

Corsicana sand.

The lower subsurface oil sand in wells of Corsicana oil field of northern Tex. It is in Taylor marl, and lies 500 to 800 ft. below Corsicana beds of Hill, which outcrop at Corsicana and are now considered same as Nacatoch sand memb. of Navarro fm.

Corson diabase.

Pre-Cambrian: Northwestern Iowa and southeastern South Dakota (?).

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 187; Sci., n. s., vol. 40, p. 144). *Corson terrane.*—Diabase included in top of Keweenawan series.

Probably named for Corson, Minnehaha Co., S. Dak.

Cortlandt series.

Age undetermined: Eastern New York (Westchester County).

J. D. Dana, 1880 (Am. Jour. Sci., 3d, vol. 20, pp. 194–220); also see 1881 (same jour., vol. 22, pp. 103–119). Hornblendic, augitic, and associated rocks cover a large part of Twp of Cortlandt (the NW. of Westchester Co.) btw. Croton River on S. and parallel of Peekskill on N., an area of about 25 sq. mi. They differ widely from the ordinary rocks of Westchester Co., and may well be designated *Cortlandt series.* In fact, a series so remarkable in constitution, so diversified in kinds, and so full of geological interest is seldom found together within so small an area anywhere on the globe. [Lists varieties.] They are not independent igneous rocks erupted from great depth, but are of metamorphic origin.

G. H. Williams, 1888 (Am. Jour. Sci., 3d, vol. 35, pp. 438–448, and vol. 36, pp. 254–269). The area occupied by *"Cortlandt series"* is mainly composed of norite; also includes gabbro, diorite, and mica diorite. It is bordered on S. mainly by mica schists, on W. mainly by lss., and on N. by gneisses.

G. H. Williams, 1888 (Johns Hopkins Univ. Circ., vol. 7, No. 65, pp. 63–65). *"Cortlandt series"* consists of diverse eruptive rocks, which, although very ancient, are little altered.

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, p. 377). *Cortlandt series* assigned to Lower Siluric [Ord.].

C. P. Berkey, 1908 (Sci., n. s., vol. 28, p. 575). *Cortlandt series* includes a wide range of granitoid medium to basic types of igneous rocks. It seems certain they represent a case of magmatic differentiation that includes not only the Cortlandt series as outlined by Dana and Williams but also two or three occurrences of typical granite.

G. S. Rogers, 1911 (N. Y. Acad. Sci. Annals, vol. 21, pp. 11–20). *Cortlandt series,* a small but remarkably complete igneous complex of granite, syenite, sodalite syenite, diorite, gabbro, norite, biotite norite, hyporite, quartz norite, etc. Surrounded on every side by Manhattan schist. Is a very complex and intricate mass. Unquestionably younger than Manhattan schist and Inwood ls., which it intrudes. Must be post-Ord. [Manhattan schist and Inwood ls. are now classified by U. S. Geol. Survey and other geologists as pre-Camb., but they were formerly regarded as Ord.] It is practically certain it is not post-Permian. In writer's opinion it is probably late Paleozoic.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 24). The *Cortlandt series* includes a group of gabbroic and dioritic rocks found just S. of Peekskill, in town of Cortlandt. It covers area of some 20 sq. mi., and is regarded as the latest intrusives in SE. N. Y. excepting Palisade diabase, of Postpaleozoic age.

J. F. Kemp, 1912 (Int. Geol. Cong. Comptes rendus, 11th sess., Stockholm, p. 701). *Cortlandt series* assigned to Ord.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226). *Cortlandt series of intrusives* cuts Manhattan schist. Its age is not known but it probably is not pre-Camb. Is tentatively classified as later than Hudson River-Wappinger-Poughquag series of sl., ls., and qtzite of Cambro-Ord. age. The rocks of Westchester Co. freest from metamorphism are the members of Cortlandt series. Age of Manhattan schist, Inwood ls., and Lowerre qtzite, is uncertain.

Corwin formation.

Cretaceous: Northwestern Alaska (Cape Lisburne region).

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 244). *Corwin series.*—Medium to heavy-bedded impure, gray and brown ss. and arkose, with sh., shaly sl., and coal beds. Occurs on coast near Wainwright Inlet, and extends SW. 180 mi. to near Cape Lisburne, where it plays important part in geology of that region. Provisionally assigned to Jura-Cret.

Named for Corwin Bluff, about 30 mi. E. of Cape Lisburne.

†Coryphodon beds.

A paleontologic name applied in some early repts to Wasatch fm. (lower Eo.) of Rocky Mtn region. According to H. F. Osborn (U. S. G. S. Mon. 55, 1929, pp. 58, 59) this genus occurs throughout the beds now assigned to Wasatch fm. by U. S. Geol. Survey, and is not recorded from overlying and underlying fms.

Cosden sand.

A subsurface sand, of Penn. age, in Okmulgee dist., central eastern Okla., lying lower than Oswego lime, higher than Bartlesville sand, and reported to correlate with Boggy sh. The name has also been applied to a sand in Fayette ss. (of Eocene Jackson age) of Pettus area, Bee Co., SE. Tex.

Cosmos sand.

A subsurface sand, about 60 ft. thick, forming basal bed of Kootenai fm. (Lower Cret.) in Border-Red Coulee oil field of NW. Mont. and SW. Alberta. In E. part of field the Cosmos sand is split into two parts by 10 to 15 ft. of gray-green pyritic siltstone, and the upper tongue, which is 5 to 15 ft. thick, is locally called *Vanalta sand*. The lower part of the Cosmos sand is characterized by presence of thin local lenses of gray-green and dark-gray ss. and an abundance of mud-pellet cgl. In places the basal bed is cgl. The sand may consist chiefly of black chert. Named for Cosmos-Iowa No. 1 well, by which it was first penetrated.

Cottage Grove sandstone.

Pennsylvanian: Central and southern Kansas and northern Oklahoma.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). In central and southern Kans. the Chanute includes a persistent bed of ss. (*Cottage Grove*), and just beneath the ss. is Thayer coal. These beds persist into northern Okla. and are of value in correlation of adjacent lss.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 49). For upper ss. mass of Chanute sh. the term *Cottage Grove ss.* is here applied, from Twp in Allen Co., Kans. It overlies Thayer coal. Is generally soft, light-buff, cross-bedded or even-bedded. Thickness 1 to 30 ft. [R. C. Moore, 1936, says 50 ft. in southern Kans.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Cotter dolomite.

Lower Ordovician (Beekmantown): Northern Arkansas and southern Missouri.

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Cotter dol.*—Chiefly two kinds of dol.—a fine-grained, argill., earthy textured, relatively soft, white to buff or gray variety known as "cotton rock," and a more massive medium-grained gray variety that weathers hackly on the surface and becomes dark on exposure. Contains some chert and a little interbedded saccharoidal ss. and green sh. Thickness 500+ ft. Uncon. underlies Powell ls. Base not exposed in these quads, but in Mo., and farther E. in Ark., where erosion has cut through it, the Jefferson City ls. underlies it. Named by E. O. Ulrich from exposures at Cotter, Baxter Co., Ark. In 1911 (Geol. Soc. Am. Bull., vol. 22) was called *Jefferson City* by Ulrich, but in 1912 he determined that Jefferson City at type loc. is older than the dol. here named *Cotter*.

Cottonwood limestone. (In Council Grove group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 112–114). Ls. No. 13 of section along Neosho River from Indian Territory to White City, Kans., is famous *Cottonwood Falls ls.*, quarried near Cottonwood Falls, where it consists of two layers, the upper one 2½ ft. thick and the lower one 3 ft. thick. Underlain and overlain by 30 ft. of dark sandy sh.

The abbreviated form *Cottonwood ls.* is well established in the literature. The fm. is overlain by Florena sh. memb. of Garrison fm. and underlain by Eskridge sh.

See also under *Beattie fm.*

Named for Cottonwood Falls, Chase Co., Kans.

†Cottonwood formation. (In Council Grove group.)

Permian: Eastern Kansas.

C. S. Prosser, 1894 (Geol. Soc. Am. Bull., vol. 6, pp. 37–41). *Cottonwood fm.* proposed to include Manhattan stone or Cottonwood ls. and overlying Cottonwood sh.

Includes Cottonwood ls. and Florena sh. memb. of Garrison fm.

Named for Cottonwood Valley, Chase and Lyon Counties.

†Cottonwood shales. (In Council Grove group.)

Permian: Eastern Kansas.

C. S. Prosser, 1894 (Geol. Soc. Am. Bull., vol. 6, pp. 38–39). *Cottonwood shales.*—Yellow fossiliferous shales, 10 ft. thick, forming upper part of Cottonwood fm. in Cottonwood Valley and at Manhattan and vicinity. Overlies Manhattan stone or Cottonwood ls.

Conflicts with Cottonwood ls. Replaced by *Florena sh. memb.*

Cottonwood beds.

Miocene: Central northern Oregon (John Day region).

W. D. Matthew, 1900 (Am. Mus. Nat. Hist. Bull., vol. 12, p. 23), gave (in table) a column headed "John Day R., Oreg., Wortman, 1880," under which appears *Cottonwood beds (Protolabis)*, shown as older than Loup Fork of Llano Estacado, Tex., and as younger than John Day.

J. C. Merriam, 1901 (Jour. Geol., vol. 9, p. 72), in a description of rocks of John Day Basin used *Cottonwood (Loup Fork) fm.*, nearly 1,000 ft. thick, uncon. underlying Rattlesnake fm. and overlying Columbia [River] lava.

J. C. Merriam, 1901 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9), replaced *Cottonwood beds* (preoccupied) with *Mascall fm.*, and stated that at Rattlesnake Creek, near Cottonwood, the Mascall is not less than 800 to 1,000 ft. thick.

Cottonwood white layer.

Name applied by W. D. Matthew and W. Granger (Am. Mus. Nat. Hist. Mem., vol. 9, 1909, p. 295) to a bed in their horizon B of Bridger fm. in Bridger Basin. (See under *Lone Tree white layer* for their subdivisions of Bridger fm.) H. F. Osborn (U. S. G. S. Bull. 361, p. 51, 1909) placed this bed in basal part of div. C of Bridger fm.

Cottonwood rhyolite.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Very glassy spherulitic lava flows. Thickness 600± ft. Occurs about headwaters of Cottonwood Canyon.

Cottonwood schists and gneisses.

A name that has been rather loosely applied to the pre-Camb. schists and gneisses of Cottonwood Creek region, central Wasatch Mtns, Utah.

†Cottonwood granite.

See under *†Little Cottonwood granite.*

Cottonwood Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 382). *Cottonwood Creek bed.*—Chiefly nearly white friable ss., 300 ft. thick; in places part of bed consists of massive, moderately hard strata. Memb. of Strawn div. Underlies Hanna Valley bed and overlies Spring Creek bed.

Named for Cottonwood Creek, San Saba Co.

Cottonwood Draw banded layers.

Name applied by W. Granger (Am. Mus. Nat. Hist. Bull., vol. 28, 1910, pp. 244, etc.) to basal part of Wind River fm. along Cottonwood Creek, near Lost Cabin, NE. corner of Fremont Co., Wyo.

†Cottonwood Falls limestone.

Permian: Eastern Kansas.

See *Cottonwood ls.*

†Couchiching.

Same as †Coutchiching.

Coudersport member (of Cattaraugus formation).

Upper Devonian or Mississippian: Central northern Pennsylvania (Potter, Tioga, and probably McKean Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 581). *Coudersport memb. of Cattaraugus fm.*—Heavy green memb., 10–20 ft. thick, about 100 ft. above base of Cattaraugus fm. Useful key bed. Persistent in adjacent parts of Potter, Tioga, and probably McKean Counties, and perhaps occurs in Cameron, Clinton, Lycoming, and Sullivan Counties. Closely resembles Oswayo, but is more massive and less cross bedded. What has been called *Oswayo* in northern Potter and Tioga Counties is probably the green Coudersport memb. of Cattaraugus fm. Named for Coudersport, Potter Co., where it occurs in quarries along W. side of town. Assigned to Upper Dev.

Cougar formation.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 136).

Cougarian series.

A term introduced by C. [R.] Keyes to cover rocks of Cordilleran region interpreted by him as having been formed during the upper Huronian epoch. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

†Coulter's Ferry sands.

Upper Cretaceous: Northeastern Mississippi (Monroe County).

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 66, 67, 73). *Coulter's Ferry sands.*—Grayish yellow, stratified, noneffervescent sand, 120 ft. thick at Coulter's Ferry. Not infrequently small lenticular masses and thin layers of gray laminated clay occur in the sand. In lower portion of the bed occur large round concretions, 3 to 4 ft. in diam., of calc., nonfossiliferous ss., usually vary hard, sometimes soft. Underlies Rotten ls. [Selma chalk] and overlies dark-colored, bluish, laminated clay.

Replaced by Coffee sand, the better established name.

Named for exposures at Coulter's Ferry, on Old Town Creek (near its confluence with the Tombigbee), sec. 34, T. 10, R. 7 E., Monroe Co.

Council Grove group.

Permian: Eastern Kansas, northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 709). *Council Grove stage.*—It is perhaps a more satisfactory classification to regard base of Perm. as marked by lower limit of Wreford ls., and writer is inclined to accept this as div. line, as indicated by Dr. Frech. If this be done the writer would class the two fms. succeeding Eskridge shales (Cottonwood ls. and Garrison) together to form a stage, for which he would propose the name *Council Grove.* The upper part of stage is well shown in bluffs of Neosho River and its tributaries in vicinity of this city, while Cottonwood ls. and overlying Florena shales may be found in Neosho Valley about 6 mi. below Council Grove. Underlies Chase stage and overlies Wabaunsee stage.

Above definition of Council Grove group was followed until 1922, when J. W. Beede (Geol. Soc. Am. Bull., vol. 33, No. 4) extended base of the Council Grove down to base of Neva ls. This change was not adopted by other geologists, however.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), expanded *Council Grove group* by including in it Eskridge sh., Neva ls., Elmdale sh., and Americus ls., and Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr. followed this definition, as did G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), and R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22). The U. S Geol. Survey has not yet had occasion to consider, for its publications, this modified definition.

See Kans.-Nebr. Perm. chart compiled by M. G. Wilmarth, 1936.

Named for Council Grove, Morris Co., Kans.

†Courtland quartzite.

Pre-Cambrian (Huronian): Central southern Minnesota (Nicollet County).

C. W. Hall, 1899 (U. S. G. S. Bull. 157, pp. 20–25), described the red qtzite of Courtland dist., and on pp. 23 and 24 used the term *Courtland qtzites,* stating that there is evidence the *Courtland qtzites* underlie a considerable belt of territory, and he also made following statements: Around Swan Lake, from 4 to 6 mi. NE. of exposures near Redstone and New Ulm, bowlders of red qtzites strew the ground in places. In Cottonwood and Watonwan Counties, about 25 mi. to SW., many sq. mi. are underlain by vitreous qtzites, and many broad surfaces appear, representing a thickness of strata of at least 1,500 ft. The fm. is, therefore, several times as thick as at Courtland, where only 250 to 300 ft. is exposed. There is no doubt the extensive exposures of red qtzites in Rock and Pipestone Counties, Minn., and in many counties of SE. S. Dak. belong to this fm.

F. W. Sardeson, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 221–242). *Courtland qtzite.*—Local name proposed for the pre-Camb. qtzite at Redstone, a conspicuous hill of qtzitic rock in Courtland Twp, Minn., midway btw. towns of New Ulm and Courtland. Is same as Sioux qtzite.

Courtney granite.

Mesozoic: Northern California (Trinity County).

O. H. Hershey, 1900 (Sci., n. s., vol. 11, pp. 130–132). *Courtney granite.*—The granite of Mount Courtney batholith. A nearby batholith is composed of entirely different granite.

†Coutchiching series.

Name proposed for oldest known pre-Camb. rocks in Rainy Lake region of NE. Minn. and adjacent parts of Ontario. Included in Keewatin series by U. S. Geol. Survey. (For definition see U. S. G. S. Bull. 769, pp. 132–135.) The spelling adopted by U. S. Geog. Bd. is *Koochiching.*

†Coutchichingan series.

A term used by C. [R.] Keyes for Coutchiching series of other geologists.

Covada group.

Probably Mesozoic, Carboniferous, and Devonian: Northeastern Washington.

C. E. Weaver, 1913 (Wash. Geol. Surv. Bull. 16, pp. 20–30). *Covada fm.*—Slates, schists, qtzites, and dolomitic lss. No fossils. Provisionally assigned to Carbf. (?) or early Mesozoic. Resembles Cache Creek beds of B. C. and Peshastin fm. of Central Cascades of Wash. Named for Covada, Ferry Co.

J. T. Pardee, 1918 (U. S. G. S. Bull. 677). *Covada group.*—Metamorphosed sh., sl., argillite, schist, qtzite, cgl., and ls. Argillite or schist predominates and is characteristic of mass as a whole. It may be subdivided. Covada fm. of Weaver includes a large part of the rocks here called *Covada group.*

†Cove limestone.

Ordovician: Appalachian region.

H. D. Rogers, 1836 (Pa. Geol. Surv. 1st Ann. Rept., pp. 12–22). The *cove ls.* is a very thick blue ls., containing layers of chert or hornstone, and ranging through many of larger valleys. Underlies cove slate and overlies a fm. of ls. and sl.

H. D. Rogers 1838 (Pa. Geol. Surv. 2d Ann. Rept., table opp. pp. 19, 30, and pl. opp. title page). *No. II.*—Blue ls. with beds of chert, about 6,000 ft. thick. Called *Cove ls.* in my first rept., but I shall drop that name. Overlies No. I, which consists of about 1,000 ft. of compact white ss., resting uncon. on Primary rocks.

The ls. referred to includes beds of Trenton to Beekmantown age, both inclusive. It was later called *Shenandoah ls.*, and is now subdivided into several named fms.

Origin of name not known. May have been derived from Cove Mtn, Franklin Co., Pa.

†Cove slate.

Ordovician: Appalachian region.

H. D. Rogers, 1836 (Pa. Geol. Surv. 1st Ann. Rept., pp. 12–22). The *cove slate* consists of dark blue, drab, and yellow sl., generally found at foot of the mtns, and in places containing rich deposits of iron ore.

H. D. Rogers, 1838 (Pa. Geol. Surv. 2d Ann. Rept., table opp. p. 19 and pl. opp. title page). *No. III.*—Called *Cove sl.* in my first rept. Consists of 6,000 ft. of dark sl., argill. sss., and some cgl., with roofing slates at top and ls. near base. Underlies No. IV (white ss.) and overlies No. II (Blue ls., called *Cove ls.* in my first rept).

Practically synonymous with Martinsburg sh.

Origin of name not known. May have been derived from Cove Mtn, Franklin Co., Pa.

Cove Creek limestone.

Mississippian; Southwestern Virginia.

C. Butts, 1927 (Va. Geol. Surv. Bull. 27, p. 16). *Cove Creek ls.*—Predominantly argill. ls., like underlying lss. of Gasper, Ste. Genevieve, and Warsaw age. Thickness 1,003 ft. Generally unfossiliferous, but one fossiliferous bed, 5 to 10 ft. thick, occurs at base and a few fossils higher up. Lower 500 ft. has considerable proportion of fairly pure ls. conspicuously shown along Cove Creek [Scott Co.] and elsewhere. Includes some coarse-grained crinoidal ls. and one bed of red ss. was noted. Underlies Pennington sh. and overlies Fido ss.

Coventry limestone.

Coventry phase of Waits River limestone.

Ordovician: Northeastern Vermont (Orleans County).

C. H. Richardson, 1908 (6th Rept. Vt. State Geol., pp. 265–291). *Coventry phase of Waits River ls.*—Youngest phase of Waits River ls. Is darker than the other 2 phases of that fm. (the Washington phase and the typical phase), more carbonaceous, sometimes shaly, and never susceptible of polish. Traverses Irasburg, Coventry, and Newport, and dips uniformly to W. [Type loc. is in Coventry, Irasburg quad.], where it is uniformly of dark color, often pyritiferous, and compact. *No fossils.*

C. H. Richardson and E. F. Conway, 1912 (8th Rept. Vt. State Geol., pp. 146–160). *Coventry phase of Waits River ls.* is dark-gray pyritiferous siliceous ls. which underlies half of Irasburg Twp.

Coventry conglomerate.

Lower Ordovician: Northeastern Vermont (Orleans County).

C. H. Richardson, 1919 (11th Rept. Vt. State Geol., p. 47). *Coventry cgl.*—Appears 10 mi. N. of Irasburg. Contains quartz pebbles 1 inch to 1 ft. diam. and fragments of Camb. schist which are occasionally at right angles. Also carries angular fragments of Ord. sl. and ls. It is a meta-cgl., for the lime has been calcitized. Can not be contemp. with Irasburg cgl. May have been formed at close of Ord. or may represent a fault breccia.

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 107–110). *Coventry phase of Irasburg cgl.* is markedly different from any of the other phases of that fm. It is characterized by well-rounded, smoothed, sometimes faceted and sometimes apparently striated boulders of pure white quartz from an inch to a foot in diam. Fragments of Camb. schists up to 1 ft. in diam. and set at right angles to each other are embedded in an Ord. paste of ls. and sl. Writer believes this rock is a fault breccia cgl. This breccia-cgl. is located about 10 mi. N. of Craftsbury, near contact of Camb. and Ord. terranes. Main road from Newport to South Troy passes over this terrane [and crosses N. part of Coventry Twp].

†Covington group.

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 9). *Covington group* proposed to embrace all strata in Cincinnati area from top of Trenton to base of Richmond. It thus includes Utica and Lorraine of previous authors.

Includes Maysville and Eden groups.

Named for Covington, Ky.

Covington sand.

A subsurface sand, of Penn. age, in Garber pool, Garfield Co., central northern Okla., which lies at 2,100 ft. depth, the Garber sand lying at 2,000 ft. and the Hoover sand at 2,400 ft.

Cowanesque.

Name applied to a glacial lake in Cowanesque Valley, north-central Pa. (See B. Willard, Geol. Soc. Am. Bull., vol. 43, No. 1, p. 192, 1932, and vol. 43, No. 2, p. 441, 1932.)

Cowaselon clay.

Pleistocene: Southeastern New York (Madison County).

B. Smith, 1914 (Am. Jour. Sci., 4th, vol. 38, p. 463). Bluish clay, 2+ ft. thick, forming basal part of Aftonian deposits. Named for Cowaselon Creek, Madison Co.

Cow Creek beds. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Central Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 141–143). *Cow Creek beds.*—In descending order: (1) Cross-bedded shell breccia, 7 ft.; (2) *Ostrea* bed, 3 ft.; (3) brecciated grit, 5 ft.; (4) stratified friable bluish sh. and calc. sand, 15 ft. Memb. of Travis Peak fm. in Burnet Co. Underlies Hensell sands and overlies Sycamore sand.

Named for Cow Creek, Burnet Co.

Cow Head limestone breccia.

Middle Ordovician: Newfoundland.

C. Schuchert and C. O. Dunbar, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 38).

Cowichan group.

Upper Cretaceous: British Columbia (Vancouver Island).

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 89).

Cowiche gravel.

Pleistocene: Central Washington (Ellensburg quadrangle).

G. O. Smith, 1903 (U. S. G. S. Ellensburg folio, No. 86). *Cowiche gravels.*—Coarse gravel and sand with covering of silt, forming terraces produced by dammed streams. Occur in broad terrace in valley of Cowiche Creek. Rest uncon. on Ellensburg fm. (Mio.).

Cow Island beds.

Upper Cretaceous: Central northern Montana (Judith River region).

C. H. Sternberg, 1914 (Sci., n. s., vol. 40, pp. 134–135). At Dog Creek [E. of Judith River and in Fergus Co.] are the typical Judith River beds of Hayden and Cope, followed below by Fox Hill-Pierre, which are in turn underlain by the *Cow Island beds*, the Judith River correlating with the Edmonton, and the Cow Island with Belly River series. Evidence of fossils corroborates distinction btw. Cow Island beds and Judith River beds at Dog Creek. [These so-called *Cow Island beds* are not described, but name is used in heading and columnar section. According to map of F. Reeves in U. S. G. S. Bull. 751C, pl. 11, Oct. 13, 1924, the beds along Dog Creek are Judith River fm. underlain by Claggett sh. Reeves's map shows several islands in Missouri River above and below mouth of Cow Creek (which empties into the Missouri near Fergus-Blaine Co. line). Some of these islands are mapped as Judith River and some as Claggett sh. The Cow Island beds of Sternberg therefore appear to belong to Claggett sh., since he states that the fossils are older than Judith River fossils.]

Cowlitz formation.

Eocene: Southwestern Washington (Lewis County) and northwestern Oregon.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). In southern Lewis Co., E. of Little Falls, there are shales and shaly lss. containing a fauna that is seemingly older than typical Tejon, but more closely related to it than to Martinez or Lower Eo. of Calif. In order to distinguish this from typical Tejon the term

Cowlitz fm. is suggested. Thickness 500 ft.; base unknown. [Probably named for Cowlitz River.]

C. E. Weaver, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 87), called this fm. *Cowlitz or marine Upper Eocene fm.*

H. G. Schenck, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 217), in description of NW. Oreg. counties, stated that Keasey sh. rests on *Cowlitz Eocene fm.*

R. W. Chaney and E. I. Sanborn, 1933 (Carnegie Inst. Wash. Pub. 439). *Cowlitz fm.* contains marine fauna indicating late middle to early upper Eo. age.

Cow Run sandstone. (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio and western West Virginia.

J. J. Stevenson, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 154). *Cowrun ss.*, 0 to 40 ft. thick, is="Salzburg" ss. of W. Va. drillers.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, p. 39). *Cowrun ss.*, 20 to 25 ft. thick, consists of massive to thin-bedded and shaly ss. Underlies Ewing ls. and overlies Portersville fossiliferous horizon. Named for stream [village?] in eastern Washington Co., Ohio. Outcrop not great in Ohio. Drillers apply name to almost any shallow sand, hence it is rather indefinite.

Cow Run sand.

Name applied to a subsurface sand in Conemaugh fm. (Penn.) of Ohio and W. Va. that has been said to correspond to Buffalo ss. memb., also to the younger Saltsburg ss. memb. This sand has also been called *First Cow Run sand*, and the name *Second Cow Run sand* has been applied to an older sand, formerly said to correspond to Homewood ss. memb. of Pottsville fm., also to correspond to the still older Connoquenessing ss. memb. In Pa. the name *Second Cow Run sand* has been applied to a sand that has been correlated with Freeport ss. memb. of Allegheny fm. According to G. H. Ashley and J. F. Robinson (Pa. Geol. Surv., 4th ser., vol. 1, 1922) and G. H. Ashley, 1931 (Topog. and Geol. Surv. Pa. Bull. G_1), the *First Cow Run sand* of Pa. is same as Big Dunkard sand and corresponds to Mahoning ss., the basal memb. of Conemaugh fm., and the Second Cow Run is the Freeport ss. memb. of Allegheny fm. But later work resulted in correlating First Cow Run sand of Pa. with Saltsburg ss. memb. of Conemaugh fm. (See G. H. Ashley and J. D. Sisler, Pa. Geol. Surv., 4th ser., Bull. M_{18}, 1933, p. 6.) According to W. Stout et al., 1935 (Geol. of nat. gas, A. A. P. G., pp. 900–901), the First Cow Run sand of Ohio lies btw. Cambridge and Ames ls. members of Conemaugh fm., and the Second Cow Run or Peeker sand is=†Lower Freeport ss. memb. (now called *Freeport ss. memb.*) of Allegheny fm.

The name is derived from Cow Run, SW. part of Lawrence Twp, Washington Co., Ohio, where the sand was discovered in wells drilled in 1861.

Cox sandstone. (In Trinity group.)

Lower Cretaceous (Comanche series): Western Texas.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 47). *Cox fm.*—Massive soft brownish ss., some intercalated gray ls., and near base a red-drab shaly memb. 100 ft. thick. Thickness averages 600 ft. Middle fm. of Fredericksburg group. Overlies Campagrande fm. and underlies Finlay fm.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745), transferred this fm. to Trinity group.

This fm. is now regarded as a transgressing unit, which in places extends upward into Fredericksburg time.

Named for Cox Mtn, El Paso Co.

Coxville sandstone.

Pennsylvanian: Central western Indiana.

G. H. Ashley, 1899 (Ind. Dept. Geol. and Nat. Res. 23d Ann. Rept., pp. 300–303, 385). *Coxville ss.* (*Merom?*).—Channel filling, in Parke Co., deposited either a short time after laying down of coal No. 6 or at a time entirely subsequent to deposition of coal measures proper, or at a time corresponding with laying down of Merom ss. of Sullivan Co. Formerly considered to be Mansfield ss. Latter theory is considered best sustained. Fills deep and broad erosion channel or system of channels carved in upper coal measures. Best exposed on NE. side of Raccoon Creek at Coxville.

Coyote sandstone member (of Madera limestone).

Pennsylvanian: Central northern New Mexico.

C. L. Herrick, 1900 (Jour. Geol., vol. 8, p. 115; Am. Geol., vol. 25, pp. 234–237; N. Mex. Univ. Bull., vol. 2, pt. 3, pp. 1–14). *Coyote ss.*—Thick ss. or cgl. Separated from overlying Manzano series by a thick series of massive gray siliceous lss., and from underlying Sandia series by a series of dark conchoidal lss. and shales. Present in Sandia, Manzano, and San Andres Mtns.

Named for Coyote Springs, Sandia Mtns.

Coyote formation.

Eocene(?): Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Coyote fm.*—Massive effusives of reddish andesites, rhyolites, and andesitic tuffs. Thickness undet. Type loc., Coyote Hills (near Plush), Lake Co.

†Coyote Mountain clays. (In Imperial formation.)

Miocene (lower): Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, p. 435). Above the Latrania sands there are enormous deposits of clay, the peculiar properties of which may make it of commercial value at some future time. I would propose that they be called *"Coyote Mountain clays."* They are extensively developed over wide areas, but type loc. has been selected in foothills bordering SE. slope of Coyote Mtn. Above these clays, and interbedded with them near top to some extent, are extensive deposits of oyster shells for which the name "Yuha Reefs" has been selected. Assigned to Plio., probably middle or upper Plio. [For further explanation by Hanna see 1926 entry under *Imperial fm.*]

See W. P. Woodring, 1931, under *Imperial fm.*

Coys Hill granite.

Late Carboniferous or post-Carboniferous: Western central Massachusetts and southwestern New Hampshire.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 319–320, map, pl. 34). *Coys Hill granitite.*—Coarse porphyritic biotite granite.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 240–241 and map). *Coys Hill granite.*—Coarse porphyritic granite. Composes mass of Coys Hill, Mass.

Cozy Dell shale member.

Eocene: Southern California (Ventura County).

P. F. Kerr and H. G. Schenck, 1928 (Geol. Soc. Am. Bull., vol. 39, p. 1090). *Cozy Dell sh. memb.*—The rhythmically bedded, fossiliferous, marine, green micaceous sh. and ss. that is typically exposed in Cozy Dell Canyon, on E. side of Ventura River, and forms middle memb. of Tejon fm. Thickness 2,500± ft. Underlies Coldwater ss. memb. and discon. overlies Matilija ss. memb.

Crab Orchard shale.

Silurian (Niagaran): Central Kentucky.

W. M. Linney, 1882 (Ky. Geol. Surv. Repts. on Garrard and Lincoln Counties). *Crab Orchard shales.*—Soft clay shales, 16 to 40 ft. thick in Garrard and Lincoln Counties. Are blue, black, olive, and brownish red; weather gray, white and sometimes green; contain few thin lss. Included in Clinton(?) group. Overlie buff Medina ss. (35 ft. thick) and underlie Corniferous lss. (Dev.).

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7). *Crab Orchard div.*—Chiefly clay sh., 110 to 180 ft. thick. Divided into Alger and Indian Fields fms. Includes all Sil. strata of east-central Ky. above Brassfield ls. [Appears to correspond in a general way to Crab Orchard shales of Linney.]

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 127–134). *Crab Orchard group* assigned to Clinton epoch. [Many details given.]

Named because they are the shales from which the celebrated Crab Orchard salts are manufactured. Town of Crab Orchard is in Lincoln Co.

Craftsbury granite.

Devonian: Northeastern Vermont (Orleans County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "Central Vt.," but without definition. Probably named for Craftsbury Twp, or one of villages of that name within that Twp, in unnamed quad. in S. part of Orleans Co.

Craggy gneiss.

Jurassic (?): Southwestern Oregon (Curry County).

G. M. Butler and G. J. Mitchell, 1916 (Min. Res. Oreg., vol. 2, No. 2). *Craggy gneiss.*—A metamorphic rock that is different from any other found in S. part of Curry Co. Diller has described a similar rock under name of amphibole schist as occurring in small masses in N. part of Co. He considers this material to be a metamorphosed phase of Myrtle fm. The Craggy gneiss consists chiefly of hornblende, feldspar, and quartz, with minor quantities of biotite, no actinolite, glaucophane, or garnet. It seems likely it is metamorphosed phase of adjacent Dothan ss. Composes West Craggy.

Craghead.

Upper Devonian: Missouri.

H. A. Buehler, 1922 (geol. map of Mo.).

Same as *Craghead Creek sh.* of other authors.

†Craghead Creek shale.

Upper Devonian: North-central Missouri.

D. K. Greger, 1909 (Am. Jour. Sci., 4th, vol. 27, p. 375). *Craghead Creek sh.*—Light-gray, highly fossiliferous, siliceous sh. at top; light-drab argill. ls., with few fossils, in middle; dark-blue and drab sh. with bands of shaly ls., highly fossiliferous, at base. Thickness 35 ft. Overlies Callaway ls. and [uncon.] underlies Kinderhook.

Replaced by *Snyder Creek sh.*, the older and better established name.

Named for Craghead Creek, 6 mi. S. of Fulton, Callaway Co.

Craig shale.

Pennsylvanian: North central Oklahoma.

G. C. Clark and C. L. Cooper, 1927 (Okla. Geol. Surv. Bull. 40H, fig. 3). [*Craig sh.* is shown as composing basal part of Cherokee fm. in geol. section for north-central Okla. Is shown as older than Little Cabin ss., but it is not clear whether it includes all beds (125± ft.) up to that ss. or only the basal 50± ft. of the beds separating the ss. from underlying Mississippi lime. Derivation of name not stated.]

Craigsville limestone.

Lower Devonian: Central western Virginia.

R. J. Holden, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 137). *Craigsville ls.*—Pure ls., 150± ft. thick, underlying Longdale ls., and forming a part of Lewistown ls. Correlated with New Scotland ls. [Probably named for Craigsville, Augusta Co.]

Crain sand.

A subsurface sand, of Upper Cret. age, in Rainbow City field, Union Co., Ark.

†Crainesville horizon. (In Midway group.)

Eocene (lower): Southwestern Tennessee and northeastern Mississippi.

G. D. Harris, 1896 (Bulls. Am. Pal., vol. 1, No. 4, pp. 18–25). *Crainesville horizon.*—Fossiliferous, gray, calc., hardened clays with green grains and peculiar ss. concretions, exposed in vicinity of Crainesville, Hardeman Co., Tenn., and also identified in northern Miss. Is of Midway age.

Occurs near top of Porters Creek clay. According to E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14, p. 64), it corresponds to his Tippah ss. memb. of Porters Creek.

G. T. Whitlatch, 1936 (Tenn. Acad. Sci. Jour., vol. 11, No. 2, p. 139). The glauconitic beds (Crainesville horizon of Harris) occurring near top of the Porters Creek in western Tenn. bear striking lithic resemblance to Lowe's Tippah ss. and probably represent the zone to which he applied that name. Writer, like Lowe (Miss. Geol. Surv. Bull. 25, 1933, p. 23), believes these beds are too local in extent and variable in strat. position to warrant a formational name, though, as suggested by Lowe, they may actually be representative of Naheola fm. of Ala.

Cranberry granite.

Pre-Cambrian: Western North Carolina and eastern Tennessee.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 3). *Cranberry granite.*—Granite, of varying texture and color, and schists and granitoid gneisses derived from the granite. Includes small or local beds of schistose basalt, diorite, hornblende schist, and pegmatite. Intrusive into Roan and Carolina gneisses. Archean.

Named for development at Cranberry, Mitchell Co., N. C.

Cranberry formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 98).

Cranberry Island series.

Cambrian or pre-Cambrian (?): Southeastern Maine (Cranberry Islands and southern part of Mount Desert Island).

N. S. Shaler, 1889 (U. S. G. S. 8th Ann. Rept., pt. 2, pp. 1037, 1042–1047, 1059, 1061, and map). On N. border of Little Cranberry Island we have a series of siliceous flaggy layers, which are probably closely related to the stratified rocks of Sutton's Island [see *Sutton Island series*]. The section is not over 100 ft. thick, but it probably occupies a considerable area beneath the surface of the strait which separates the two islands. Above this we find a very extensive series of volcanic rocks, which have a thickness of at least 2,000 ft.; to which I give the name of *Cranberry Island series*. At their contact with Sutton's Island series the volcanic beds of Cranberry Islands consist of porphyries, breccias, and amygdaloids, all apparently bedded, probably by a succession of lava flows and volcanic ash showers. On Cranberry Island we find essentially a repetition of the section shown on Little Cranberry Island, with exception that proportion of clay slates and bedded qtzites is much larger than the volcanic materials, and the schists and slates are more distinctly mingled with the igneous materials. [Map explanation states: "Cranberry Island series essentially the same as the Sutton Island series [which he assigned to Camb. or pre-Camb.] with many beds of volcanic ash."] No fossils.

On the 1933 geologic map of Maine, by A. Keith, the rocks of Cranberry Islands and S. part of Mount Desert Island are mapped as Devonian igneous, and the rocks of Sutton Island appear to be mapped as "igneous, mainly Carbf."

Named for development in Great Cranberry and Little Cranberry Islands, S. of Mount Desert Island.

Cranbrook formation.

Cambrian: British Columbia.

S. J. Schofield, 1922 (Canada Geol. Surv. Bull. 35, p. 12).

Crandall Hill sand.

Drillers' term for a sand of Chemung age in Potter Co., Pa., that is said to occur in strat. position of Bradford Third sand. It is main producing horizon of Coudersport gas pool. (See C. R. Fettke, Geol. Soc. Am. Bull., vol. 44, No. 3, pp. 602–603, 632, 636, 1933, and Pa. State Coll. Bull., Min. Industries Exp. Sta. Bull. 19, 1935, p. 110.)

Cranktown sandstone.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). *Cranktown ss.*—Ss. with cgl. lenses; the ss. commonly red to deep purple, nearly everywhere cross-bedded, commonly rather fine-grained, and largely composed of small fragments of feldspar, for most part angular. Thickness 0 to 500 ft. Deposition thrice interrupted by volcanic activity, resulting in an andesite flow (Houston andesite) near base, a bed of rhyolite tuff, and several flows of rhyolite near top. Upper part of the ss. is younger than Pacific quartz latite.

Named for exposures at a small group of prospectors' cabins, locally called Cranktown, on Silver Creek about 1 mi. below Mogollon.

Cranston beds.

Pennsylvanian: Eastern Rhode Island (Cranston Township, Providence County).

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 159–164). *Cranston beds.*—Metamorphosed sss., shales, and pebbly beds. Poorly exposed, but seen in SW. part of Cranston [Twp, R. I.]. Form basal part of Rhode Island Coal Measures and believed to be in large part older than Tenmile River beds. Include Sockanosset sss. and Pawtucket shales. Rest on Wamsutta series.

†Crawford shale.

Mississippian and Devonian (?): Northwestern Pennsylvania.

J. F. Carll, 1879 (2d Pa. Geol. Surv. Rept. I_3 Atlas, pl. 11). *Crawford shales,* 450 ft. thick, underlie Mountain sands and overlie Venango oil sand group in NW. Pa. oil region. Include Pithole grit [Berea ss.] in middle.

H. M. Chance, 1879 (2d Pa. Geol. Surv. Rept. V, pp. 221–226). *Crawford Upper (Cuyahoga) shales,* 135 ft. thick, underlie Congl. series (No. XII), and are separated from *Crawford Lower (Bedford red) shales* by Berea grit.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. V, p. 224, footnote). I propose for the shales above and below the Berea grit the term *Crawford sh. group,* as they make the broad belt of lake and swamp land across that county.

J. P. Lesley, 1880 (2d Pa. Geol. Surv. Rept. Q_3, p. 59, footnote). *Crawford shales* [restricted].—Argill. bluish-gray shales, 90 ft. thick. Underlie Shenango ss. [Burgoon ss.] and overlie Sharpsville ss. Include Meadville Upper ls. about 25 ft. below top. [The beds btw. Burgoon ss. memb. and Sharpsville ss. memb. have for many years been called *Meadville sh. memb. of Pocono fm.*]

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, p. 68). The name *Crawford shales* if retained should be confined to that part of Cuyahoga series beneath Shenango ss. and above Corry ss., a vertical interval of about 200 ft., but as this interval contains the Meadville lss., which have played so distinguished a rôle in settling our northwestern State geology, the name *Meadville group* may replace that of *Crawford sh.* entirely.

Crawford series (also Crawford subseries).

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal. vol. 21, No. 71, pp. 40–46, table opp. p. 61, 129). *Crawford series (or "subseries")* includes highest Miss. strata in NW. Pa. and NE. Ohio. The strata from top of Shenango sh. down to top of Berea ss. constitute a genetic series such as merits a series designation. They are a faunal and depositional entity. The name "Crawford sh." has fallen into desuetude. Gradational contacts in this section are universal. Wherefore it has seemed advisable to resurrect the available and entirely satisfactory term "Crawford" for this sequence of serial or sub-serial rank. It is naturally divisible into 2 groups, Meadville monothem and Shenango monothem. There is discon. at top of Berea ss.

†Crazy Mountain beds.

A term applied by G. H. Eldridge (U. S. Tenth Census, vol. 15, maps 50 to 54, 1886) to the rocks of the Crazy Mtns, Little Belt Mtns quad., Mont., which were later formally named and mapped by W. H. Weed as Livingston fm. (See U. S. G. S. Little Belt Mtns folio, No. 56, 1899.)

Crazy Mountain granite.

Eocene: Central southern Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Light-colored, coarse-grained hornblende granite of lighter color and coarser grain than Loco diorite, which it cuts. Assigned to Eocene. [Mapped over considerable area in Crazy Mtns.]

†Creamy sandstone.

Pennsylvanian: Eastern Colorado (Denver Basin region).

G. H. Eldridge, 1896 (U. S. G. S. Mon. 27). [See definition under †*Wyoming fm.*]

N. M. Fenneman, 1905 (U. S. G. S. Bull. 265, pp. 20, 22–24). *"Creamy" ss.* of Eldridge [color term] replaced by *Lyons ss.*

W. T. Lee, 1927 (U. S. G. S. P. P. 149, pp. 5, 12, pl. 1). The beds called Lyons ss. in Colorado Springs and Castle Rock folios are correctly correlated with "Creamy" ss. of Morrison region, which in turn was formerly correlated, erroneously, with Lyons ss. of Lyons, Colo. These beds can not be same as Lyons ss. of type loc., which consists of 100 ft. of hard, ledge-making ss., characterized by conspicuous cross bedding. As originally defined, however, some of red sed. rocks here referred to Ingleside fm. were included in lower part of Lyons ss. In this paper Lyons ss. is restricted to the cross-bedded upper part of the Lyons of previous repts. The "Creamy" ss. of Morrison region is of Penn. age and belongs to Fountain fm. The white cross-bedded ss. at Lyons, or Lyons ss. as here restricted, is considered to be of Perm. age, and is absent in Morrison, Colorado Springs, and Castle Rock areas. The Ingleside fm. and underlying Fountain fm. are of Penn. age.

Credit member.

Upper Ordovician: Toronto, Canada.

W. A. Parks, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 103–104).

See quotation under *Dundas fm.* Type loc. not stated.

Creede formation.

Miocene (probably upper Miocene): Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Creede fm.*—Water-laid deposits, 0 to 2,000± ft. thick. Upper memb. consists of breccia, cgl., and tuff with intercalated lava flows. Lower memb. consists of thinly laminated white shaly tuff, in part sandy and with some breccia and cgl., and interbedded with travertine. Plants from lower tuffs indicate correlation with Miocene Florissant lake beds. Uncon. overlain by Fisher quartz latite and uncon. underlain by Potosi volcanic series. Named for development on slopes of both sides of Willow Creek about town of Creede.

Crekola sandstone member (of Boggy shale).

Pennsylvanian: Eastern Oklahoma (Muskogee County).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Crekola ss. memb. of Boggy sh.*—Brown ss., regularly bedded, blocky, medium texture, 10 ft. thick. Lies 10± ft. below Inola ls. memb. of Boggy and 6± ft. above Secor or Upper Witteville coal. Named for fact that village of Crekola, in E½ sec. 10, T. 14 N., R. 17 E., is located on this ss.

Cresaptown iron sandstone.

Silurian: Western Maryland.

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol., pp. 28–31). *Cresaptown iron ss.*—An iron-rich ss. or lean "iron ore," of deep-red color, lying about 175 ft. above base of Rose Hill fm. [pre-Rochester part of Clinton fm.] and overlain by upper sh. beds of Rose Hill fm. Some of Cresaptown beds are distinctly oolitic; and interbedded with the iron ss. are variable amounts of sh. Thickness 30 ft. at Pinto; 10 ft. at Cumberland. Contains fossils.

Crescent formation.

Eocene: Northwestern Washington.

R. Arnold, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 451–468, map). *Crescent fm.*—Black basalt and greenish basalt tuff and tuffaceous sands, 1,200 ft. thick. Uncon.

underlies Clallam fm. Named for occurrence in vicinity of Port Crescent. Comprises region immediately W. of Crescent Bay and a prominent ridge extending from there eastward to Freshwater Bay. Eocene fossils.

Crescent City beds.

Miocene and Pliocene: Northwestern California (Del Norte County).

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 31–35). Somewhat similar beds [to those northward and southward from Point St. George, Del Norte Co., Calif., which consist of soft yellowish and gray shaly sss. and whitish shales full of Mio. fossils] occur by wharf at Crescent City (*Crescent City beds*), and among their fossils Dr. [W. H.] Dall recognizes *Pecten parmeleei* and *Terebratalia hemphilli*, species heretofore known only from southern Calif. Plio. It is probable that these soft Mio. and Plio. beds have a wide extent under the Pleist. of the low, broad coastal plain extending from Smith River to 3 mi. S. of Crescent City.

Crescent Crater dacites.

Age (?): Lassen Volcanic National Park, California.

H. Williams, 1932 (Calif. Univ. Dept. Geol. Sci. Bull., vol. 21, No. 8, geol. map). [See under *West Prospect basalt*.]

Cresswell limestone. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 51). *Cresswell ls.*—Top memb. of Winfield fm. Has been called the "concretionary ls." Persists from Nebr. to Okla. in a thickness of 4 to 11 ft. Is solid massive ls. at most points in southern Kans., but northward from there it carries large concretions, a small amount of chert, and at most places is interrupted by a thin sh. near middle. Becomes less massive and non-concretionary in its northern occurrence. Named for Cresswell Twp, Cowley Co., Kans. Type loc. on E. side of golf course, in NE. ¼ sec. 18, T. 34 S., R. 4 E., N. side of E. edge of Arkansas City. Overlies Grant sh. memb. of Winfield fm. and underlies Luta ls. in central and southern Kans. The Luta probably does not extend to Nebr., where Odell sh. memb. of Enterprise sh. overlies Cresswell ls. [On p. 56 Luta ls. is included in Marion fm. On pp. 57–58 Condra says:] The *Luta ls.* is thought not to extend to northern Kans. and Nebr., but it is possible that part of lower gray zone of Odell sh. memb. of Enterprise sh. in this area may be correlative with it in age and thus represent a sh.-mudstone facies of its development. The Luta has a thickness of 7 ft. or more in central and southern Kans., reaching 18 ft. or more at a few places. It appears that some authors have assigned too great a thickness to the Luta in various exposures by including part of Cresswell ls., and we find its thickness at type loc. not as great as given by Dr. Beede. There is a small deformation at type loc. and Luta-Winfield contact is not very definite. Whether the Luta should be correlated with the Winfield or with the Marion has not been determined to full satisfaction of all geologists concerned, nor is it agreed that it is not a zone of Cresswell ls. It seems, however, that it was developed in the cycle which produced the Cresswell, in which deposition changed from lime to lime and sh., becoming more shaly at top as a transition to lower zone of Odell sh. It also appears that faunal content is not markedly different from that of Winfield fm.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), treated Luta ls. as top memb. of Winfield ls. This change has not yet been considered by U. S. Geol. Survey for its publications.

Creston quartzite.

Pre-Cambrian: Southeastern British Columbia and northwestern Montana (Purcell Range).

R. A. Daly, 1905 (Canada Geol. Surv. Summ. Rept. 1904, pp. 96–100; Am. Jour. Sci., 4th, vol. 20, pp. 186+). *Creston qtzite.*—Wonderfully homogeneous, highly indurated, thick platy structure, gray sss., with occasional intercalations of argill. material. Thickness 9,900 ft. Conformably underlies Kitchener qtzite. Both probably pre-Camb. Occurs at int. bdy, 49 Par., in section from Port Hill, Idaho, to Gateway, Mont.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 4, 115° 30' to 116°). *Creston fm.*—Generally thick-bedded gray qtzite and metargillite; sometimes dolomitic.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast., 1910, vol. 2, pp. 120, 178). Named for station on Canadian Pacific Ry (in Kootenay Province, SE. part of B. C.).

Creston shale. (In Washington formation.)

Permian: Western West Virginia and southeastern Ohio.

R. V. Hennen, 1911 (W. Va. Geol. Surv. Rept. Wirt, Roane and Calhoun Counties, p. 154). *Creston red sh. or Creston Reds.*—Dark red sh. with ls. nuggets. Thickness 40 to 60 ft. Underlies Washington A coal and overlies Lower Marietta ss.

Named for occurrence at Creston Flats, 1 mi. E. of Creston, Wirt Co., W. Va.

Crestone conglomerate phase.

Permian: Southern-central Colorado (Sangre de Cristo Range).

F. A. Melton, 1925 (Jour. Geol., vol. 33, p. 812). The largest boulders in Upper Sangre de Cristo cgl. have diam. of 8± ft., but this extreme coarseness, even though it is a very prominent feature near Crestone, is only of local development, and in both directions along the range the upper series becomes thinner and finer in grain. For this reason the coarse conglomeratic series has been named by the writer the *Crestone conglomerate phase of the Upper Sangre de Cristo conglomerate.* Near Crestone the coarse phase overlaps the Lower cgl. and rests on Pre-Camb. granite. Though an angular uncon. was not seen btw. the two divisions of Sangre de Cristo cgl., it is believed that further search in this area may reveal such a break.

Creta dolomite. (In Blaine formation.)

Permian: Southwestern Oklahoma (Greer and Jackson Counties).

G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 49, pp. 29–40, 42, 47, 48, 63). *Creta dol. memb. of Blaine fm.*—Very pure dol., light gray, fine-grained, porous, and in some places platy. Thickness 13'' to 25''. South of Mangum it lies 26 to 30 ft. below Mangum dol. memb. of the Blaine. Rests on 3 ft. of massive gyp. Occurs S. of Elm Fork. Named for station of Creta, in W. part of Jackson Co.

Cretaceous period (or **system**).

The youngest system of Mesozoic era. The U. S. Geol. Survey includes in it both Upper Cret. and Lower Cret. Some geologists, however, restrict the name to Upper Cret., while others restrict it to Upper Cret. plus some older deposits which are by most geologists included in Lower Cret. For definition see U. S. G. S. Bull. 769, pp. 56–61.

†Cretaceous No. 1.

A term applied in early repts of some pioneer American geologists (F. V. Hayden and others) to the rocks now known as *Dakota ss.*

†Cretaceous No. 2.

A term applied in early repts of some pioneer American geologists (F. V. Hayden and others) to the rocks now known as *Benton sh.*

†Cretaceous No. 3.

A term applied in early repts of some pioneer American geologists (F. V. Hayden and others) to the rocks now known as *Niobrara ls.*

†Cretaceous No. 4.

A term applied in early repts of some pioneer American geologists (F. V. Hayden and others) to the rocks now known as *Pierre sh.*

†Cretaceous No. 5.

A term applied in early repts of some pioneer American geologists (F. V. Hayden and others) to the rocks now known as *Fox Hills ss.*

Cretacic.

A variant of *Cretaceous* employed by some geologists.

Crews sand.

A subsurface sand, of Penn. age, in Garber pool, Garfield Co., central northern Okla., which lies at 1,800 ft. depth, the Campbell sand lying at 1,700 ft. and the Garber sand at 2,000 ft.

Crill terrane.

Upper Cretaceous: Northwestern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 148, 150). *Crill chalks and lss.*, 100 ft. thick, underlie Hawarden sh. and overlie Woodbury [restricted] sh. All included in Coloradan series.

See Keyes' statement under †*Dixon chalk*.

Named for old site of Crill mill, on Sioux River, above Sioux City.

Criner formation.

Middle Ordovician: Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich. See under *West Spring Creek fm.*

C. E. Decker (1930) proposed abandoning *Criner* for *Bromide fm.* See under *Bromide fm.*, Decker 1930 entry, also Decker and C. A. Merritt, 1931 entry under *Bromide fm.* They discarded Criner fm.

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, p. 105). *Criner fm.* should be retained.

C. E. Decker, 1933, did not use *Criner fm.* See this entry under *Simpson fm.*

Named for exposures at S. end of Criner Hills, S. of Overbrook, Love Co.

Crinerville limestone member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 15). About 600 ft. above Westheimer memb. of Hoxbar fm. occurs *Crinerville ls. memb.* of Hoxbar, 10 or more ft. thick. Lower layers locally crammed full of *Fusulinae*.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 42–43). *Crinerville memb.* is 10 to 30 ft. thick. Lies 400 to 500 ft. above Westheimer memb. Type loc. is near center of W½ sec. 28, T. 5 S., R. 1 E., a few rods N. and NE. of Crinerville schoolhouse.

C. W. Tomlinson, 1934 (A. A. P. G. Bull., vol. 18, No. 8, p. 1085). Recent tracing has proved Westheimer ls. to be same as Confederate ls. (basal memb. of Hoxbar fm.) and Westheimer ls. has been dropped. (See under *Confederate ls. memb.*) It has also proved that Union Dairy ls. is same as Crinerville ls., and Union Dairy has been dropped.

†Crinoidal limestone.

Descriptive term applied in early repts to many lss., of different ages, containing crinoid remains. In early Pa., Ohio, W. Va., and Md. repts it was applied to Ames ls. memb. of Conemaugh fm. (Penn.).

†Cripple Creek breccia.

Tertiary: Central Colorado (Teller County).

W. Cross, 1896 (Colo. Sci. Soc. Proc., vol. 5, p. 30). *Cripple Creek breccia.*—Of volcanic origin. Contains nearly all productive gold veins of Cripple Creek dist.

In U. S. G. S. Pikes Peak folio, No. 7, 1894, Cross mapped this fm. as andesitic breccia. The geographic name is considered unnecessary and has fallen into disuse.

Cripple Creek granite.

Pre-Cambrian: Eastern Colorado (Pikes Peak).

E. B. Mathews, 1900 (Jour. Geol., vol. 8, pp. 214–240). *Cripple Creek type of granite.*—Appears finer than Pikes Peak type and more evenly grained than Summit type. Is younger than Pikes Peak type. Most characteristically developed in area to W. of line drawn from Lake George to town of Cripple Creek, and thence in a somewhat sinuous line to waters of Oil Creek. Is saccharoidal with rectangular feldspars; poor in perthitic feldspars, micropegmatite, and fluorite.

W. Lindgren and F. L. Ransome, 1906 (U. S. G. S. P. P. 54, pp. 20, 28). *Cripple Creek granite* cuts the gneiss and schist and probably intrudes Pikes Peak granite.

L. C. Graton, 1906 (U. S. G. S. P. P. 54). *Cripple Creek granite.*—Light-red, medium, fairly even-grained; slight porphyritic appearance; quartz more abundant and more evenly distributed than in Pikes Peak granite. Suffered much less shearing and deformation than Pikes Peak granite, and is undoubtedly younger than Pikes Peak granite. Contains streaks and patches of reddish to dark-gray gneissic rocks.

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). In Colorado Springs and Manitou quads. Cripple Creek granite occurs in a few small irregular masses and in numerous thin dikes that cut Pikes Peak granite.

On 1935 Colo. geol. map included in Front Range granite group.

Cripple Deer sandstone member (of Alsobrook formation).

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama.

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Cripple Deer ss. memb.*—Upper third [30 ft.] of Alsobrook fm. on Cripple Deer Creek. Impregnated with petroleum residue; largely barren of fossils.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23, pp. 17, 128, 179, 182). *Cripple Deer ss. memb.*—Upper memb. of Alsobrook fm. At type loc. consists of 36½ ft. of thin-bedded ss. to sandy sh., ripple-marked and with wavy deposition lines; much of it impregnated with asphalt. Type loc. along highway on N. side of Cripple Deer Valley [Miss. and Ala., according to his map].

Cristobal limestone.

Ordovician: Southern New Mexico.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 6). *Cristobal lss.*—Main body of late Ordovicic ls. section in Franklin, Caballos, Fra Cristobal, and Mimbres Ranges. Thickness 165 ft.

Cristobal formation.

Cretaceous: Southern Mexico.

W. A. VerWiebe, 1925 (Pan-Am. Geol., vol. 44, p. 132). Named for excellent outcrops near city of San Cristobal, in central Chiapas.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 328), assigned "San Cristobal ls. of VerWiebe, 1925" to Lower Cret.

Critizer limestone.

See *Critzer ls.*, correct spelling.

Critzer limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). [See under *Schubert Creek ls.*] Named elsewhere in this Guidebook by Jewett.

J. M. Jewett, 1932 (pp. 99, 100, 103 of book cited above). *Critizer ls.* is second ls. lentil from base of Swope fm. It is brown, earthy, massive, and varies from an oolite to a dense crystalline ls. A large *Bellerophon* abundant. Thickness locally 15 ft. To S. pinches out near Linn-Bourbon Co. line. Type loc. is S. of Critizer, Linn Co., in sec. 17, T. 22, R. 23 E. Is believed to extend well into Mo.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 74–75, 80). *Critzer* is correct spelling. Jewett classed it as memb. of Swope fm., and, according to F. C. Greene, N. D. Newell, and me, based on 1934 field work, assigned it to erroneous position above Schubert Creek ls. It is believed by Greene and me to be="Fragmental ls." of Iowa geologists. For present recognition of "Critzer" as a named memb. of Bourbon fm. is withheld, although it may prove to be useful name for a marker bed near top of Bourbon fm. from Linn Co., Kans., northeastward.

Croasdale quartzite.

Silurian: Northeastern Pennsylvania (Delaware Water Gap region).

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 479). *Croasdale qtzite.*—Qtzitic ss. underlying Decker Ferry beds and uncon. resting on 15 ft. of greenish shales that overlie Bossardville ls. in Kittatinny Valley. Apparently represents Sylvania horizon of Mich. A detailed study of the fms. as exposed in Broadhead Creek section of Pa., will soon be published by Miss E. Kurtz.

The compiler cannot find any record of Miss Kurtz having published the promised paper, and the foregoing is only record of *Croasdale qtzite.*

Croatan sand.

Pliocene (lower): Coastal Plain of North Carolina north of Hatteras axis.

W. H. Dall, 1892 (Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, pp. 209, 213–216). For the beds found along estuary of Neuse River, N. C., the local Indian name of *Croatan beds* may be used. [Fossils listed.] The Croatan beds are obviously newer than those of the Waccamaw, yet when compared with the admitted Pleist. beds of S. C., such as those of Simmon's Bluff, the presence in the Neuse of 41 out of 96 species which have not been known later than Plio. forbids us to regard the fauna as later than Plio.

W. C. Mansfield, 1928 (U. S. G. S. P. P. 150, pp. 134–140), after a study of typical Croatan deposits and their fossils, discovered that beds of both Plio. and Pleist. age had been included in the fm., and he restricted the name to the Plio. beds, which consist chiefly of coarse ferruginous more or less fossiliferous sand rising to an observed max. height of about 4 ft. above the beach, and are uncon. overlain by Pleist. beds. He also changed name to Croatan *sand*.

Now regarded as approx.=Waccamaw marl, a name applied to the Plio. deposits S. of Hatteras axis.

Named for development around Croatan, near Neuse River, Craven Co.

Crockett member. (In Claiborne group.)

Eocene: Eastern Texas (Houston to Sabine Counties) and northwestern Louisiana.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Crockett memb. of Claiborne fm.*—Name proposed by E. A. Wendlandt and G. M. Knebel for that memb. of Claiborne fm. in Tex. which occurs below Milams memb. and above Sparta sand memb. At type loc., in vicinity of Crockett, Houston Co., the Cockfield overlies the Crockett, overlapping the Saline Bayou and Milams members. A composite section extending from 1.8 mi. N. of Crockett on Palestine road to 2.6 mi. SW. of courthouse on Midway road, is as follows (descending): (1) calc., brownish gray, fossiliferous clay with zone of small ferruginous concretions, 15 ft.; (2) brown, medium-fine sand, 2 ft.; (3) grayish-brown clay with sand partings and a few ferruginous concretions, 14 ft.; (4) brown clay, much weathered, 30 ft.; (5) brown, sandy clay with streaks of laminated clay, much weathered, 30 ft.; (6) ferruginous glauconitic ss., 1 ft.; (7) gray sandy clay with streaks of weathered glauconitic ss., 10 ft.; (8) gray, calc., fossiliferous clay and chocolate-brown carbonaceous clay with streaks of light-gray sand, 25 ft.; (9) ferruginous sand, cross-bedded, and clay lumps, 5 ft.; (10) grayish-brown clay with selenite, 30 ft.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, pp. 1351, 1360–1361). *Crockett fm.*—Chocolate brown and gray clay containing some beds of fossiliferous glauconite with concretionary zones of fossiliferous brown sandy ls., some thin beds of sand, clay, ironstone concretions, and in places is calc. Thickness 350 to 450 ft. Underlies Milams memb. of Cook Mountain fm. Overlies Sparta sands. Where overlain by Yegua fm. the contact is transitional and is usually selected where the last macro fossils appear. Well exposed SW. of Crockett, Houston Co., Tex.

In eastern Tex. these beds are treated as a memb. of Cook Mtn fm. by U. S. Geol. Survey and in La. as a memb. of St. Maurice fm.

F. B. Plummer, 1933 (Univ. Tex. Bull 3232, pp. 612, 655+). *Crockett fm.*—Underlies Cockfield fm., overlies Sparta fm., and includes Little Brazos ls., Moseley ls., and, at base, Eaton greensand lentil.

H. B. Stenzel, 1935 (Univ. Tex. Bull. 3501, pp. 267–279), restricted *Crockett* to the 100 ft. of partly marine beds above Moseley ls. and named the 85 ft. of underlying beds in Stone City section, Burleson Co., the *Stone City beds*. He included in his Stone City beds the Moseley ls. and Eaton greensand lentil of Renick, and stated that Crockett as restricted included a cgl. at base which rested discon. on Moseley ls.

Croghan moraine.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 41). Well-defined ridge from just W. of Petries Corners nearly to Croghan.

Croghan syenite granite complex.

Pre-Cambrian: Northwestern New York.

See under *Diana syenite complex.*

Croghan West moraine.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). Lies about 1 mi. W. of Croghan moraine and parallel to it from 2 mi. E. of Bush's Landing to Beaver River. Can be traced intermittently 6 mi. farther, to NW. of Croghan.

Croixan.

Croixian.

Variants of *St. Croixan series* that are used by some geologists.

Cromwell sand.

A subsurface sand, of early Penn. age, in Cromwell field, Seminole Co., central Okla.

C. O. Rison and J. R. Bunn, 1924 (Pet. Engineering in Cromwell oil field, Seminole and Okfuskee Counties, Okla., Reprint from Mid-Continent Oil and Gas Assoc. Year Book, Dec. 1, 1924, p. 7). *Cromwell sand zone* top is penetrated at 3301 to 3557 ft. depth. Thickness 125 to 174 ft. Lies 175 to 250 ft. below Harjo sand and 300 to 370 ft. below Brunner sand. All Penn.

A. I. Levorsen, 1927 (A. A. P. G. Bull., vol.. 11, No. 7), showed *Cromwell ss.* as underlying Pitkin ls. [Miss.] in south-central Okla., and as older than Gilcrease sand.

A. I. Levorsen, 1928 (Okla. Geol. Surv. Bull. 40BB, p. 17). [See under *Lyons ls.*, also under *Papoose sand* (of Okla.).]

This sand at its outcrop has been named *Union Valley ss. memb. of Wapanucka ls.*, by R. V. Hollingsworth (1934), and said to compose middle memb. of the Wapanucka, which is of early Penn. (Pottsville) age.

Cromwell moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Cromwell, Carlton Co.

Crooked River formation.

Recent(?): Central northern Oregon (Cascade Mountains).

E. T. Hodge, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 163). The *Crooked River fm.* partially fills great canyons cut in the *Madras fm.* and has been cut into canyons. In the high Cascade Mountains the drainage is deranged by the recent lavas. [All there is about *Crooked River fm.* and *Madras fm.* As the other fms. are described in ascending order, and as this is described after Deschutes sand, "probably post-Pleistocene," it is assumed it is probably Recent. Was this intended as a name for the intracanyon lavas that Hodge says overlie his Cascade fm. ?]

Crooks complex.

Pre-Cambrian: Central Arizona (Bradshaw Mountains).

T. A. Jaggar, Jr., and C. Palache, 1905 (U. S. G. S. Bradshaw Mtns folio, No. 126). *Crooks complex.*—Is closely associated with Bradshaw granite, but differs from it in that it is marked by alternations of diorite, aplite, gabbro, schist, and granite. Is largely intrusive igneous, and trend of its bands is often transverse to adjacent schists. In places it merges into Bradshaw granite. Although mapped as a single fm. it is really a mixture of diorite-granite and schist units in bodies too small to be differentiated on the map. The granite of the complex is identical with Bradshaw granite. The fm. is probably Algonkian. Named for exposures in Crooks Canyon in NW. part of this quad.

Cropsey morainic system.

Pleistocene (Wisconsin stage): Central eastern Illinois. See F. Leverett, 1899 (U. S. G. S. Mon. 38, p. 258). *Cropsey Ridge* runs past Cropsey, McLean Co.

†Cropsy Peak type.

A field named applied by E. S. Larsen to part of Fisher quartz latite on Cropsy Peak, Platoro-Summitville region, SW. Colo. (See Colo. Geol. Surv. Bull. 13, 1917.)

Crosby sandstone.

Upper Devonian: Western central New York (Keuka-Seneca Lake region).

I. W. Fox, 1932 (A. A. P. G. Bull., vol. 16, No. 7, pp. 677, 681, 687). *Crosby ss.*—Heavy, massive, brown ss., in 2 or more members, 6 ft. or less in thickness; in places weathers reddish brown. [According to scale of columnar section the 6 ft. is total thickness of Crosby ss.] The upper members are more massive and extremely hard. Rests on West River fm. and is basal memb. of Standish fm. in Keuka and Seneca Lake area.

Cross Cut sand.

A subsurface sand in Cross Cut-Blake dist., Brown Co., north-central Tex., that lies at 1,200 ft. depth, near div. line btw. Strawn and Canyon groups (Penn.), but whether it is of late Strawn or early Canyon age cannot be determined because of absence of Palo Pinto ls. (See E. D. Klinger's rept on the Cross Cut-Blake dist., Brown Co., Tex.) In Burkett deep well, Coleman Co., it lies at 1,400 ft. depth.

Cross Lake group.

Pre-Cambrian: Manitoba (Cross Lake area).

H. C. Horwood, 1935 (Roy. Soc. Canada Trans., 3d ser., vol. 29, sec. 4, p. 140).

Cross Plains sandstone.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Cross Plains ss.*—Ss. 50 to 200 ft. thick, lying near or 40 ft. below top of Appleton stage. Overlies Russellville shales. [Derivation of name not stated.]

Is a part of Atoka fm.

Cross Plains sand.

A subsurface sand, of Penn. age, in Baum field, Callahan Co., north-central Tex., lying at 1,650 ft. depth.

†Cross Timbers.

See under †*Upper Cross Timbers* and †*Lower Cross Timbers*. Named for development in physiographic province in eastern Tex. locally called "Cross Timbers."

Crosswicks clay.

Upper Cretaceous: New Jersey.

T. A. Conrad, 1869 (Am. Jour. Sci., 2d, vol. 47, pp. 359–360). *Crosswicks group.*—The lower beds of eastern Cret. are exposed in sections of the deep cut of Chesapeake and Delaware Canal and at Crosswicks. Fossils [listed].

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull. vol. 8, pp. 315, 329). *Crosswicks clays.*—Chiefly very dark-colored or black clays, at times slate or drab-colored toward top, or, as in vicinity of Matawan Creek, interstratified with layers of white sand; the dark clays frequently glauconitic. Named for village of Crosswicks, on Crosswicks Creek, Burlington Co. Composes lower part of Matawan fm. in Monmouth, Middlesex, Mercer, Burlington, and Camden Counties, N. J.

W. B. Clark, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 435–440). The *Crosswicks clays* include Woodbury clay bed above and Merchantville clay bed below, and compose basal part of Matawan fm. [group].

Based upon recent field work of C. W. Carter (under supervision of L. W. Stephenson), the U. S. Geol. Survey has recently adopted *Crosswicks clay* for the deposits in region of Chesapeake and Delaware Canal, Md.

and Del., which include the equivalents of Merchantville and Woodbury fms. of N. J., but which can not be differentiated either lithologically or faunally. *Crosswicks* was originally introduced to include the Merchantville and Woodbury fms. of N. J., which can be differentiated, and for that reason the name was many years ago discarded by U. S. Geol. Survey as unnecessary. It is now, however, considered more desirable to use *Crosswicks* in the Canal region of Md. and Del. than to introduce local name for the undiff. Woodbury and Merchantville deposits of that area.

Croton limestone. (In St. Louis limestone.)

Mississippian: Southeastern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, p. 231). *Croton ls.* substituted for "Springvale beds" of Bain, for lower memb. of St. Louis ls. in Iowa, because the beds at Springvale are now believed to be of Keokuk age. Discon. underlies Verdi or Upper St. Louis lss. and overlies Spergen fm. Consists for most part of massive, compact, buff to brownish dolomitic ls., but frequently these beds are found to grade laterally in short distances into dense, fine-grained gray nondolomitic ls. Again, the two phases may have an interbedded relationship. Is brecciated at many localities.

Named for exposures in vicinity of Croton, Lee Co.

Croton gypsum.

Permian: Central northern Texas (Stonewall County).

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 9). [*Croton gyp.* is shown as higher in section than Eskota dol. and lower than Memphis ss., all of which are included in so-called Whitehorse-Cloud Chief fm. Is mapped in Stonewall Co. Derivation of name not stated.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 167). Croton gyp. is same as Eskota gyp. and is discarded.

Croton Falls hornblendite.

Age (?): Southeastern New York (Westchester and Dutchess Counties).

C. R. Fettke, 1914 (N. Y. Acad. Sci. Annals, vol. 23, p. 228). *Croton Falls hornblendite.*—Massive, dark-green, coarsely crystalline hornblendite. A basic intrusive. Starts at Croton Falls and extends as a ridge, 2½ mi. long and ½ mi. wide, in NE. direction on E. side of Croton River. Associated with Manhattan schist.

Crouse limestone member (of Garrison shale).

Permian: Central northern Oklahoma (Osage County).

K. C. Heald, 1916 (U. S. G. S. Bull. 641B, pp. 21, 22). *Crouse ls.*—A prominent ls., 3± ft. thick, which lies 70± ft. below Wreford ls. and 50 ft. above Cottonwood ls. in Foraker quad., Osage Co. Characteristic features are form of outcrop, which shows many large massive blocks; absence of recognizable fossils in any abundance, with exception of small Fusulinas, which are plentiful; and presence of many smooth round holes, which are vertical or steeply inclined to the bedding.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), used this name in SE. Nebr. See under *Bigelow ls. fm.*

Named for Crouse Hill, Foraker quad., Osage Co.

Crowduck Lake conglomerate.

Pre-Cambrian: Ontario.

L. Greer, 1931 (Ontario Dept. Mines 39th Ann. Rept., pt. 3, p. 47).

Crowleyan series.

A term introduced by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 22, p. 252, 1915) for early Tert. deposits of Mo. Derivation of name not stated. In Pan-Am. Geol., vol. 39, No. 4, 1923, p. 320, he used *Crowleyan* to include Wilcox group and Porters Creek clay of Ill.

Crown conglomerate.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 66–67). *Crown cgl.*—Three cgls., each 10 or 20 ft. thick, interbedded with strata resembling typical Chisos beds. Many of pebbles and bowlders well rounded; most of them consist of various kinds of lavas and trap rocks, but lss. are also well represented, and some of these contain Lower Cret. fossils. Regarded as uppermost part of Chisos beds.

Named for Crown Peak, Brewster Co.

Crown Point limestone.

Lower Ordovician: Eastern New York (Champlain Valley).

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95), adopted the subdivisions of the Chazy proposed by E. Brainerd and H. M. Seely in 1888 (Am. Geol., vol. 2, pp. 323–330), as explained under *Chazy group*, and proposed *Crown Point ls.* for group B or middle Chazy, probably from exposures at or near Crown Point, Essex Co.

†Crow Ridge series.

Cretaceous and Jurassic: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, pp. 399–455). *Crow Ridge fm.* [on map], *Crow Ridge series* [text heading].—Altered argill. siliceous rocks—hornstone, adinoles, and qtzites—comprising all Mesozoic rocks of Elkhorn min. dist. Thickness 1,680 ft. Overlain by andesites. Underlain by Quadrant fm. Named for SW. spur of Crow Peak, to which name "Crow Ridge" is applied.

Includes part or all of Colorado sh., Kootenai fm., and Ellis fm.

Crow River morainic system.

Pleistocene (Wisconsin stage): Southeastern Minnesota (Hennepin and adjacent counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 84–86). Includes Anoka and Montrose moraines. Named for Crow River drainage basin in Hennepin and adjacent counties.

Crow's Mill limestone. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Springfield quadrangle).

T. E. Savage, 1915 (Ill. Geol. Surv. Bull. 20, pp. 99–107). *Crow's Mill ls.* is in McLeansboro fm. 176± ft. above coal No. 7 in Springfield quad.

G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 26). *Crows Mill ls.* of Springfield region lies 230± ft. above coal No. 6 and may = either Carlinville or Shoal Creek ls. [On p. 37 he says it lies 275± ft. above coal No. 6. On p. 43 he says it is probably same as Carlinville ls.]

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129–138). *Macoupin ls.* [new (?) name] is 4 to 7 ft. thick locally in Sangamon Co. and is known as *Crows Mill ls.*

Crowsnest volcanics.

Cretaceous: Alberta and British Columbia.

W. W. Leach, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 197).

Crow Wing formation.

Huronian (upper): Central Minnesota (Crow Wing, Aitkin, and Cass Counties).

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 101–106). The Upper Huronian (Cuyuna series) of Cuyuna dist. is lithologically divided into 3 conformable fms. (descending) Crow Wing fm., Aitkin fm., and basal cgl. The Crow Wing is divided into Cuyuna memb. (above) and Emily memb. (below).

See under *Cuyuna memb.* and *Emily memb.* Apparently named for Crow Wing Co., in N. part of which it covers a large area.

Cruse oil zone.

Tertiary: Trinidad.

G. A. Macready, 1920 (Am. Inst. Min. and Met. Engrs. Trans. [preprint 1017], p. 9).

Cruse sand.

Miocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 63).

†Crusher ledge.

A descriptive term applied in early Mo. repts to the ls. capping the bluffs at Kansas City. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 112, 121), stated: "Crusher ledge" at Kansas City is Argentine ls.

†Crusher Hill alternating shales and limestones. (In Council Grove group.)

Permian: Central Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kansas, p. 9). [No description except statement that thickness is 140 ft. and that the beds form lower part of Strong City beds, underlie Strong flints [Wreford ls.] and overlie 12 ft. of sh. [Florena] which rests on Cottonwood ls. Derivation of name not stated.]

Same as Neosho sh. memb., older name.

Cryptozoic eon.

A term applied by C. Schuchert and C. O. Dunbar (Textbook geol., pt. 2, pp. 70, 82+, 1933) to the pre-Camb. rocks as a whole, which they divided into Proterozoic and Archeozoic. Derived from the Greek κρυπτός, hidden.

†Crystal sandstone.

A shortened form of †*Crystal City ss.*, employed by C. [R.] Keyes.

Crystal Beach moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Probably same as Alden moraine of N. Y.

†Crystal City sandstone.

Lower Ordovician: Eastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 352, 358). ***Crystal City ss.***—Brittle white ss., 50 ft. thick, underlying Joachim ls. and overlying Potosi ls., in SE. Mo.

Discarded many years ago, as a local term for St. Peter ss., the older name.

Named for exposures at Crystal City, Jefferson Co.

Crystal Dale moraine.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 41). Extends N. from S. edge of Lowville quad. through Puffer School and just W. of Crystal Dale to within ½ mi. of Strifts School, thence bends to E. and extends 2½ mi. farther N., passing about a mi. E. of Kirschnerville. At S. end appears to merge with Dkob moraine.

Crystal Falls limestone member (of Harpersville formation).

Pennsylvanian: Central northern Texas (Stephens County, Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 39). *Crystal Falls ls. memb.*—In lower part of Harpersville fm., of Cisco group. Occurs in vicinity of Crystal Falls, Stephens Co.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 161–164). *Crystal Falls ls. lentil of Harpersville fm.*—Lowermost ls. of Harpersville fm. Lies 40 to 80 ft. above base of the Harpersville. Consists of yellow or gray ls., nodular, weathering locally red or purple, with av. thickness of 2 or 3 ft. Lies 60 to 80 ft. below Belknap ls. lentil of Harpersville. [Plummer and Moore distinctly showed 3 other lss. in interval btw. Crystal Falls ls. and Belknap ls., one of which is so-called "Upper Crystal Falls ls." of subsequent repts.]

The geol. maps of Coleman, Shackelford, and Stephens Counties issued by Tex. Bur. Econ. Geol. in Feb., May, and June, 1929, applied "Lower

Crystal Falls ls." to the Crystal Falls ls. of Plummer and Moore, and called a ls. lying 10 to 20 ft. above that ls. the "Upper Crystal Falls ls." They gave the thickness of the lower ls. as 5 to 10 ft. and of the upper ls. as 5 ft. E. H. Sellards, 1933 (Univ. Tex. Bull 3232), adhered to *Crystal Falls ls.* of Plummer and Moore, which is present approved definition of U. S. Geol. Survey.

Crystal Falls formation.

Upper Huronian: Northern Michigan (Crystal Falls district).

J. Zinn, 1933 (Mich. Acad. Sci., Arts, and Lett., vol. 18, pp. 446–448, 454). *Crystal Falls iron fm.*—In the past the iron fm. in Upper Huronian of Crystal Falls dist. has been called *Vulcan memb. of Michigamme sl.* But the true Vulcan of Menominee range is now thought to be Middle Huronian. For this reason the iron fm. at Crystal Falls will be referred to in this paper as *Crystal Falls fm.* It consists of rather thick horizons of cherty siderite, interlayered with thinner horizons of ferruginous or graphitic sl. The whole iron fm. is of considerable thickness if the interlayered slates be included. It rests conformably on the footwall graphitic slates, and is conformably overlain by the hanging-wall sediments. Has been traced almost continuously to Iron River dist. to W. and to Florence dist. to S.

†Crystal Falls series.

A term applied in some early repts to the Huronian rocks of Crystal Falls dist., Mich.

Crystal Mountain sandstone.

Ordovician (?) (Lower Ordovician ?): Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557; Slates of Arkansas, Ark. Geol. Surv., pp. 30, 32). *Crystal Mtn ss.*—Lower 300 ft. massive, coarse-grained, white ss. which weathers light brown; upper 400 ft. massive ss. interbedded with black to gray sh., the sh. in places altered to ribboned sl. In many parts of fm. the lower ss. is thickly set with network of quartz veins from thickness of knife blade to several inches; in other parts there are fissures from several inches to several ft. wide the walls of which are lined with magnificent clusters of quartz crystals, which gave rise to name of Crystal Mtns. Overlies, probably uncon., Collier sh.; grades into overlying Ouachita sh.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, pp. 67–68). "Ouachita sh." divided into 3 fms. and abandoned. The basal of the 3 fms. (here named *Mazarn sh.*) rests on Crystal Mtn ss. as here defined. The middle of the 3 fms. (here named ***Blakely ss.***) was in 1909 regarded by Purdue as upper part of Crystal Mtn ss., but has since been determined by Purdue and writer to occur in middle of "Ouachita sh." The ***Crystal Mtn ss.*** as here defined consists of 850 ft. of coarse-grained massive gray to brown ss., calc. in places, with a cgl. at base which contains ls. and chert pebbles derived from underlying Collier sh. Clusters of quartz crystals are found in fissures at many places. Has not yielded any fossils, but from strat. position is tentatively assigned to Ord. Rests uncon. on Collier sh.

Named for Crystal Mtns, Montgomery Co., Ark.

Crystal Pass limestone member (of Sultan limestone).

Devonian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 15, etc.). ***Crystal Pass ls. memb.***—Very thin-bedded light bluish-gray ls., of porcelain-like texture, without fossils or chert. Thickness 150 to 260 ft. Top memb. of Sultan ls. Underlies Dawn ls. memb. of Monte Cristo ls. (Dev.) and overlies Valentine ls. memb. of Sultan ls. Named for Crystal Pass, sec. 2, T. 25 S., R. 58 E.

Cuba sandstone.

Upper Devonian: Western New York.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, pp. 524–528). *Cuba ss.* is separated from overlying Wolf Creek cgl. by 600 ft. of beds containing common Chemung species, and rests on recognized Chemung deposits.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 25). *Cuba ss.* lies near middle of Chemung beds in Cattaraugus and Allegany Counties.

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, p. 968). *Cuba ss. lentil.*—Medium to coarse grained, somewhat arkosic ss., usually light cream colored. Thickness 10 to 15 ft. Exposed in quarry a few rods E. of Erie depot at Cuba, Allegany Co. Included in Chemung beds, about 40 ft. above their base in Olean and Salamanca quads.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Cuba ss.* lies stratigraphically below Girard sh. and above Northeast sh.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 152–153). *Cuba ss.* is a most important horizon marker; easily traced up Ischua Creek to near Machias [Cattaraugus Co.], where name *Ischua ss.* was early appropriated to it by Horseford. [Gives same strat. position as in 1923, and repeated it in 1925 (Geol. Soc. Am. Bull., vol. 36, p. 464).]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), placed Cuba ss. btw. Chadakoin (above) and Northeast sh. (below) and included them all in Chemung. She stated: *Cuba ss.* carries *Spirifer disjunctus* fauna and marks upper limit of *Spirifer (Delthyris) mesacostalis* in N. Y. Thickness 10 to 15 ft.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71), divided his Girard stage into Girard sh. (above) and Cuba ss. (below).

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.* Strat. position and names of underlying and overlying fms. changed.]

Cuba sandstone. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Cuba ss.* to beds in Carbondale fm. of Fulton Co. beneath his Big Creek sh. and uncon. above his Canton sh. Thickness and derivation of name not stated.

H. R. Wanless, 1931 (Ill. State Geol. Surv. Bull. 60, pp. 179–193). In places Cuba ss. cuts out Canton sh. and all beds down to under clay of coal No. 5.

Probably named for town of Cuba, Fulton Co.

Cuba moraine.

Pleistocene (Wisconsin stage): Southwestern Ohio. Belongs to Shelbyville morainic system. See U. S. G. S. Mon. 41 and Mon. 53. Named for Cuba, Clinton Co.

Cuchara formation.

Eocene: Southern Colorado (Huerfano County).

R. C. Hills, 1893? (Colo. Sci. Soc. Proc., vol. 4, p. 9; paper read Feb. 2, 1891). [See 1893? entry under *Poison Canyon fm.*]

H. F. Osborn, 1929 (U. S. G. S. Mon. 55). *Cuchara fm.* is of middle Wasatch age.

Cuchillo formation.

Lower Cretaceous (Comanche series): Southwestern Texas (Presidio region) and northern Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 324), and 1910 (Soc. geol. mexicana Bol., t. 7, p. 95).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 271, 294). *Cuchillo fm.* was named by Burrows, from Conchos Valley section N. of Kansas City, Mexico & Orient line, a short distance N. of Presidio. Overlies Las Vigas fm. and underlies the heavy-bedded main ls. called Aurora by Burrows, Mountain ls. by Hill, and upper Glen Rose-Fredericksburg. The Cuchillo is identifiable as the main horizon of *Dufrenoya* and *Douvilleiceras*, which Böse collected near Aurora mine, 5 km. S. of Cuchillo Parado.

Cucuracha formation.

Oligocene: Panama Canal Zone.

D. F. MacDonald, 1913 (Canal Record, vol. 6, p. 214, and Geol. Soc. Am. Bull., vol. 24, p. 709).

Cuesta diabase.

Lower Cretaceous: Southern California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Cuesta diabase.*—Geologically related intrusive masses and sheets of pre-Chico age, occurring upon opposite sides of the long area of Toro sh. which extends from near Cuesta Pass on S. to N. edge of San Luis quad. Other diabases occur in the area.

Named for exposures near Cuesta and Cuesta Pass, San Luis Obispo Co.

Cuesta formation.

Tertiary: Mexico (Baja California).

A. Heim, 1922 (Geol. Mag., vol. 59, p. 543).

Cueva rhyolite.

Tertiary(?): Southern New Mexico (Dona Ana County).

K. C. Dunham, 1935 (N. Mex. School Mines Bull. 11, pp. 53, 55). *Cueva rhyolite,* 120 to 250 ft. of tuffs, mud flows, and rhyolite flows. Younger than Orejon andesite and overlies Soledad rhyolite. Type loc. La Cueva, W. of mouth of Fillmore Canyon, Organ Mtns. In absence of evidence assigned to Tert.

Cuitaca granodiorite.

Age(?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 328).

Culberson series.

Permian: Western Texas.

C. [R.] Keyes, 1932 (Pan-Am. Geol., vol. 57, pp. 350, 351, 354). *Culbersonian reef series* occupies interval btw. Manzano ss. [Abo ss.] and Maderan [Madera ls.].

C. [R.] Keyes, 1933 (Pan-Am. Geol., vol. 59, pp. 143–145). The provincial assemblage of sediments centering on the Wiley ridge [Wiley Mtns, Tex.] is lately given title of *Culberson series,* a name derived from Culberson Co., Tex. Is older than Guadalupian series. Includes (descending) (1) ls., (2) Eddy sss., (3) lss. Its *most conspicuous memb. or terrane is* Eddy ss., 2,000 *ft. thick, the major part of* which is what G. B. Richardson called Delaware [Mtn] fm.

Culebra formation.

Oligocene and Miocene: Panama.

E. Howe, 1907 (*Isthmian Canal Comm. Ann.* Rept. 1907, pp. 108–138; Econ. Geol., vol. 2, p. 644) and 1908 (Am. Jour. Sci., 4th, vol. 26, p. 222).

Cullom limestone.

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 11, 20, 35). *Cullom ls.*—Massive fossiliferous ls. 4 to 8 ft. thick. Forms cliff. Overlies Kanwaka sh. and lies 6 to 8 ft. below Cedar Creek ls; all included in Platte sh. Named for town.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 45). *Cullom ls.* was named by Condra and Bengston from near Cullom Station, Cass Co., Nebr. It consists of 2 lss. separated by about 1 ft. of bluish gray argill.-calc. fossiliferous sh. The upper ls. is 2 ft. thick, gray, massive. In most places lower ls. is somewhat thinner than upper one and weathers yellowish brown. The Cullom ls. is very persistent, holding its faunal and lithologic features from southern Kans. to Rock Bluff, Nebr., and Folsom, Iowa.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 13). *Cullom ls.* abandoned, as another name has priority. The so-called Cullom ls. of Bull. 1 is DeKalb ls. memb.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 100). Studies by Condra, F. C. Greene, and Moore in Oct. 1932, indicate that †Cullom ls. (abandoned) is equiv. lower part of Westerville ls.

Cultus formation.

Triassic: Southern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 16 and 17). *Cultus fm.*—Chiefly dark gray to black argillite, with ss. and fine-grained cgl. Overlies Chilliwack series. [Mapped around S. shore of Cultus Lake, B. C., at and near 122° mer.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 516). *Cultus fm.* is 3,000 to 7,000(?) ft. thick. Occurs along Cultus Ridge. Few fossils, but little doubt as to Triassic age.

Cumberland sandstone.

Ordovician (Upper): Southern Kentucky.

N. S. Shaler, 1877 (Ky. Geol. Surv., 2d ser., vol. 3, pp. 152, 153, 155, 159–160, 387). *Cumberland ss.*—Fine-grained greenish ss., 30 to 100 ft. thick, at top of Cincinnati group or Blue Limestone series. Regarded as = Oneida cgl. and Medina ss. of N. Y. [On several pages is included in "Cincinnati series."] Underlies so-called Clinton ore.

A. F. Foerste, 1900 (Ind. Dept. Geol. Nat. Res. 24th Ann. Rept.). The Clinton ls. has often been included in *Cumberland ss.* by Linney. Shaler did not give section nor describe top and bottom limits, so that it is impossible to tell just what he included. But name will be found very useful for rocks in southern Ky., and may deserve a wider application. Is typical about Burksville, Cumberland Co. Is 5 to 100 ft. thick and unfossiliferous. Correlated with Oswego ss. by Linney and Ulrich.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 434–436). "*Cumberland ss.*" of Shaler belongs to Richmond group, but basal part may belong to Lorraine.

A. F. Foerste, 1902 (Am. Geol., vol. 30, btw. pp. 359 and 369). Major part of Shaler's Cumberland ss. is of Lorraine age, but it probably also included some beds of Richmond age.

J. M. Nickles, 1902 (Jour. Cincinnati Soc. Nat. Hist., vol. 20, p. 89). *Cumberland ss.* of Ky. probably belongs to upper div. of Richmond group.

A. M. Miller, 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 2). Saluda memb. (*Cumberland River ss.*) is top memb. of Richmond stage in Ky.

Named for exposures along Cumberland River in Cumberland and adjoining counties.

†Cumberland quartzite.

Pre-Cambrian: Northeastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 106–107). *Cumberland qtzites.*—Bands of qtzite interbedded with schists or green slates and forming part of Blackstone series. Believed to uncon. underlie Ashton schists. One outcrop traceable from S. side of Sneech Pond, along to main street southeastward for 1½ mi. in village of Cumberland Hill.

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, p. 11). "Cumberland" qtzite is same as Grafton [Westboro] qtzite, which has priority, and "Cumberland" is also in use in several other senses. Hence abandoned.

Westboro qtzite is now used instead of †*Grafton qtzite.*

Cumberland series.

Pennsylvanian: Nova Scotia and New Brunswick.

W. A. Bell, 1927 (Roy. Soc. Canada Trans., 3d ser., vol. 21, sec. 4, pp. 75–108, table).

Cumberland Gap shale member (of Chattanooga shale)

Devonian or Carboniferous: Southern Tennessee and southwestern Virginia.

J. H. Swartz, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 485–499). *Cumberland Gap memb.*—Lower black sh. memb. of Chattanooga sh. [restricted]. Conformably underlies Olinger gray sh. memb., the middle memb. of Chattanooga sh. [On p. 499: The Olinger memb. is of the same age as the [upper part of the] Cumberland Gap memb., with which it intertongues to S., representing merely a different environmental condition. In SE. Tenn. rests uncon. on Rockwood fm. From Rockwood northward it everywhere rests on interbedded gray and black sh. of Portage age. Clearly exposed along Lee Highway on N. edge of town of Cumberland Gap, Tenn. In vicinity of Chattanooga, Tenn., it is about 8 ft. thick; at Hagans, Va., 127′ 7″ thick; at Big Stone Gap, Va., about 90 ft.

J. H. Swartz, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 431–448), assigned these beds to Mississippian.

Cumberland Head shale.

Middle Ordovician: Eastern New York (Champlain Valley).

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95, map forming pl. 13). [On this map (of portion of towns of Plattsburg and Peru, Clinton Co.) *Cumberland Head shales* block is placed above Trenton lss.]

H. P. Cushing and R. Ruedemann in 1910 (N. Y. State Mus. Bull. 145, p. 97) correlated *Cumberland Head sh.* with upper part of Trenton ls. of Trenton Falls and Watertown region, and called underlying ls. Trenton ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), correlated *Cumberland Head sh.* of Champlain Valley with middle and lower Trenton and as=Canajoharie and Snake Hill shales of east-central N. Y.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 39). For shaly phase of upper Trenton typically developed along East Canada Creek below Dolgeville, Herkimer Co., Cushing (1909) has proposed the name *Dolgeville sh.* These shales were previously described by Cushing as "Trenton-Utica passage beds." In Lake Champlain region to N. and E. from Plattsburg somewhat similar passage beds of uncertain strat. equivalency have been mapped as *Cumberland Head sh.* by Cushing (1905).

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 108–116). *Cumberland Head sh.* (Cushing 1905, pl. 13) consists of blue-black slaty lss. and calc. shales with some firmer ls. bands. Replaces Canajoharie sh. on N. Y. side of Champlain Basin. Lithologically very different from Canajoharie sh. of Panton shore and southern Champlain basin in general, for prevailing element is slaty ls. and graptolite sh. was not observed at all. Beds are strangely barren of fossils, but those found suggest lower and middle Trenton. Are probably in part at least= Canajoharie sh., but are lithologically and faunistically a different facies and deposited under different conditions if not in a separate basin, therefore deserve separate name. Named for Cumberland Head, near Plattsburg, N. Y. Overlain by Stony Point sh. and underlain by Trenton ls.

Cumberland River sandstone.

Upper Ordovician: Southern Kentucky.

See 1919 entry under *Cumberland ss.*

Cumnock formation. (In Newark group.)

Triassic (Upper): Central North Carolina.

M. R. Campbell and K. K. Kimball, 1923 (N. C. Geol. and Econ. Surv. Bull. 33, pp. 20, 25–43). The name *Cumnock fm.* is given to the generally light-colored rocks (shales, sss., and cgls.) bearing coal or associated with the coal. Varies greatly in thickness and composition throughout the field. On Cumnock property it includes at top brown sss. and shales. Cumnock coal bed lies from 100 to 150 ft. above its base. Thickness of fm. 600 to 1,000 ft. Is middle fm. of Newark group. Underlies Sanford fm. and overlies Pekin fm.

Named for section exposed in mine shaft at Cumnock, Lee Co.

Cundiff limestone. (In Caddo Creek formation.)

Pennsylvanian: Central northern Texas (Jack County).

J. M. Armstrong, 1929 (Tex. Bur. Econ. Geol., geol. map of Jack Co.). *Lower Cundiff ls.* lies 50± ft. above base of Caddo Creek fm. and *Upper Cundiff ls.* lies 90± ft. above Lower Cundiff ls.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 40). Three ledges of ls. outcropping in E. part of Jack Co. near Cundiff, take their name from the village. The *Upper Cundiff ls.* consists of 3± ft. of hard crystalline ls. apparently of algal origin; it is present in Wise Co. The *Lower* [*Middle*] *Cundiff ls.* consists of 3± ft. of hard crystalline ls. apparently of algal origin; it is present in Wise Co. and is separated from Upper Cundiff ls. by 75± ft. of sh. The lower of the 3 ls. ledges pinches out before Wise Co. is reached. The Cundiff ls. overlies Hog Creek shales, both of which are members of Caddo Creek fm.

Cunningham sands.

Subsurface sands of Chester (Miss.) age in Ind., *Cunningham shallow sand* being applied to a sand correlated with Cypress ss., and *Cunningham deep sand* to a sand correlated with Sample ss.

†Cup Coral member. (In Dornick Hills formation.)

Pennsylvanian: Central southern Oklahoma (Carter County).

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull. vol. 6, No. 1). *Cup Coral memb. of Glenn fm.*—Blue shales separated by thin sss. and an occasional ls.; 1,500 to 1,800 ft. thick. Is easily distinguished by a white ls. near top, which carries a large cup coral (*Campophyllum torquium*); S. of Ardmore the ls. is exposed in only one place. To S. of Woodford 5 of the 7 ss. beds are asphalt bearing. Fossils listed. Underlies Deese memb. and overlies Otterville ls. memb.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331–347). *Glenn fm.* includes only Deese and Cup-Coral members of Goldston.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7–21). Deese fm. (5,000± ft. thick) underlies Hoxbar fm. and rests on Dornick Hills fm., which overlies Springer fm. and includes Otterville ls. restricted.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). *Dornick Hills fm.*, 1,500 to 4,000± ft. thick, includes Goldston's Otterville and Cup Coral members of Glenn fm. and a little more. "Cup Coral memb." is discarded as confusing and inappropriate. As mapped by Goldston its strat. limits were rather variable, and name gives no clue to type loc. Also, cup corals are common at certain horizons in overlying Deese fm., and occur also in Jolliff, Otterville, and other ls. members of Dornick Hills fm., and at one locality in Hoxbar fm.

†Cupriferous series.

A descriptive term (meaning copper bearing) applied in early repts on Lake Superior region to *Keweenawan series* of modern nomenclature.

Curdsville limestone.

Middle Ordovician (Trenton): Central Kentucky.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 9, 18). *Curdsville substage.*—Cherty crystalline ls., 30 ft. thick, characterized by *Dinorthis pectinella*. Overlies Highbridge ls. and underlies Logana bed. Basal fm. of Lexington stage.

Named for Curdsville Station, Mercer Co.

Curecanti granite.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). More homogeneous than the other granitic bodies of the region. Chiefly a pink to gray fine-grained, even-textured granite in which either biotite or muscovite, or both, may be present. Small irregular patches of coarse or even pegmatitic granite are scattered throughout the mass. Intrudes the Archean biotite schist. Is exposed for 3½ mi. along Black Canyon, from a point 1½ mi. E. of Curecanti Creek to Nelson Gulch. Extends only a short distance up Curecanti Creek, but walls lower canyon of Blue Creek for 1½ mi. from its mouth.

The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

†Curl formation.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 26). *Curl fm.*—Shales and sss., with bluish or greenish clay sh. in lower part. Thickness 300 ft. Underlies Hogshooter ls. and overlies Lenapah ls.

Same as Coffeyville fm., older name.

Named for Curl Creek, Nowata Co.

Curlew limestone member (of Tradewater formation).

Pennsylvanian: Western Kentucky and southeastern Illinois (?).

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pl. showing section of Lower Coal Measures) and 1857 (Ky. Geol. Surv. vol. 3, pp. 13, 23). *Curlew ls.*—Ls., 4 ft. thick, in Lower Coal Measures; separated from overlying Curlew ss. by 34 ft. of sh., including Curlew coal and with ss. or ls. at top.

Apparently named for Curlew, Union Co., Ky.

†Curlew sandstone. (In Tradewater formation.)

Pennsylvanian: Western Kentucky and southeastern Illinois (?).

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pl. showing section of Lower Coal Measures) and 1857 (Ky. Geol. Surv. vol. 3, pp. 13, 23). *Curlew ss.*—Massive ss., 20 ft. thick, in Lower Coal Measures; separated from underlying Curlew coal by 5 ft. 3 in. of sh. or ls. and 5 ft. of sh. Overlain by 42 ft. of sh. with clay ironstones.

Apparently named for Curlew, Union Co., Ky.

Curry iron-formation member (of Vulcan iron-formation).

Pre-Cambrian (middle Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Curry ore-bearing memb.*—Top memb. of Vulcan fm. Consists of 100 to 225 ft. of interbedded jaspilites and ferruginous quartzose slates. Grades into underlying Brier sl. memb. Underlies Hanbury sl. Named for exposures north of Curry Mine.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), adopted *iron-fm.* and *iron-fm. memb.* as lithologic terms, and changed age of *Vulcan iron-fm.* from upper Huronian to middle Huronian, and adopted *Curry iron-fm. memb.* for the Curry rocks.

Curry Creek series.

Oligocene: British Columbia.

L. Reinecke, 1915 (Canada Geol. Surv. Mem. 79, pp. 53, 56).

Curtis formation. (In San Rafael group.)

Upper Jurassic: Southeastern and central Utah and southwestern and northwestern Colorado.

J. Gilluly and J. B. Reeside, Jr., 1926 (U. S. G. S. Press Bull. 6064, March 30, 1926. Name adopted at joint conference of J. Gilluly, J. B. Reeside, Jr., R. C. Moore, and H. E. Gregory, from area specially studied by Messrs. Gilluly and Reeside.) *Curtis fm.*—Green-gray cgl. and sh. and heavy-bedded gray ss. Thickness 76 to 253 ft. Uncon. overlies Entrada ss. and conformably underlies Summerville fm. Belongs to San Rafael group.

Named for exposures on Curtis Point, near head of Cottonwood Springs Wash, on NE. side of San Rafael Swell, SE. Utah.

For additional details see U. S. G. S. P. P. 150, 1928 (by J. Gilluly and J. B. Reeside, Jr.), and U. S. G. S. P. P. 183, 1936 (by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.).

Curzen limestone.

See *Curzon ls.*

Curzon limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri, southeastern Nebraska, and northeastern Kansas.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 57). *Curzons ls.*—Underlies Forest City sand rock and overlies sh. Higher ls. than Forbes ls. Included in Perm.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). Years ago Mo. Surv. used name *Curzen* for what seems to be basal 5 to 8 ft. of Topeka ls. memb. of Shawnee fm. It consists of bluish gray to brownish ls. interbedded with thin shales. Is overlain by Turner Creek sh. and underlain by Iowa Point sh., top bed of Calhoun sh. memb. of Shawnee. [This is definition followed by R. C. Moore and G. E. Condra, 1932.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11). *Hartford (Curzon) ls.*, basal memb. of Topeka ls. fm., usually consists of 4 or 5 uneven, dark-gray beds separated by sh. seams, but in places consists of 2 beds separated by sh. Thickness 6 to 7 ft. Underlies Turner Creek sh. memb. and overlies Iowa Point sh. memb. of Calhoun sh. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 195). Rock to which Gallaher referred as *Curzen's ls.* is unidentifiable; and therefore Condra is author of name. Condra gives no type loc., but presumably 1 is in vicinity of Curzon [Holt Co.], Mo. Name is discarded. Condra agrees (personal communication, July 8, 1934) *Hartford* is preferable to *Curzen.*

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser.), restricted *Curzen ls.* as explained in June 1937 entry under *Topeka ls.* On p. 51 they state: Type loc. of Curzen ls. is E. of Curzon Station, SE. of Forest City, Holt Co., Mo. Reason for apparent change in spelling of name of station since Gallaher worked there has not been learned. It is assumed Gallaher had opportunity to secure correct spelling and that R. R. may have changed spelling through error.

Named for Curzon, Holt Co., Mo.

Cushina formation.

Lower Ordovician: British Columbia (Robson district) and Alberta.

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, p. 458); 1924 (ditto, vol. 67, No. 9, p. 485); and 1928 (ditto, vol. 75, p. 226). *Cushina fm.*, Lower Ozarkian, B. C.

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 304–307). *Cushina fm.* is=Mons fm. and is Lower Ord.

Cushing granodiorite.

Late Carboniferous (?): Southwestern Maine.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 176). *Cushing granodiorite.*—Thoroughly gneissoid, of light to dark-gray color, and for most part finely and evenly but only slightly porphyritic in texture. Assigned to late Carbf. (?). Named for exposures on Cushing Island, in Casco Bay.

On 1933 geol. map of Maine, by A. Keith, this granite appears to be mapped as Carbf.

†Cushing limestone member (of Elmdale formation).

Pennsylvanian: Central northern and central Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 80). The Elmdale fm. consists of variegated shales with thin lss., usually less than 3 ft. thick, including *Cushing ls. memb.* The Cushing memb. has been traced farther S. into the red beds than any other ls. It is exposed near [about ½ mi. W. of] Cushing [Payne Co.], and has been followed S. across Lincoln Co., passing near Chandler, Sparks, and Prague, and finally disappears N. of North Canadian River in NE. Pottawatomie Co.

This ls. is now known to be the Red Eagle ls. memb., which has priority, and the name "Cushing" has been abandoned. (See Okla. geol. map, H. D. Miser, 1926.)

Cusseta sand member (of Ripley formation).

Upper Cretaceous: Western Georgia (Stewart, Chattahoochee, Marion, Schley, Taylor, Macon, Crawford, Houston, Bibb, and Twiggs Counties).

J. O. Veatch, 1909 (Ga. Geol. Surv. Bull. 18, pp. 86–89). *Cusseta sand memb. of Ripley fm.*—Non-calc. sands and clays. The sands, which predominate, are made up of quartz and mica, are unconsolidated, varicolored, cross bedded, and generally fine grained. They are unfossiliferous except for lignitized and silicified wood, and are often very ferruginous, containing thin crusts and layers of siliceous limonite, and limonitic nodules. In the sand are pockets of white, drab, and black, massive-bedded clays, and also thin lenticular layers of laminated clays. The clay is both light and dark colored and massive bedded, and contains well-preserved fossil leaves and minute cubes of pyrite. Underlies Renfroes marl and overlies Blufftown marl, the basal memb. of Ripley. Thickness 250 to 800 ft.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 135, 151–153, 155). Northeastward from Chattahoochee River the basal 200 or 300 ft. of the marine beds composing Ripley fm. merge along the strike into shallow-water equivalents (*Cusseta sand memb.*), which differ in their essential lithologic characters from typical Ripley beds. The Cusseta memb. consists of irregularly bedded, unconsolidated sands, with subordinate clay lenses, probably of sound or estuarine origin, but perhaps in part of shallow marine origin. Typical marine beds ("Renfroes marl" of Veatch) separate Cusseta sand memb. from overlying Providence sand memb. in narrow belt from Chattahoochee region through Stewart, Chattahoochee, Marion, and Schley Counties, to Macon Co., where they appear to pinch out, so far as surface outcrops are concerned, but there is evidence that buried representatives of these typical marine beds extend E. at least as far as Marshallville. The similarity of the materials of Cusseta sand memb. to the shallow-water phase of underlying Eutaw fm. in its E. extension renders the two fms. separable only with difficulty, and the same is true of this memb. with respect to overlying Providence sand memb. where the intervening marine beds pinch out. The Cusseta memb. outcrops in parts of Stewart, Chattahoochee, Marion, Schley, Taylor, Macon, Crawford, Houston, Bibb, and Twiggs Counties. [pp. 151–153.] [On p. 135 of above rept. is a section at Blufftown, which gives thickness of Cusseta memb. as 100 ft., and shows it as underlain by 50 ft. of "typical marine beds" of Ripley, consisting of gray calc. sand with some fossils, which forms top bed of

Veatch's "Blufftown marl," the rest of the †Blufftown being the gray, calc., glauconitic sand and gray calc. aren. clay that form upper 45 ft. of Eutaw fm.]

L. W. Stephenson and J. O. Veatch, 1915 (U. S. G. S. W. S. P. 341, p. 65), repeated foregoing description of *Cusseta sand memb.* but did not repeat the Blufftown section and did not describe any typical Ripley beds as underlying Cusseta memb., but described the Cusseta as basal memb. of Ripley fm. and Tombigbee sand as upper memb. of Eutaw fm. All subsequent repts (Ga. Geol. Surv. Bulls. No. 21, 1916; No. 31, 1917; and No. 44, 1929; and Jour. Geol., vol. 27, pp. 177–179, 1919) treat Cusseta sand as basal memb. of Ripley and Tombigbee sand as upper memb. of Eutaw fm. Whether the 50 ft. of Ripley marine beds said to underlie the Cusseta in the several counties mentioned above are now included in Cusseta sand memb. or in underlying Eutaw fm. is not apparent, but, being marine, they are probably included in Tombigbee sand memb.

Named for exposures in vicinity of Cusseta, Chattahoochee Co.

†Cussewago sandstone.

Devonian or Carboniferous: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 91–98). *Cussewago ss.*—As exhibited along Cussewago Valley [Crawford Co.] this is a very peculiar rock, usually of buffish brown color but in places dark green or greenish blue; is quite coarse, and in many places contains pebbles. Thickness 25 ft. Underlies *Cussewago Middle shales and flags* and overlies Riceville shales. Is basal fm. of Oil Lake group.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69) and 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 461, 463, 464), renamed *Cussewago sh.* (calling it *Hayfield sh.*) and retained *Cussewago ss.* for the ss. overlying Riceville sh.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202), divided "Knapp fm. (revised Cussewago group)" of NW. Pa. into (descending): Hayfield sh. memb., Glade ss. memb., Ridgway sh. memb., Ludlow cgl. memb., and Smethport sh. memb. (or upper "Riceville"). He did not explain relations of Glade ss. and underlying members to Cussewago ss. In 1934 (Bulls. Am. Pal., vol. 21, No. 71) Caster divided the rocks btw. the "middle sh." and the Riceville into (descending) Wetmore cgl. memb. and Kushequa sh. memb. (including Marvin Creek ls. zone), and discarded Cussewago ss.

Cussewago shales.

Devonian or Carboniferous: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 94–96). *Cussewago Upper shales.*—Bluish or ashen gray shales 5 ft. thick. Underlie Corry ss. and overlie *Cussewago ls.* (2 ft. thick), which rests on *Cussewago Middle shales and flags*, 30 ft. thick and lithologically like Cussewago Upper shales. The Cussewago Middle shales rest on *Cussewago ss.* In some places the whole interval btw. Corry ss. and Cussewago ss. is filled with sandy flags without the ls. The Cussewago ls. greatly resembles Meadville Upper and Meadville Lower lss. but is a better ls. All included in Oil Lake group.

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 461, 463, 464). *Cussewago sh.* is renamed *Hayfield sh.*, and *Cussewago ss.* is retained for the ss.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 60, etc.), included Cussewago ls. of White in Hayfield sh. of Chadwick.

Cussewago limestone.

See under *Cussewago shales.*

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202), introduced *Littles Corner ls.* for a ls. in Hayfield sh. "that is probably the Cussewago ls. of White," but he did not define it. In 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 116, 121) Caster stated *Littles Corner ls.* replaces Cussewago ls.; and he included it in Hayfield fm. of Chadwick, which was introduced to replace Cussewago sh. of White. Chadwick called this ls. "Hayfield ls."

Cussewago stage.

Cussewago monothem.

Terms applied by K. E. Caster (Bulls. Am. Pal., vol. 21, No. 71, 1934, table opp. p. 61, pp. 53, 103) to the rocks underlying Berea (Corry) ss. and overlying his Riceville sh. restricted in NW. Pa. Include (descending)

Hayfield sh., Littles Corner ls., Tidioute sh., Cobham cgl., East Kane sh., Wetmore cgl., and Kushequa sh., the latter the upper part of Riceville sh. of previous usage.

Custards shale member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 137). *Custards sh. memb. of Meadville stage.*—Lies at top of Meadville monothem in Crawford Co., where it rests on French Creek ls. Was mentioned by I. C. White as "Meadville upper shales." From exposures in vicinity of Custards village, on Conneaut Creek, Crawford Co., it is proposed this memb. be known as *Custards sh.* Best exposure is at Peterson's Falls, on Rocky Creek, 2 mi. W. of Custards.

Custer granite gneiss.

Jurassic (?): Southwestern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 15, 121° to 121° 30'). *Custer granite gneiss.*—Sheared granodiorite. [Forms Custer Ridge, B. C.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 523). Custer granite gneiss seems to cut Hozomeen series. Tentatively referred to Jurassic (?). Is possibly pre-Camb. or late Paleozoic.

Custer formation.

Triassic (?): Oklahoma, Texas, Kansas.

R. Roth, 1932 (Jour. Geol., vol. 40, No. 8, pp. 688–725). *Custer fm.* is herein proposed for those red beds which in Kans. occur btw. Dog Creek shales and Lower Cret. or Comanche group. It occupies same interval in Okla. except where Dog Creek shales are absent, in which case the Custer may rest upon various members of the Blaine or Flower-Pot shales. In Tex. the Custer occupies interval btw. base of Memphis ss. and Santa Rosa cgl., or btw. the shales that overlie Croton gyp. and Camp Springs cgl. or Comanchean at Double Mtn, Tex. In West Tex. the Custer is=interval btw. Santa Rosa cgl. and Capitan ls. or top of Carlsbad ls. Named for Custer Co., Okla., where almost whole fm. is well exposed. The uncon. at base of the Custer increases as distance from Rocky Mtns decreases, except in Tex. Writer believes it is present well above the Queen sand zone. [Assigned Custer to Lower Triassic (Bunter of Europe) and correlated it with Moenkopi, Timothy, Thaynes, Woodside and other Triassic fms. of Rocky Mtns region, which he states it resembles in lithology.]

G. E. Anderson, 1933 (Jour. Geol., vol. 41, No. 8, pp. 834–839). Roth (1932) included in Triassic the Whitehorse ss., Cloud Chief gyp., and the Quartermaster. For these 3 units he proposed *Custer.* [Anderson discusses Roth's reasons for assigning these rocks to Triassic, and does not accept them. He assigned the rocks to Perm., as heretofore.]

Custerian series.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 43, pp. 109, 125, 126). The Morrison strata, which because of character of their vertebrate fauna were formerly given a Late Jurassic date, are now best treated with the Early Cretacic deposits—not the marine Comanchean series of Gulf Embayment, but a distinct provincial succession, the *Custerian series* of fluviatile and epirotic accumulations of Black Hills region. The entire section is well displayed in Black Hills. [Includes Fuson, Minnewaste, and Lakota fms., and in table on p. 109 excludes "Morrisonian series."]

Named for exposures in Custer Co., S. Dak.

Cutbank sand.

Lower Cret., Mont. See under *Moulton sand.*

Cutler formation.

Permian: Southwestern Colorado, southeastern Utah, and northeastern Arizona, and northwestern New Mexico.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). Beds here named *Cutler fm.* compose greater part of "Red Beds" of region. They were hitherto provisionally included in Dolores fm. Field work of 1904 in Ouray quad. revealed notable angular uncon. immediately below the most commonly fossiliferous beds of Dolores fm. Through this uncon. the Dolores [restricted] can be seen to transgress more than 1,000 ft. of old "Red Beds" and several hundred ft. of Rico and Hermosa. In view of these facts the name *Dolores* is here restricted to the Triassic strata, embracing the fossiliferous cgl. and overlying beds up to La Plata ss., of Jurassic age, and the non-fossiliferous strata btw. Rico fm. below and base of Triassic are named *Cutler fm.*, for exposures on Cutler Creek, which enters Uncompahgre River about 4 mi. N. of Ouray, Colo. The Cutler is a complex of bright-red sss. and lighter-red or pinkish grits and cgls. alternating with sandy shales and earthy or sandy lss. of varying shades of red. It rests conformably on Rico fm. and is uncon. overlain by Telluride cgl. (Tert.), the Triassic Dolores fm. restricted being absent in this (Silverton) quad. Thickness of Cutler 1,000+ ft.

The present definition of Cutler fm. in its type region (SW. Colo.) conforms to above original definition, namely, it rests conformably on Rico fm. and is uncon. overlain by Dolores fm. (Upper Triassic and Jurassic?), where that fm. is present. In SE. Utah, NE. Ariz., and NW. N. Mex. the Cutler is overlain by Moenkopi fm. (Lower Triassic) and underlain by Rico fm. (See A. A. Baker and J. B. Reeside, Jr., A. A. P. G. Bull., vol. 13, No. 11, 1929, pp. 1413–1448.) In a part of SE. Utah (Salt Valley anticline and NW. flank of Uncompahgre Plateau, Grand Co.) where the lss. of Rico fm. are absent, the red beds corresponding to Rico fm. of SW. Colo. are now included in Cutler fm. (See U. S. G. S. Bull. 863, 1935, by C. H. Dane.)

Cutler limestone member (of McLeansboro formation).

Pennsylvanian: Southwestern Illinois (Perry County).

A. H. Bell, C. Ball, and L. McCabe, 1931 (Ill. Geol. Surv. Press Bull. 19). *Cutler ls. memb.*—Mottled ls., light-gray with pink or purplish cast, massive, fossiliferous, with black spherical concretions. Thickness 5 to 8 ft. Base lies 6 to 19± ft. above Galum ls. memb. and 52± ft. above Herrin (No. 6) coal in vicinity of Pinckneyville and Jamestown, Perry Co. Named for typical exposures in vicinity of Cutler, Perry Co.

Cutright sandstone member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 118, 181, 182, 189, 212+, 250, 256, 278, etc.). *Cutright ss. memb. of Edwardsville fm.*—Massive ss. with *Taonurus;* 7 ft. thick at Gent, where it lies 6 ft. above base of Edwardsville. In other sections it is 3 to 6 ft. thick. On road leading to Cutright Ridge, S. center sec. 4, T. 7 N., R. 1 E., 1¼ mi. SE. of old Payne P. O., it is 1 ft. thick. [In pl. 5, opp. p. 212, author places Cutright ss. memb. 6± ft. below Weed Patch memb. and on p. 214 he gives a section showing it 10½ ft. above Floyds Knob fm. On p. 279 he states it is named for Cutright bridge across Salt Creek, center sec. 4, T. 7 N., R. 1 E., from Cutright Ridge to S., and from "the Cutright community" in general, and that it is fine-grained, somewhat argill., usually more tightly cemented than many of Edwardsville sss.]

Cuyahoga formation (also **Cuyahoga group**).

Mississippian: Ohio and western Pennsylvania.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 21). *Cuyahoga sh.*—Dove-colored sh. and fine blue ss., 150 ft. thick, overlying Berea grit and forming topmost fm. of Waverly group in northern Ohio. Underlies Sub-carbf. [Maxville] ls.

As above defined Cuyahoga included at base the black Sunbury sh. As later used by Prof. Newberry it included Black Hand and Logan fms. Sunbury was excluded from Cuyahoga by Orton in 1879, and Logan was excluded in 1880. Black Hand was made a distinct fm. in 1878, but some geologists now include part of Black Hand in Logan fm. and the rest of it in Cuyahoga fm. (See J. E. Hyde, Jour. Geol., vol. 23, pp. 655–682, 757–759, 1915.) The U. S. Geol. Survey at present follows the original definition of *Black Hand*, treating it as a distinct fm. underlying Logan fm. and overlying Cuyahoga fm. (See under *Black Hand fm.*) The

Ohio Geol. Survey, however, appears to follow Hyde's expanded definition of Cuyahoga, which includes, at top, the Black Hand memb. of Hyde. In NW. Pa. and NE. Ohio the *Cuyahoga group* is divided into (descending) Meadville sh., Sharpsville ss., and Orangeville sh.

Named for exposures along Cuyahoga River, btw. Akron and Cleveland.

Cuyama formation.

Tertiary (Pliocene?): Southern California (Cuyama Valley).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215). *Cuyama fm.*—Nonfossiliferous yellow and pink clays, sand, and gravel, in large part nonmarine. Thickness 250 to 600 ft. Rest on eroded edge of Santa Margarita fm. and older beds. Crop out only in Cuyama Valley. Overlain by Quat. terrace gravels.

Cuyamaca basic intrusive.

Probably pre-Cretaceous: Southern California (Cuyamaca region, San Diego County).

F. S. Hudson, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 6, pp. 181, 192–207, map). *Cuyamaca basic intrusive.*—Chiefly gabbros, norites, and basic diorites. Three units mapped (1) hypersthene diorite, (2) augite diorite, and (3) norite, gabbro, etc. Cuts Julian schist and Stonewall quartz diorite.

Named for the three peaks of Cuyamaca Mtns.

†Cuyuna series.

Huronian (upper): Central Minnesota (Crow Wing County).

C. K. Leith, 1907 (Econ. Geol., vol. 2, pp. 145–152), described the rocks (sed. and igneous) of Cuyuna Range, Minn., but did not apply geographic names to any of the fms. On p. 147, however, he casually used the term *Cuyuna series*, stating that "the anamorphism of the Cuyuna series is probably to be explained in large part by the existence of intrusives in the area itself and to the west and south of it." On p. 149 he stated: The *Cuyuna sediments* probably belong in the same series with the slates and schists of the Carlton, Cloquet, and Little Falls areas. On p. 150 he said: Succession and lithology are in accord with distribution and general structural relations in pointing to the identity of the Cuyuna-Carlton-Little Falls series with the Upper Huronian or Animikie of the Lake Superior region. On p. 151 he spoke of the "probable equivalence of the Cuyuna and Carlton series."

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 99–106), described the rocks of Cuyuna dist., Minn., and divided them as follows:

Post-Keweenawan shaly sediments and cgls.
Uncon.
Keweenawan.
    Basic intrusives and extrusives.
    Acid intrusives.
Uncon.
Upper Huronian (*Cuyuna series*).
    Crow Wing fm.
        1. *Cuyuna memb.* (mainly green slaty and schistose rocks (partly volcanic), enclosing, in lower part, the Deerwood iron-bearing memb.). Strongly magnetic.
        2. *Emily memb.* (some green but largely dark-colored slaty rocks, probably few if any volcanics, and many scattering lenses of iron-bearing rocks, which are only slightly magnetic or nonmagnetic).
    Gradation.
    Aitkin fm. (gray slates and phyllites; volcanics absent; contains some iron carbonate, but extensive iron-bearing lenses virtually lacking; nonmagnetic).
    Basal cgl.
Uncon.
Middle Huronian (Mesabi group).

The U. S. Geol. Survey does not use a local geographic name for the upper Huronian rocks of the different districts of Mich., Minn., and Wis., but for many years called them all "Animikie group," to which the so-called "Cuyuna series" corresponds. "Animikie group" has now, however, been discarded, because it is said to include rocks of both upper and middle Huronian age.

Cuyuna member (of Crow Wing formation).

Huronian (upper): Central Minnesota (Crow Wing County).

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 101–106). *Cuyuna memb.*—Mainly green slaty and schistose rocks (partly volcanic), enclosing, in lower part, Deerwood iron-bearing memb. Is strongly magnetic. Uncon. underlies Keweenawan rocks, and overlies Emily memb. As one approaches upper part of Emily memb. of Crow Wing fm. the green-colored rocks become dominant over the darker rocks, and gradually all the differences become sufficiently pronounced to justify considering upper part of Crow Wing fm. as a separate memb., now named *Cuyuna memb.* The Cuyuna memb. contains an abundance of volcanic rocks. Some of these are contemp. basic flows and some are tuffaceous, and all are very schistose and green, wherefore the term "green schist," which has become so common a term and has been used promiscuously, applying often to rocks of all colors, has arisen. Most of drilling in Cuyuna dist. has been in this horizon. It marks the productive part of Cuyuna dist. The Cuyuna memb. contains small narrow layers of dark rocks but none of these are extensive nor are they horizon markers. It also contains nearly all the qtzite that drilling has disclosed, and none of these are horizon markers. It also contains very extensive bands of iron-bearing fm., which were originally a cherty iron carbonate and now show all stages of metamorphism. Near base is a persistent layer of ore fm. About 500 ft. or more above it is a second layer. Collectively these have heretofore been called *Deerwood ore-bearing memb.*

Cygne shales.

A corruption of "Marais des Cygnes shales," employed by C. [R.] Keyes, instead of *Pleasanton fm.*, the commonly accepted name. (See Pan-Am. Geol., vol. 56, pp. 348–349, 1931.) He also uses *Cygnes shales* for same fm. (See Pan-Am. Geol., vol. 58, No. 3, p. 223, 1932.)

Cynthiana formation.

Middle Ordovician (Trenton): East-central Kentucky, southwestern Ohio, and southern Indiana.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 13, 14, 211–212). *Cynthiana fm.*—Lss., with interbedded clay and clay sh., 40 to 90 ft. thick, divided into Greendale bed below and Point Pleasant bed above. Overlain by Utica sh. and underlain by Lexington ls.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, pp. 295–297), divided *Cynthiana fm.* into (descending): Nicholas ls., 35 ft.; Greendale bed, and Perryville bed. He repeated this classification in 1910 (Denison, vol. 16), and stated that *Cynthiana fm.* is essentially exact equiv. of Catheys fm. of Tenn. In 1912 (Denison, vol. 17) he stated that Nicholas and Greendale are = Catheys and that Perryville is older than Catheys. In 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1) he stated that Catheys (= Cynthiana) is younger than Perryville.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, btw. pp. 317 and 342), decribed *Cynthiana* as 38 to 45 ft. thick in Georgetown quad., Ky., and as underlying Eden sh. and overlying Perryville.

A. F. Foerste, 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, pp. 109–145). *Cynthiana fm.* was introduced to include all strata btw. top of Lexington ls. as here defined, i. e., top of Cornishville ls., and base of Eden, i. e., base of Fulton layer.

A. M. Miller, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 651–657) divided *Cynthiana fm.* of Ky. (40 to 90 ft. thick) into Point Pleasant ls. above and Greendale ls. below, and described it as resting discon. on Cornishville ls. memb. of Perryville ls., with minor discon. at its top. He repeated this classification in 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 2).

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided *Cynthiana fm.* into (descending) Rogers Gap, Gratz, Bromley, and Greendale, and showed it as underlying Fulton sh. and overlying Cornishville memb. of Perryville.

Named for Cynthiana, Harrison Co., Ky.

Cypress sandstone. (Of Chester group.)

Mississippian: Southern Illinois and Indiana, western Kentucky, Tennessee, and northwestern Alabama.

H. Engelmann, 1868 (St. Louis Acad. Sci. Trans., vol. 2, pp. 189–190; paper read in 1862). *Cypress sss.*—Quartzose sss. with some shaly portions, about 150 ft. thick, in midst of Lower Carbf. of southern Ill. Overlain by 150 ft. of siliceous lss. and shales and underlain by siliceous lss. and shales, the latter in places aren. Regarded as more fully developed equiv. of Ferruginous [Aux Vases] ss. of Mo.

Later work by S. Weller, E. O. Ulrich, and C. Butts established fact that Cypress ss. is much younger than Aux Vases ss., and present generally accepted definition is that Cypress ss. underlies Golconda fm. and overlies Paint Creek fm. or, to east (in Crittenden Co., Ky.), the Gasper fm., the upper part of which is=Paint Creek fm.

Named for exposures on Cypress Creek, SE. Union Co., Ill.

Cypress Creek chert.

Lower Devonian: Southwestern Tennessee.

C. O. Dunbar, 1917 (Geol. Soc. Am. Bull., vol. 28, p. 207). The remnant of a southward extension of N. Y. Oriskany, for which the name *Cypress Creek chert* is proposed. It is white or yellowish chert carrying fossils [listed]. Separated from overlying Camden chert by a time break, and from underlying Linden sh. and ls. by a longer time break. [Appears to occupy position of Harriman chert.]

Cypress Hills beds.

Oligocene: Saskatchewan.

N. B. Davis, 1918 (Canada Dept. Mines, Mines Branch Rept. clay resources of southern Saskatchewan, p. 11).

Cyrene member (of Edgewood limestone).

Silurian (early): Southwestern Illinois and northeastern Missouri.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 361, 376). *Cyrene memb.*—Gray to brown ls., 0–15 ft. thick, forming lower fossiliferous ls. phase of Edgewood ls. In places overlain by Bowling Green memb. of Edgewood ls. Upper half to two-thirds of Cyrene memb. is oolitic and=Noix oolite memb.

In later repts this name has been applied to beds beneath Noix oolite memb. See under *Noix oolite memb.*

Named for exposures at Cyrene, Pike Co., Mo.

†Cyril gypsum member.

Permian: Central Oklahoma (Caddo County).

F. G. Clapp, 1920 (Min. and Met., Am. Inst. Mg. and Met. Engrs, No. 158, sec. 27, Feb. 1920). *Cyril gyp. bed.*—Most prominent fm. in Cement field, Caddo Co., Okla. Believed to underlie Whitehorse ss. Rests on a great mass of generally gray sss. of Perm. age. In southern Caddo Co. is thought to be practically synonymous with Blaine fm. There is no sign of division into 3 gyp. beds, as in central Okla.

F. Reeves, 1921 (U. S. G. S. Bull. 726, p. 48). *Cyril gyp. memb. of Greer fm.*—Consists of 2 gyp. beds separated by 0 to 20 ft. of gypsiferous shales. The upper gyp. is massive, pink to white crystalline gyp., with occasional lentils of gray ss. and a thickness of 0 to 85 ft. The lower gyp. resembles the upper gyp., except that at certain localities it is laminated and has appearance of thin-bedded ls.; its thickness is 0 to 40 ft. The Cyril rests uncon. on Day Creek dol. At E. end of Keeche Hills the upper gyp. rests uncon. on Whitehorse ss.

This name is now replaced by *Cloud Chief gyp.*, for reasons stated under *Cloud Chief gyp.*

Named for exposures near Cyril, Caddo Co.

Dadina schist.

Mississippian: Southeastern Alaska (Dadina and Chetaslina Rivers).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 27, map). *Dadina schists.*—Sed. and igneous. Coarse quartz biotite schist along S. side of a tributary of Dadina

River that drains from flanks of Snider Peak. Across the Dadina the rocks consist of (ascending): Near base a succession of dark, bedded, crushed and altered lavas of andesitic type; higher are amphibolite schists, mica schists, and small bodies of gray marmorized lss., all cut by quartz diorite dikes; in gorge of Chichokna Creek several varieties of schist outcrop. The phases of schists on Dadina and Chetaslina Rivers that are not demonstrably igneous are very similar to Klutina series of Schrader. The rocks are pre-upper Carbf., tentatively pre-Sil.

†Daemonelix beds.

A paleontologic name that has been applied to a part (*Daemonelix* zone, lower Mio.) of Arikaree fm. of western Nebr.

Dagger Flat sandstone.

Upper Cambrian: Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1064–1066). *Dagger Flat ss.*—Oldest rock found in place in Marathon region. Base nowhere exposed. Is exposed in long narrow belts in center of anticlines in both Marathon and Dagger Flat anticlinoria, but widest area of exposure is on S. side of Dagger Flat NE. of Buttrill ranch, where massive sss. form conspicuous ledges. This is type loc. The beds in all places are so intricately contorted that exposed thickness not exactly known, but a probable max. of 300 ft. is found on S. side of Dagger Flat. Here lowest strata are conspicuous ledges, each 4 to 5 ft. thick, of white saccharoidal, moderately coarse-grained ss., weathering pale brown. In places these pass into fine cgl. of rounded vein quartz pebbles, some of which show a notable secondary regrowth of quartz crystals. The massive sss. pass up into flaggy and thinly laminated brown and greenish micaceous sss. with much interbedded sh., the latter predominating toward top. In upper part several layers of laminated calc. brown ss. contain fossils [listed]. There are also several layers of cgl. composed of small block chert, gray ls., and clear quartz pebbles in a brown sandy ls. matrix. To NE. of Woods Hollow Tank nodular layers of sandy ls., which weathers to peculiar chocolate-brown velvety surface, are plentiful. Underlies Marathon ls., but in places younger fms. are overthrust onto Dagger Flat ss. Fossils are Upper Camb., according to E. Kirk and C. E. Resser.

Daggett sand.

A subsurface sand, of early Penn. (Cherokee) age, in Henryetta dist., central eastern Okla., which is reported to correlate with upper Dutcher sand and to lie higher than Deaner sand.

Dagmar limestone.

Middle Cambrian: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Dagmar ls.*—Argill. ls., medium to dark-gray on fresh fracture, yellowish to grayish white on weathered surface; some parts finely banded; others consist of alternating lenses or layers of dense and oolitic rock of medium gray color. Distinct horizon marker. Thickness 75 to 100 ft. Underlies Herkimer ls. and overlies Teutonic ls. Named for Dagmar Mine.

Daguilla diorite schist.

Age (?): Isle of Pines.

C. Schuchert, 1935 (Hist. Geol. Antillean-Caribbean region, p. 526).

Dake quartzite.

Pre-Cambrian: Central southern Wisconsin (Sauk County).

A. Leith, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 216, pp. 329–330). *Dake qtzite.*—Encountered in 42 diamond drill holes in Baraboo dist., all of which penetrated the qtzite and entered underlying Freedom fm. Thickness varies up to max. of 214 ft., where it is overlain by Rowley Creek sl. It is coarse-grained qtzite containing large amount of sericite and chlorite as a matrix to the quartz grains. Large part of fm. is coarsely conglomeratic, with large and sometimes angular pebbles. Occasionally lower part is loosely cemented with iron oxide, possibly derived from underlying Freedom fm. The qtzite is not known to outcrop, but writer believes that one, and possibly several, surface exposures formerly thought to be the much older Baraboo qtzite are Dake qtzite. One is on S. bank of Baraboo River, near W. Baraboo; another, more extensive, is on a low ridge 2± mi. E. of Baraboo on N. side of main highway from Baraboo to Portage. Because sole description of the qtzite which was found in the drill holes was made by C. L.

Dake, and because writer believes the rock exposed on this ridge is same as that found in the drill holes, he has named it Dake Ridge. There being no other topog. feature after which the fm. could be appropriately named the qtzite is named *Dake qtzite.*

Dakota sandstone.

Upper Cretaceous: North Dakota, South Dakota, southeastern Montana (?), eastern Wyoming (?), eastern Colorado, Nebraska, Kansas, northeastern New Mexico, northwestern Oklahoma.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 419, 420). *Dakota group* (*Formation No. 1 of Cret.*).—Yellowish, reddish, and occasionally white ss., with, at places, alternations of various-colored clays and lignite beds. Thickness 400 ft. Occurs in hills back of town of Dakota; extensively developed in Dakota Co. [Nebr.] below mouth of Big Sioux River, thence S. into NE. Kans. and beyond. Underlies Fort Benton group, of which it may probably be only a memb.

The name *Dakota ss.* has in the past been applied over large areas in the Western States where the correctness of its application has in recent years been seriously questioned. At present the name is restricted by U. S. Geol. Survey to areas E. of Front Range, and the rocks occupying approx. the same strat. position in areas W. of Front Range are tentatively called *Dakota (?) fm.* In some parts of eastern Colo. the name as used by Hayden and other early workers included marine beds of Lower Cret. age now called *Purgatoire fm.* The geographic extent of Purgatoire fm. remains to be determined. In Bellevue section of Larimer Co., Colo., the rocks believed by some geologists to be wholly of Dakota age are divisible into several units, which, although unnamed, are at present collectively called *Dakota group.* Other geologists, however, believe that the Purgatoire is represented in Bellevue section. If the Purgatoire proves to be present in Bellevue section it will be removed from Dakota group of W. T. Lee. The Dakota is chiefly of continental origin.

The ss. in Black Hills region, Wyo.-So. Dak., that for many years was called *Dakota ss.* is now known not to be true Dakota ss., but a ss. of Lower Cret. age, to which the name *Fall River ss.* is now applied. It is opinion of some geologists that the younger Newcastle ss. may be true Dakota of this region, but this is undet.

Dakota moraine.

Pleistocene: South Dakota and southwestern Minnesota.

T. C. Chamberlin, 1883 (U. S. G. S. 3d Ann. Rept., p. 394).

Dakotan series.

A term introduced by C. R. Keyes to cover Dakota ss. and correlated deposits.

Dale quartzites.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38). *Dale qtzites.*—Qtzites, 2,800 ft. thick, composing basal fm. of Uintan series (Early Cambric) of Utah. Overlain by 100 ft. of unnamed sh. and underlain by Monon series. [Derivation of name not stated.]

Dalhousie limestones.

Silurian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 204).

Dalhousie shales.

Lower Devonian (Helderbergian): New Brunswick.

J. M. Clarke, 1911 (N. Y. State Mus. Bull. 149, p. 126).

Dalhousie sand.

A subsurface sand at base of Blairmore fm. of southern Alberta, Canada.

Dalhousie Mountain andesites.

Age (?): Quebec

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 70).

†Dallas limestone.

Upper Cretaceous (Gulf series): Northern Texas.

R. T. Hill, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 298). *Dallas ls.*—Soft mag. ls., earthy fracture, fine texture, highly foraminiferous; blue on fresh exposure but decomposes and bleaches rapidly. Underlies Navarro beds (*Exogyra ponderosa* marl) [as here used included Taylor marl] and overlies Eagle Ford shales.

Same as Austin chalk, better established name.

Named for occurrence at Dallas.

Dallas deposits.

Pleistocene: Central southern Iowa.

J. L. Tilton, 1913 (Sci., n. s., vol. 38, p. 241; Iowa Acad. Sci. Proc., vol. 20, p. 218). *Dallas deposits.*—Deposits, of whatever nature (partly gravel, partly sand, partly gumbo, either without pebbles or with a few pebbles), formed in closing stages of Kansan ice age as Kansan ice melted, leaving a surface deposit over Kansan drift. Loveland of Shimek and Buchanan gravel correlate in part with these deposits, but have more restricted definitions.

Named for Dallas, Marion Co.

Dalles formation.

Miocene or Pliocene: Central northern Oregon and central southern Washington.

E. D. Cope, 1880 (Am. Phil. Soc. Proc., vol. 19, p. 61; Am. Nat., vol. 14, p. 458). A lacustrine fm. which is found on Columbia River, Oreg. Contains many vegetable remains. *Material is coarse and sometimes gravelly. Prof. Condon in his* unpublished notes calls it *Dalles group.* Overlain by beds of second great volcanic outflow and underlain by lava flow which has furnished the material for the lacustrine fm.

T. Condon, 1902 (The two islands, pp. 13–14, 139, 142, 145). *Dalles group.*—Well-defined ledge of gray ss. Remnant of an old lake bed. All Mio. deposits in Oreg. are disturbed; this deposit was not disturbed. Is a Plio. lake bed. Years ago writer designated [but did not publish] the group of rocks to which this gray ss. belongs as *The Dalles group, Plio.* [He appears to consider Dalles older than his Silver Lake group (Plio.) and younger than his Yakima group (Plio.).]

I. A. Williams, 1916 (Oreg. Bur. Mines and Geol. Min. Res. Oreg., vol. 2, No. 3), practically traces Satsop fm. into *The Dalles beds,* but says he can not say they are exactly equivalent.

J. H. Bretz, 1917 (Jour. Geol., vol. 25, p. 454). In vicinity of The Dalles is a stratified deposit of volcanic aggl., tuff, and ash, with strata of river sand and gravel, 1,000 ft. thick, capped by a flow of gray basalt. Western margin of deposit is uptilted on flank of eastern anticline. Though no pebbles of qtzite or granite were found, it seems probable from strat. evidence that the deposit is a local phase of Satsop fm.

R. W. Chaney, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 137). A collection from *The Dalles group* is of particular interest, since few fossils have previously been obtained from this fm. The flora suggests Plio. or Pleist.

J. H. Bretz, 1921 (Geol. Soc. Am. Bull., vol. 32, pp. 36–37). *The Dalles beds* of Oreg. are thought to be made up of 2 fms.: (1) a post-deformation deposit of volcanic ejectamenta of local origin and small extent, of Pleist. age; and (2) a lower fm. that is thought to be a phase of Satsop fm.

J. P. Buwalda, 1921 (Min. Res. Oreg., Oreg. Bur. Mines and Geol., vol. 2, pp. 19–20). *The Dalles fm.*—White to gray and bluish white beds of ss. and volcanic ash with some cgl. strata. *Apparently deposited in lakes and by streams.* Overlain by basic volcanic rocks and underlain by Columbia River basalt.

J. H. Bretz, 1925 (Jour. Geol., vol. 33, p. 246). At The Dalles, Oreg., there is an upper sed. fm. that has never been described, consisting largely of volcanic debris, and a pre-deformation river deposit commonly known as *The Dalles beds* and in all probability a phase of Satsop fm.

J. P. Buwalda and B. N. Moore, 1927 (Sci., n. s., vol. 67, p. 236). Geologists have differed regarding ages of "Satsop" and *Dalles* fms. Writers have obtained fragmentary mammalian fossils from *Dalles fm.* representing not Quat. but approx. upper Mio. or lower Plio. This age determination is corroborated by lithologic resemblance to middle Neocene Ellensburg fm. of central Wash., by apparently similar relations of the 2 fms. to Columbia lavas, and by induration of Dalles beds, which is = that of lower or middle Neocene deposits of West and is much greater than that of Quat. fms. *Hood River fm.* is new name proposed for unique cgl. and ss. strata underlying Dalles fm. in Columbia River gorge, which was heretofore called "Satsop fm." but is older than typical fossiliferous marine Satsop fm. of Wash. coast. [See also papers by these authors in Geol. Soc. Am. Bull., vol. 39, pp. 116–117, 1929, and Carnegie Inst. Wash. Pub. 404, pp. 11–26, 1930.]

A. M. Piper, 1931 (U. S. G. S. Press Notice 52,343, Apr. 7). *Dalles fm.* of Dalles region uncon. overlies Yakima basalt and uncon. underlies late Plio. or early Pleist. andesite.

Dalmar sand.

A subsurface sand in Cisco group (Penn.) of Archer County, Tex., lying a little more than 300 ft. above Gose sand, and approx. at horizon of Newcastle coal.

Dalton formation.

Lower Cambrian: Western Massachusetts.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). [*Dalton phyllite* is shown as underlying Hoosac schist and as overlying [underlying] Cheshire qtzite, which rests on Becket gneiss.]

B. K. Emerson, 1899 (U. S. G. S. Bull. 159), included the Dalton in Cheshire qtzite as defined and mapped. His map included Dalton type loc.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 32–34 and map). *Dalton fm.*—At some places in western Mass. the lowermost Camb. strata consist of gneissoid cgl. having max. thickness of 600 or 700 ft. The pebbles are chiefly quartz (black, blue, and commonly white) but a few are feldspar or gneiss. This cgl. can be traced for miles across Hinsdale and into Washington. Is best exposed at site of former Dalton clubhouse, on high hill S. of Dalton Station, in open pasture farther S., and on SE. to new lookout tower. The cgl. was originally feldspathic and has generally changed to a thin fissile light-colored gneiss or schist in which the muscovite is generally a greasy hydrated sericite. Grades into overlying Cheshire qtzite. Rests uncon. on Becket gneiss. [According to personal communication of B. K. Emerson, the *Dalton fm.* of 1917 publication is same as *Dalton phyllite* of 1892 Hawley sheet.]

Dalton phyllite.

See under *Dalton fm.*

Dalton gneiss.

Pre-Cambrian: Northwestern Connecticut.

W. M. Agar, 1932 (Am. Jour. Sci., 5th, vol. 23, p. 35), mapped a fm. called *Dalton gneiss*, but this name was not mentioned in text, and map did not show town of Dalton.

Dalton sandstone member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup region).

J. D. Sears, 1934 (U. S. G. S. Bull. 860A). *Dalton ss. memb. of Mesaverde fm.*—Massive sss. that laterally replace the upper part of Dilco coal memb. of Mesaverde fm. in part of area from Gallup eastward toward Mount Taylor. In N. part of T. 16 N., R. 17 W. this ss. body is 180± ft. thick, and includes only 2 thin beds of softer ss. and sandy sh. To E. it is both split and underlain by beds of marine sh. composing the W. end of Mulatto tongue of Mancos sh. Where split by Mulatto tongue the upper memb. of Dalton ss. is 100± ft. thick and the lower memb. 72± ft. thick. Still further E. both sss. are completely replaced by marine

Mancos sh. Named for excellent exposures at Dalton Pass, where it supports the divide and forms a conspicuous bench in canyon draining to N. Is of Colorado age.

Damascus red shale.

Upper Devonian: Northeastern Pennsylvania (Monroe, Pike, Wayne, Susquehanna, Perry, and Bradford Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 584–585). *Damascus red sh.* introduced to replace *Montrose red sh.* of I. C. White, preoccupied by Montrose ss. of N. Y., and poorly exposed at White's type loc., Montrose, Susquehanna Co., Pa. Crops out around Beach Lake (also written Beech Lake) on main highway, and thence N. to and along Delaware River, where it is well exposed near Damascus, Wayne Co. At Montrose, Susquehanna Co., it is probably less than 100 ft. thick, in central Wayne Co. 200 ft., near Damascus 400 ft. and possibly considerably more. [Distribution described.] Underlies Honesdale ss. and overlies Paupack ss. memb. of Shohola fm. Is lowest persistent red div. of Catskill group, and is of Canadaway age. North of the Anthracite fields the Damascus overlies New Milford fm.

Dam Lake quartzite.

Pre-Cambrian: Minnesota.

H. B. Ayers, 1911 (Sci., n. s., vol. 33, p. 465). *Dam Lake qtzite.*—The qtzite of Dam Lake (Aitkin Co., Minn.) has been explored by drilling through both contacts with adjoining rock, and results prove it to be Pokegama qtzite, here overlying Keewatin fm.

Damnation limestone.

Middle (?) Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 35 and passim). *Damnation ls.*—Most distinguishing feature is bright buff color to which it weathers. At type loc. consists of platy, dull-gray to tan-gray, fine-grained, fairly pure ls. in beds averaging 1 inch in thickness, with irregular bedding surfaces, and with a few flakes and nodules of buff clay irregularly distributed both btw. and within the lss. Thickness averages 25 ft. Overlies Wolsey sh. (Middle Camb.) and underlies Nannie Basin ls. Forms the steep slope at foot of the cliffs on SW. side of Pagoda Mtn in NE. ¼ sec. 9, T. 22 N., R. 13 W. This slope lies at head of Damnation Creek, which flows SW.

C. F. Deiss, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 1, p. 98), assigned this fm. to Middle Camb. without a query.

Dana diorite.

Late Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 244–247 and map). *Dana diorite.*—A broad band of black hornblende-plagioclase rock, generally foliated and then commonly called hornblende schist, which forms a selvage to Monson granodiorite and follows all the sinuosity of its boundary. It also borders all large areas of schistose rocks resting in this gneiss. A second band of white, very fine-grained granite or aplite [New Salem aplite] commonly occurs next inward, separating this mafic zone from the normal coarser gray granite gneiss of central area. The alternating layers of black diorite and white aplite make up the "ribbon gneiss." Is well developed across Ware and Dana, Mass.

Dana.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Danbury granodiorite gneiss.

Pre-Cambrian (?): Western Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 104, 108, and map). *Danbury granodiorite gneiss.*—Presents two important facies—biotite granite and a diorite in which hornblende becomes an important constituent and quartz is less prominent. The two grade into each other, although generally speaking, more hornblende occurs in Greenwich and Wilton areas and parts of

Monroe than in the mass N. of Danbury. The rock is prevailingly porphyritic, with pink or white phenocrysts of feldspar, closely crowded, often attaining a length of 1 to 2 inches. The groundmass in which the larger feldspar crystals are set consists essentially of two varieties of feldspar, quartz, and biotite or hornblende or both. Of igneous origin and intruded before metamorphic action converted igneous and sed. rocks alike into gneisses and schists.

W. M. Agar, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 1–19). *Danbury granodiorite gneiss* of 1907 map of Conn., by H. E. Gregory and H. H. Robinson, continues into Westchester Co., N. Y., where it is called *Harrison diorite*. It includes a number of more or less intermingled rock types whose different phases are not equally developed in all areas in which they occur. It is not a unit but a very variable fm., usually with high content of hornblende and a porphyritic aspect. It grades into biotite schists and quartz-oligoclase-biotite gneisses and all these types are intersected and sometimes intimately penetrated by granite and pegmatite. Writer tentatively places the complex in pre-Camb. with probably exception of the youngest granite, which may be as young as Ord.

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 354–373). *Danbury gneiss* is in part composed of Thomaston granite. It intrudes Grenville.

Danby formation.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 396). *Danby fm.*—Is a departure from the usual carbonate deposits of the Valley. Great variety of beds in the fm., but they are separated from the other fms. chiefly by amount of ss. and qtzite and by their varicolored dolomites. The qtzite beds are composed of clean white sand, in layers 1 or 2 ft. thick, interbedded with massive dolomites like those of underlying Rutland dol., and with transitional strata, like sandy dolomites and ss. The qtzite beds usually stand out like white reefs above the other layers. Some peculiar dolomites, of pink, buff, and green colors, also occur. These are very fine-grained and tough and form ridges. Associated are thin seams and layers of greenish sl. Beds considerably folded. Thickness 300± ft. Grades into overlying Wallingford dol. Is=Hubbardton sl., Stiles phyllite, and Brezee phyllite.

Named for fact that it surrounds town of Danby, Rutland Co., in Wallingford quad.

Danby member.

A term applied by G. H. Chadwick (Pan-Am. Geol., vol. 60, 1933, pp. 99, 348, 349, 350, 354) to *Dalmanella danbyi* zone of Cayuta sh. memb. of Chemung fm. of central southern N. Y.

Danforth member (of Dundas formation).

Ordovician: Ontario.

W. A. Parks, 1925 (Ontario Dept. Mines 32d Ann. Rept., pt. 7, p. 107).

Danforth formation.

Pliocene: Southeastern Oregon (Harney Basin).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr. (U. S. G. S. W. S. P. in press). *Danforth fm.*—In vicinity of Burns the upper part consists of a distinctive rhyolitic tuff-breccia memb., also stratified siltstone, ss., tuff, and volcanic ash, with layers of glassy or perlitic rhyolite at a few horizons; and the lower part consists of massive rhyolite, commonly spherulitic. In dist. S. of Harney Playa the fm. consists of (descending): (1) the distinctive tuff-breccia memb. and associated rocks; (2) an equally distinctive basaltic breccia memb. and associated siltstone, ss., and cgl. and 2 intercalated layers of basalt; (3) stratified siltstone, ss., and ash; and (4) spherulitic rhyolite. Thickness 20 to 800+ ft. Rests uncon. on Steens basalt. Is uncon. overlain by Harney fm. in some areas and by fangl. that may be younger than Harney fm. in other areas. Named for Danforth Ranch.

†Dannemora formation.

Pre-Cambrian: Northeastern New York (Clinton and Franklin Counties).

H. P. Cushing, 1901 (N. Y. State Mus. 53d Ann. Rept., pt. 1, pp. r36 to r69 and map). *Dannemora fm.*—A complex of gneiss and granite. Gneisses of unknown origin (probably mostly igneous, in part certainly igneous), and include four varieties, which grade into one another through intermediate varieties. Whether Dannemora rocks are older, younger, or of same age as sedimentary Grenville rocks does not appear. If there is any fm. in northern Adirondack region which is= Ottawa gneiss of Canada, or which may be of Archean age (in restricted sense in which that term is now employed by U. S. Geol. Survey) it is this Dannemora fm. Unfortunately, in the dist. in Clinton and Franklin Counties where it prevails, the Grenville series is practically absent. Very similar gneisses are associated with undoubted Grenville rocks in western Adirondacks. In ordinary Dannemora gneiss garnet is rare but it is abundant in the Grenville gneisses. The fm. is well exposed all over Dannemora Mtn and throughout Dannemora Twp, Clinton Co.

H. P. Cushing, 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1, pp. r81 to r82). *"Dannemora" fm.*—Closely interbanded with the lss. and schists of the Grenville are granitic, gabbroic, and other gneisses which seem to represent closely contemp. igneous intrusions. In other districts (Clinton Co., for example) these or similar gneisses are found by themselves and represent the fundamental gneiss, if that fm. appears at all in Adirondack region. From difficulty of establishing this and of defining any separation from Grenville rocks, the writer a year ago proposed to refer such rocks to "Dannemora" fm., the term being wholly provisional, and to apply to areas of gneiss where the distinctive rocks of the Grenville are absent, yet whose proper reference to the fundamental gneiss is wholly doubtful. It is thought likely these rocks belong with Grenville series, but it is convenient to give them a separate designation for present. In western Adirondacks Smyth's recent work has shown an abundance of a granitic gneiss which has unmistakable irruptive contacts against the Grenville rocks quite like those to N. in Canada. Whether these granites are the equivalents of those in the eruptive center of the Adirondacks, or of the Dannemora granitic gneiss, or are wholly distinct from either, seems entirely uncertain.

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95). *Doubtful gneisses (Saranac fm.)*.—Red acid gneisses, practically but not utterly free from Grenville admixture and at same time seem to have no connection with the later igneous intrusions; often interbanded with and often in large masses are two other kinds of gneiss of common occurrence, gray and black. Nearly all or quite all seem to be igneous. Uncertain whether same as Ottawa gneiss of Canada. *Saranac fm.* is here introduced to replace "Dannemora fm.," because of possible confusion of latter name with a noted Scandinavian locality. The rocks are well exposed along Saranac River, Clinton Co., and its near vicinity.

D. H. Newland, 1908 (N. Y. State Mus. Bull. 119, pp. 8–22). *Saranac fm.*—Gneisses of undet. origin. Mainly red acid gneisses, but other gneisses also present. More detailed investigation may resolve them into elements which can be classed with the igneous or the sed. series, but they have been found so far to have no well-defined connection with either. Principal area of these gneisses seems to be on northern borders in Clinton and Franklin Counties.

H. L. Alling, 1919 (N. Y. State Mus. Bull. 207, 208, pp. 113–145). North of town of Saranac Lake are a variety of gneisses and granitelike rocks that are today a puzzle to most observant and careful workers. Some may be igneous but others are sed. These doubtful gneisses are sometimes referred to as *Saranac fm.* Many of these gneisses are certainly later than the Grenville. Some of granites may be older than Grenville, but this is not determined.

W. J. Miller, 1919 (Jour. Geol., vol. 27, pp. 28–54). The Lyon Mtn granite is perhaps most conspicuous memb. of Cushing's Saranac fm.

†Dan River series.

A name applied by E. Emmons (Geol. Rept. of Midland Counties of N. C., N. C. Geol. Surv., 1856) to the Upper Triassic rocks (Newark group) of Dan River region of central northern No. Car.

Danville stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Danville stage.*—Undiff. Coal Measures, underlying Appleton stage in Ind. Terr. and Ark. Thickness not measured.

Represents lower part of Atoka fm.

Probably named for Danville, Yell Co., Ark.

Danville Landing group.

Danville Landing beds.

Synonymous terms applied to uppermost part of Jackson fm. of La. and Miss. by M. A. Hanna, D. Gravell, and J. McGuirt (11th Ann. Field Trip Shreveport Geol. Soc., 1934, table opp. p. 30, pp. 35–37). Not described, but said to correspond to Cocoa sand of Cushman and to be younger than typical Cocoa sand. Said to overlie Yazoo "group," but apparently the beds were in previous repts included in Yazoo of Miss. Fossils mentioned. Danville Landing is said to be on Ouachita River in Catahoula Parish, La.

Darby formation.

Upper and Middle Devonian: Northwestern Wyoming.

E. Blackwelder, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 420). *Darby fm.*—Introduction of this new name is made necessary because none in present use fits stratigraphy of western Wyo. The Darby is apparently = Peale's Three Forks sh. plus upper part of his Jefferson ls. It rests discon. on Leigh dol. memb. of Bighorn dol., and in some places on underlying massive memb. of the Bighorn. It is separated from overlying Madison ls. locally, if not generally, by eroded surface. Consists of a varied sequence of shales and dolomites, of white, gray, green, lavender, buff, red, brown, and black colors; but somber colors predominate. Some beds are massive, others thin and brittle. Fossils rare. Named for canyon of Darby Creek, on W. slope of Teton Range, where well exposed. Extends over most of NW. Wyo. [Gives detailed section (footing 428½ ft.) on E. slope of Sheep Mtn near head of Green River.]

Daredevil formation.

Pre-Cambrian: Kenora district, Ontario.

F. J. Pettijohn, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1895, 1900, map, etc.).

Darien moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Darien, Walworth Co.

Darling oil sand.

A subsurface oil sand in Warren Co., Pa., stated by Carll (1883) to lie 190 ft. higher than Sheffield or Blue Jay oil sand and lower than Balltown oil sand. Probably of Chemung age.

Darling sand.

A subsurface sand in lower part of Kootenai fm. (Lower Cret.) in Cutbank dist., Glacier Co., NW. Mont. According to J. G. Bartram (Geol. of nat. gas, A. A. P. G., 1935, pp. 257, 267) this sand is now called *Cutbank sand.*

Darlington shale. (In Allegheny formation.)

Pennsylvanian: Southwestern Pennsylvania (Beaver County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 308–316). [See under *Darlington underclay.*]

Darlington underclay. (In Allegheny formation.)

Pennsylvanian: Southwestern Pennsylvania (Beaver County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 308–316). [The following succession of beds is given (descending): Darlington coal (Upper Kittanning); *Darlington underclay; Darlington shales; Darlington plant bed;* Kittanning coal.]

Darlington plant bed. (In Allegheny formation.)

Pennsylvanian: Southwestern Pennsylvania (Beaver County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 308–316). [See under *Darlington underclay.*]

Darlington granodiorite.

Jurassic (?): British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 80).

Dashner limestone.

Pennsylvanian: Northeastern Kansas.

R. C. Moore, Sept. 4–7, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 41). *Dashner ls.*—Basal memb. of Topeka ls. Rests on Calhoun sh. and underlies Jones Point sh. Consists of light-bluish ls. that weathers brown, fine grained, dense, massive; upper 1 ft. contains chert nodules and *Osagia;* lower 2½ ft. has some large *Triticites, Allorisma,* and *Osagia.* Brachiopods and Bryozoans common throughout. Thickness 5½ ft. [Derivation of name not stated.]

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser., p. 52). Dr. Moore in 1935 [not regarded as publication] and again in 1936 (10th Ann. Field Conf. Kans. Geol. Soc. Guidebook, p. 41) used "Dashner ls." for the lower memb. of Topeka ls. but in a publication issued in 1936 (Kans. Geol. Surv. Bull. 22, pp. 194, 195 [issued Aug. 31, 1936]) did not use the name. Dr. Moore states (personal communication) that his type loc. is Dashner farm, SE. of Haynies Station (now Sargents siding) in Iowa. The interval which Moore classified as "Dashner" at his type loc. appears to have included not only the interval which he classified as "Dashner" in Kans. River Valley, but also the Iowa Point sh. and Curzen ls. members. This memb. is too poorly defined on Dashner farm to permit its being a good type loc. But at mouth of Wolf River the Wolf River ls. is separated from Curzen ls. above by 10± ft. of sh. and shows as complete a development as was seen in all of area covered in this study. In view of these facts and because Dr. Moore may have abandoned "Dashner," writers feel they are justified in giving new name *Wolf River* to lower memb. of the Topeka, defining a type loc. where it is well developed and clearly set off from other ls. members both above and below.

Datil formation.

Tertiary (probably late): Southwestern New Mexico (Alamosa Creek Valley, Socorro County).

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A). *Datil fm.*—Well-indurated tuffs, rhyolites, cross-bedded sss., and cgls. Members very variable. Thickness 2,000± ft. Underlies Quat. gravels and uncon. overlies Chamiso (Upper Cret.) and older fms. No fossils. Regarded as probably late Tert. Named for fact it is the mountain-forming series of Datil Mtns.

Daube member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 16). Some 600 ft. above Anadarche memb. of Hoxbar fm. is *Daube memb.* of Hoxbar, including a ls. similar to Anadarche ls., associated in one locality with a ls. cgl. Just below Daube ls. occurs only bed of coal known in Ardmore basin. It reaches max. reported thickness of 4 ft., and is known for at least 4 mi. along the strike in T. 5 S., R. 2 E. Above Daube ls. the upper 1200 ft. of Hoxbar fm. consist of tan to brown shales with several sandy lss. or calc. sss., including *Zuckerman sandy ls. memb.*

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 44). Some 400 to 600 ft. above Anadarche memb. occurs the 10-foot *Daube ls.,* so named for occurrence at abandoned coal mine of Daube, Westheimer, Munzesheimer, and Zuckerman, in SE¼ of sec. 8, T. 5 S., R. 2 E. Of similar character to Anadarche ls. Immediately beneath it lies only known coal bed (4 ft. thick) in Ardmore Basin. Lies 400 to 500 ft. below Zuckerman memb. of Hoxbar fm.

Davenport beds.

Middle and Upper Devonian: Eastern Iowa.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, p. 24). The name *Lower Davenport beds* is suggested for lower nonfossiliferous ls. at Davenport, which furnished the fragments for second stage of Fayette breccia; and *Upper Davenport beds* is suggested for fossiliferous ls. overlying Lower Davenport beds and heretofore called *Gyroceras* beds, also included in Fayette breccia. The Lower Davenport beds overlie Kenwood beds.

In 1895 (Iowa Geol. Surv. vol. 4, pp. 121+) Norton introduced *Wapsipinicon stage* for beds underlying Cedar Valley ls. and overlying Coggon substage, and included in it the Davenport, Kenwood, and older beds. In 1901 Norton transferred his Coggon beds to Dev. and to Wapsipinicon ls. This definition of Wapsipinicon ls. was followed for many years; but in 1928 (Iowa Univ. Studies, vol. 12, No. 7, n. s. No. 14) C. H. Belanski treated Upper Davenport beds of Iowa Geol. Survey as basal memb. of Cedar Valley ls., "in accordance with field work done by M. A. Stainbrook (unpublished thesis, State Univ. of Iowa)." Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, divided Wapsipinicon ls. into (descending) Davenport memb., Spring Grove memb. (new name), Kenwood memb., Otis memb., and Coggon memb. and showed *Davenport memb.* as older than Independence sh., a distinct fm. (See also under *Independence sh.*) In this same vol. (p. 260) M. A. Stainbrook stated: "Upper" Davenport is sublithographic and belongs to Cedar Valley ls. [Upper Dev.].

Davenport member.

Upper Ordovician: Toronto, Canada.

W. A. Parks, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 103–104).

See quotation under *Dundas fm.* Type loc. not stated.

†David City formation.

Pleistocene (early Nebraskan): Eastern Nebraska.

A. L. Lugn and G. E. Condra, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 190). *David City fm.* (early Nebraskan), a gravel and sand deposit 20 to 100 ft. thick is at base of Pleist. section in eastern Nebr. Is overlain by Nebraskan till and gumbotil up to 100 ft. in thickness.

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 326, 332–333). *David City fm.* (Nebraskan) consists of outwash fluvioglacial material of sand, gravel, and some clay. Thickness few ft. to 150 ft. Underlies Nebraskan till and is believed to be of Nebraskan age. Is widespread, but not a continuous sheet, because of bedrock on which it was deposited. Fills old buried pre-Pleist. valleys. Said to be 150 ft. thick E. of David City, where it has been penetrated in deep test wells. Rests uncon. on Cret.

Davidson sands.

Davidson shallow sand has been applied to a subsurface sand in Brazil fm. (Penn.) of Ind. and *Davidson deep sand* to a subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Tar Springs ss.

Davidson granophyre.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

M. G. Hoffman, 1930 (Okla. Geol. Surv. Bull. 52, pp. 39–48). *Davidson granophyre.*—Very fine-grained to dense granophyre, of light pink to dark gray color, with blackish streaks. Is a fine-grained intergrowth of quartz and alkali feldspar. Outcrops in W. half of Davidson Hill and NW. along Little Medicine Creek for about ½ mi. Considered younger than Saddle Mtn granophyre and older than Carlton granophyre. Is intruded by Lugert granophyre.

†Davion rock.

Miocene: Southern Mississippi.

B. L. C. Wailes, 1854 (Rept. Agric. and Geol. Miss., pp. 214–216). *Davion Rock of Fort Adams.*—Ss. of argillo-siliceous composition, dingy white color, small proportion of sand, cemented together and tinged by brownish red metallic oxide. [Distribution described. Seems to regard it same as †Grand Gulf ss.]

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 90). *Davion rock* (*Miocene ?*), 350 to 400 ft. thick, sandy clay rock of light gray to brownish gray color with a cementing material of reddish brown to purple iron oxide. Should probably be considered a fm. in Grand Gulf group. Underlies Pascagoula fm. and overlies Grand Gulf ss.

The Davion Rock of Wailes is now considered to probably be Catahoula ss. The Davion rock of Lowe is Hattiesburg clay, in whole or in part.

Named, according to E. N. Lowe, for outcrops in precipitous bluff at Fort Adams, Wilkinson Co., "which is now usually called Fort Adams Hills, but is also called Loftus Heights, a name by which it was exclusively known in early part of 19th century. During the French occupation of Miss., about beginning of 18th century, this bluff was called La Roche à Davion, so named for a pious and devoted priest of that name, who had established a mission there."

Davis formation. (In Elvins group.)

Upper Cambrian: Missouri.

E. R. Buckley, 1907 (Mo. Bur. Geol. and Mines vol. 10, 2d ser., *separate*), in a table divided Elvins fm. into (descending) Doe Run, Derby, and Davis, without defining the subdivisions.

H. A. Buehler, 1907 (Mo. Bur. Geol. and Mines vol. 6, 2d ser., p. 231). *Davis fm.*—Bluish, impure, calc. sh. intercalated with thin beds of mag. ls. and dol. Underlies Derby and overlies Bonne Terre. Thickness 100 ft.

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1, p. 33). *Davis fm.*—Much blue sh. with aren. dol., ls., and ls. cgl. Thickness 150 to 190 ft. The persistent Central marble boulder memb. lies 63 ft. below top. Underlies Derby fm. and overlies Bonne Terre fm. Is lower part of Elvins fm. of Ulrich.

G. W. Crane, 1912 (Mo. Bur. Geol. and Mines vol. 10, 2d ser.). *Davis fm.*—Mainly alternating beds of soft sh., shaly ls., and cgl. Upper memb., 70 ft. thick, can be distinguished from lower memb. by comparative abundance of soft sh. beds from a few inches to 9 ft. thick, and by absence of "edgewise" cgl. Lower memb. consists of 100 ft. of very shaly mag. ls., thin beds of "edgewise" cgl., and thicker beds of soft sh. with horizontal thin plates or discs of ls. Overlies Bonneterre fm. and conformably underlies Derby fm.

H. A. Buehler, 1917 (Am. Inst. Min. Engrs. Bull. 130, pp. 1699–1718). *Davis sh.*—Chiefly thin-bedded dolomitic ls. and sh. with several layers of edgewise cgl., the latter chiefly in lower part and distinctive of fm. A boulder horizon of pure ls., the boulders usually less than 6 ft. thick, lies 100 ft. above base.

Named for outcrops on Davis Creek, St. Francois Co.

Davis oil and gas horizon.

Name applied to 85± ft. of lenticular subsurface sands, ls., and sh. in Cotton Valley field, Webster Co., NW. La., stated to lie at a horizon corresponding to a lower part of Glen Rose fm. of Trinity group (Lower Cret.). Named for lease on which first well was drilled to these beds. Includes at top a bed that has been called *Tillman sand lens*, and lower down a bed that has been called *Bodcaw sand lens.*

Davis Creek beds.

Miocene: Northwestern Nevada (Washoe County).

R. W. Chaney, 1924 (Geol Soc. Am. Bull., vol. 35, pp. 162–163). *Davis Creek beds.*—A series of tuff, ss., and sh. underlying Modoc lavas in Washoe Co. Fossil plants in white diatomaceous ash in these beds seem to clearly establish their Mio. age.

Dawn limestone member (of Monte Cristo limestone).

Mississippian (lower): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 17, etc.). *Dawn ls. memb.*—Thin-bedded dark-gray ls.; little chert; in large part of area altered to dol. Thickness 60 to 400 ft. Many lower Miss. fossils. Basal memb. of Monte Cristo ls. Underlies Anchor ls. memb. Well exposed W. of Dawn mine, SW¼ sec. 15, T. 23 S., R. 58 E., Goodsprings quad.

Dawson arkose.

Upper Cretaceous and Eocene (?): Eastern Colorado (Douglas County region).

G. B. Richardson, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 267–276). *Dawson arkose.*—Varicolored cgl., ss., sh. and clay, rhyolitic tuff and lava, but chiefly sss. and arkosic grits, with basal cgl. Thickness 2,000 ft. Contains vertebrates of Eocene age, according to Gidley. Is basal fm. of Monument Creek group of Hayden. Uncon. underlies Castle Rock cgl. and uncon. overlies Laramie fm. Lower part is regarded as = Arapahoe and Denver fms. [See also G. B. Richardson, U. S. G. S. Castle Rock folio, No. 198, 1915.]

The age of this fm. (previously classified as *Eocene*) was changed, in Dec. 1935, to *Upper Cret. and Eocene (?)*, as explained under *Lance fm.*, last entry.

Named for Dawson Butte, about 6 mi. SW. of Castle Rock, Douglas Co.

Dawson sand.

Drillers' name for a sand in Mauch Chunk sh. (Miss.) of W. Va. that probably corresponds to Droop ss. memb. of W. Va. Survey.

Dawson.

Name applied to a Pleist. glacial lake in Great Lakes region. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, p. 614, 1932.)

Day Creek dolomite. (In Cimarron group in Kansas; in Woodward group in Oklahoma.)

Permian: Central southern Kansas and northwestern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies vol. 6, pp. 3, 44). *Day Creek dol.*—Nearly white true dol., 1 to 5 or more ft. thick, overlying Red Bluff sss. [Whitehorse ss. of present nomenclature] and underlying Hackberry shales in Kans. Included in Kiger div.

For subsequent interpretations see under *Quartermaster fm.*

R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40HH). The term "Day Creek dol." of Cragin has been applied to Weatherford dol., Greenfield dol., and Quartermaster dol. It is believed its continued use will only serve to confuse. Writer does not know what bed, if any, in SW. Okla., corresponds to Day Creek dol. of Kans.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 405–432). *Day Creek dol.* has 2 members, Upper and Lower Day Creek dolomites, separated by 1 to 3 ft. of brown to maroon sh. The Day Creek was formerly supposed to occur below Cloud Chief gyp. In this paper it is placed above Cloud Chief gyp. and conformably below Quartermaster fm. The Day Creek of type area (central Clark Co., Kans.) consists of 2 ft. of hard light-gray ls. or dolomitic ls. Characteristic Whitehorse sand and sh. are below it, and above is the dark red or maroon sh. which makes a contrast in color to the reddish buff of the Whitehorse below. In this type area the Day Creek commonly contains aggregates of smoky or reddish chert. In Okla., particularly in eastern Harper, western Woods, and NE. Woodward Counties, this same description applies to the Day Creek. Here, however, occurs a pinkish or purplish calcitic or dolomitic bed, about 3 inches thick, 3 ft. above *Lower Day Creek dol.* It seems well to include this upper thin dol. bed as a part of the Day Creek and it is here called *Upper Day Creek dol.* and the lower bed, which was called originally the *Day Creek*, is here called *Lower Day Creek dol.* Brown sh., weathering maroon, separates these 2 dolomites. It is not recalled whether this Upper Day Creek bed occurs at type area in Clark Co., Kans., but it probably does, as it is widespread in its exposures in NW. Okla. Unless removed by erosion this Upper Day Creek dol. can almost everywhere be found above horizon of the Lower Day Creek. To W. and S. of Supply the Lower Day Creek becomes very sandy and even grades into ss. [Mentions localities where "the Lower Day Creek horizon is merely the top of Whitehorse ss. and Upper Day Creek is poorly exposed."] The Day Creek dolomites are somewhat lenticular or grade laterally into sand or sh. Their horizon can be definitely placed by sequence of beds and change from Whitehorse fm. to Quartermaster.

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437), does not regard Mr. Evans's interpretation of strat. relations of various fms. as proved.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232), does not recognize this unit in Tex.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, p. 1474). Which of the dol. beds of lower part of Quartermaster fm. is = Day Creek dol. of NW. Okla. is open question.

Named for Day Creek, Clark Co., Kans.

Day Point limestone.

Lower Ordovician: Eastern New York (Champlain Valley).

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95), adopted the subdivisions of the Chazy proposed by E. Brainerd and H. M. Seely in 1888 (Am. Geol., vol. 2, pp. 323–330), as explained under *Chazy group*, and proposed *Day Point ls.* for group A or lower Chazy, which is well exposed at Day Point, Peru Twp, Clinton Co.

Dayton limestone.

Silurian (Niagaran): Southwestern Ohio.

E. Orton, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 143) and 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 271, 297, 299–301, 309, fig. 1, opp. p. 310). *Dayton stone* (1870 rept.), *Dayton ls.* (1871 rept.). Even-bedded massive ls. 5 to 10 ft. thick, sparingly charged with fossils and containing at least 90 per cent of carbonate of lime. Lowest memb. of Niagara group in Montgomery and Highland Counties. Overlain by Niagara sh. and underlain by Clinton [Brassfield] ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28), assigned this ls. to Clinton epoch, as did A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173). He gave further details on pp. 138, 149–150, listed the fossils, and stated that in Adams and Highland Counties it is conformably overlain by Alger clay.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 133), stated *Dayton ls.* is probably younger than Oldham ls.; is typically exposed in vicinity of Dayton, Ohio; and is probably lower Clinton.

†Dayton moraine.

See under *Lake Escarpment morainic system.*

Deadman limestone.

Triassic (?): Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492). *Deadman ls.*, 150 ft. thick. A memb. of Nugget ss. of Fort Hall Ind. Res. Overlies Higham grit and underlies Wood sh.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 41). *Deadman ls. memb. of Nugget ss.*—Dense purplish-gray ls. of almost lithographic quality, with subordinate amounts of gray and greenish chert. Thickness 150± ft. Overlies Higham grit memb. of Nugget and underlies Wood sh. memb. of Nugget. Named for Deadman Creek, in NE. part of T. 4 S., R. 38 E. Boise meridian, in NE. part of Fort Hall Ind. Res., near headwaters of which it is exposed.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713, pp. 29, 52), treated Deadman ls., Wood sh., and Higham grit as distinct fms., and restricted Nugget ss. to upper part ("main ss. memb.") of Nugget ss. as recognized by him in previous repts. This is present generally accepted definition.

Deadman Island beds.

Pleistocene: Southern California.

J. P. Smith, 1910 (Jour. Geol., vol. 18, chart opp. p. 217), applied *Deadman Island beds* to lower part of San Pedro fm. and *Los Cerritos beds* to upper part of San Pedro.

U. S. Grant, IV, and H. R. Gale, Nov. 3, 1931 (Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 37, 43). *Deadman Island "Plio."* [of some early repts] is here called *Timms Point zone,* because Deadman Island no longer exists; and, because of its cold-water fauna, it is correlated with a glacial age and assigned to Pleist. Deadman Island was an island formerly located in San Pedro Harbor but has now been entirely removed by steam shovels.

Deadwood formation.

Upper Cambrian: Western South Dakota (Black Hills), eastern Wyoming, and southeastern Montana.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 505). *Deadwood fm.*—Red brown qtzite and ss., locally conglomeratic, and partly massive. Thickness 4 to 150 ft. in Black Hills. Upper part is thinner bedded softer sss., in some cases interbedded with more or less sh. Basal memb. is usually hard massive reddish brown qtzite; portions of basal beds are conglomeratic, ranging from a sprinkling of quartz pebbles in the ss. to a very coarse heavy cgl. of large rounded masses of crystalline rocks and vein quartz in a red-brown matrix. Rests uncon. on pre-

Camb. granites and schists and underlies Englewood ls. [Miss.]. In northern Black Hills is separated from Englewood ls. by a mass of buff ls. of Sil. age [Whitewood ls., of pre-Richmond Upper Ord. age].

W. M. Furnish, E. J. Barragy, and A. K. Miller, 1936 (A. A. P. G. Bull., vol. 20, No. 10, pp. 1329–1341), reported finding of poorly preserved Ord. (Middle?) fossils [listed and figured] in upper 70 ft. of Deadwood fm. of type section, and they recommended transfer of these beds from Deadwood fm. to overlying Whitewood ls. (which is classified by U. S. Geol. Survey as Upper Ord.). These 70 ft. of beds are described as consisting of (descending): (1) Transitional, 10 ft.; (2) siltstone memb., 20 ft., numerous fossils; and (3) sh. memb. 40 ft., few fossils. They rest on a ss., called "Scolithus ss.," 15 ft. thick, which has not yielded fossils. Authors conclude with following statements: Data presented seem to indicate that all beds in northern Black Hills above Scolithus ss. and below typical Whitewood dol. may be correlated with Middle Ord. Nó diagnostic fossils were found in Scolithus ss. or subjacent beds, and their age was not determined. Typical Whitewood dol. presumably is Upper Ord. It seems advisable for the present at least to include all Ord. beds above Scolithus ss. in Whitewood fm.

Deadwood Gulch rhyolite tuff.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). *Deadwood Gulch rhyolite tuff.*—White banded rhyolite, in small fragments, in an exceedingly fine-grained siliceous matrix. Thickness 10 to 400 ft. Older than Mogollon andesite and younger than Last Chance andesite.

Named for exposures in upper part of Deadwood Gulch, Mogollon dist.

Deanefield shale. (In Pottsville formation.)

Pennsylvanian: Western Kentucky (Hartford quadrangle).

J. H. Gardner, 1927 (Ky. Geol. Surv., ser. 6, vol. 26, pp. 135, 137, 153). *Deanefield sh.*—Very dark sandy clay sh., which weathers brownish gray. Thickness 75 ft. Holds Hamlin coal, about 25 ft. above base. Included in lower part of Pottsville group. Extends throughout territory from Butler to Daviess Counties, and is widely exposed around Deanefield and Fordsville. Forms surface rock, capped by Aberdeen ss., over large portion of Whitesville and Owensboro quads.

Deaner sand.

A subsurface sand, 0 to 60± ft. thick, of early Penn. or late Miss. age, in Okla., correlated by some with lower part of Dutcher sand series (Penn.) and by others with Miss. In type region (Deaner-Clearview pool, Okfuskee Co.) the sand lies at 2,800 ft. depth and Lyons sand at 3,150 ft. depth. Considered younger than Kingwood sand.

Dean Lake chert member.

Mississippian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 47 and passim). *Dean Lake chert memb.*—Generally thinnest memb. of Madison ls. in this area but the most persistent and striking. Outstanding characteristics are great amount of black, blue-black, and dark-gray chert, which occurs as nodules and as intercalated beds btw. the lss. In type loc. lower 23 ft. is blackish-gray lss. interbedded with black-gray and dull tan-gray chert in nodules up to 5 inches diam. Upper 37 ft. massive, blue gray, thick-bedded lss. with crinoid stems and brachiopod fragments, interbedded with beds of very fossiliferous dark chert up to 7 inches thick. Thickness 51 to 74 ft. Underlies Rooney chert memb. and overlies Saypo ls. memb., all in Madison ls. Named for small cirque lake lying at foot of cliffs that form upper part of E. side of Pentagon Mtn. Type loc. SE. side of the mtn, in SW¼ sec. 14, T. 25 N., R. 14 W.

Deanville moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Deanville, Lapeer Co.

Dearborn limestone.

Middle (?) Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 36 and passim). *Dearborn ls.*—At type loc. (North Fork of Dearborn River, in W. ⅓ sec. 6, T. 17 N., R. 7 W.) can be roughly divided into (descending): (1) Irregularly bedded, platy dull-gray fine-grained lss. in beds averaging 1 inch in thickness, interbedded with thin olive-gray calc. sh. in upper part, 127 ft.; (2) massive, thick-bedded crumbly gray argill. lss. with flakes and nodules of buff and some orange clay, 152 ft.; (3) thin-bedded micaceous gray-buff shaly lss. with green-gray micaceous calc. sh. in upper fourth, 180 ft. Thickest (459 ft.) in Dearborn region; thinnest (135 ft.) in vicinity of Prairie Reef. Overlies Nannie Basin ls. and underlies Steamboat ls.

Dease series.

Permian to Ordovician (?): British Columbia.

F. A. Kerr, 1926 (Canada Geol. Surv. Summ. Rept. 1925, pt. A, p. 80).

Death Canyon member (of Gros Ventre formation).

Middle Cambrian: Western Wyoming (Teton, Owl Creek, and Wind River Mountains).

B. M. Miller, 1936 (Jour. Geol., vol. 44, No. 2, pp. 119+). *Death Canyon memb.*—Largely fine-grained dark-gray and black ls. mottled with brown; the lss. thin-bedded for most part, in layers ½ to several inches thick, separated by argill. seams and partings. Fossils. Thickness 285 ft. in Teton Range. Gradually thins and interfingers with sh. to E., disappearing in middle parts of Owl Creek and Wind River ranges. Is 219 ft. thick at DuNoir, with many sh. beds in lower part; 100± ft. at Torry Creek; about 40 ft. at Bull Lake Creek. [See *Bull Lake Creek sh.* of Branson.] Overlies lower sh. div. (100± ft. thick) of Gros Ventre fm. and underlies upper sh. div. (200 to 300 ft. thick) of the Gros Ventre. Type section is along divide btw. Death and Teton Canyons, in Teton Range.

Death Valley formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Death Valley fm.*—A considerable number of interbedded lss., calc. argillites, and schists that occupy E. flank of S. part of Panamint Range. Thickness unknown. Little time could be devoted to this large area and present descriptions are necessarily sketchy. If there is any ascertainable strat. sequence it is unknown. The interbedding of rocks, which do not vary greatly in lithologic details, would probably seriously hamper separating Death Valley fm. into mappable units. Apparently nonfossiliferous. Conformably overlies Telescope group. Referred to lower Paleozoic (?). [Mapped over large area to W. of Death Valley.]

Deaton formation.

Deaton series.

Deaton iron-ore series.

Ordovician (Middle): Northwestern Georgia.

J. W. Spencer, 1893 (Ga. Geol. Surv. Paleozoic group, pp. 46, 83). *Deaton ore beds or series.*—Ferruginous lss., 100 to 200 ft. thick, included in Chickamauga series of Polk Co. and probably of Whitfield Co. Underlie Rockmart sl. and overlie Maclurea ls.

According to C. W. Hayes (U. S. G. S. Rome folio, No. 78, 1902) these beds belong in lower part of Rockmart sl., and rest on Chickamauga ls.

Named for exposures at Deaton mine, Polk Co.

Decatur limestone.

Silurian (late Cayugan): Western Tennessee.

W. F. Pate and R. S. Bassler, 1908 (U. S. Nat. Mus. Proc., vol. 34, pp. 410–432). *Decatur ls.*—Massive white crinoidal ls. with some mag. beds. Sometimes 70 or more ft. thick. Toward top becomes slightly shaly and more fossiliferous. At Lady's Bluff consists of (descending): Yellow argill. ls., 2 ft.; massive white mag. ls., 30 ft.; argill. grayish ls. weathering into sh., 11 ft.; massive mag. ls., grayish at top and yellowish toward bottom, 20 ft. Top fm. of Niagaran of West Tenn. Uncon. underlies Linden fm. (Lower Dev.) and overlies Lobelville fm., top fm. of Brownsport group. [See also under *Brownsport fm.*]

E. O. Ulrich has for years classified this fm. as of late Cayugan age. Some geologists, however, still consider it of Niagaran age. (See A. F. Foerste, Denison Univ. Bull., Jour. Sci. Lab., vol. 30, 1935, pp. 184–185.)

Named for Decatur Co., but type section is at Tuck's Mill, 1½ mi. N. of Decaturville.

†Decatur sand. (In Claiborne group.)

Eocene (middle): Southeastern Mississippi.

E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14, p. 78). *Decatur sand.*—Unconsolidated sand, white to yellowish, nonfossiliferous, probably marine; persistent; 18 to 25 ft. exposed. Outcrops mainly in SE. Miss., near Enterprise, Wautubbee, and Decatur. Rests on Enterprise green marl (probably conformably) and is overlain by Wautubbee marl (perhaps uncon.). Included in Lisbon fm.

The name is preoccupied. Replaced by Kosciusko ss. memb. of Lisbon fm. Named for exposures near Decatur, Newton Co.

†Decaturville limestone.

Upper Cambrian: Central Missouri.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, p. 42). *Decaturville ls.* 200 ft. thick, the Fourth Mag. ls. or Proctor ls. Underlies Gunter ss. and overlies Lesueur ls. Assigned to Camb. or Ozark.

G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 67). *Bonne Terre ls.* is=Decaturville ls.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267). Decaturville ls.=Bonneterre ls.

The 1922 geol. map of Mo. shows the rocks at and around Decaturville to be Roubidoux and underlying fms.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.). Proctor fm. is about 60 ft. thick in type loc., in Miller, Morgan, and Camden Counties. The only outcrops of Bonne Terre fm. are in St. Francois Mtn region, over about 200 sq. mi.

The 1926 geol. map of Mo. shows the rocks at and around Decaturville to be pre-Gasconade.

J. Bridge, 1930 (personal communication). The Decaturville ls. is Bonneterre dol., and Proctor dol. is absent at Decaturville.

Named for exposures at Decaturville, Camden Co.

Decaturville chert.

Upper Ordovician (Richmond): Central Missouri (Camden County).

G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 67), divided Richmond of Greene and Camden Counties into Maquoketa shales and *Decaturville chert,* which rested on Joachim ls. On p. 59 of same vol. he called the chert *Spencer chert.*

Decaturville chert.

Lower Devonian (Helderbergian): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 744). *Decaturville chert.*—Porous gray chert, 0 to 6± ft. thick. At base thinner bedded sandy chert which weathers more readily and is not well exposed. Although thin extends half way across State. Not identified E. of Tenn. River except in Hardin Co. Fauna closely allied to Birdsong, New Scotland, and Becraft. Seems best referred to earliest Becraft time. Well developed in vicinity of Decaturville, Decatur Co. Uncon. overlies Birdsong sh. and uncon. underlies Quall ls. Is top fm. of Helderbergian or Linden group.

Deception porphyry.

Pre-Cambrian: North-central Arizona (Jerome district).

L. E. Reber, Jr., 1922 (Am. Inst. Min. and Met. Engrs Trans., vol. 66, p. 12). In Deception Gulch, at N. end of Jerome area, where it adjoins the quartz porphyry, the nature of the material is open to question. The appearance is similar to that of known volcanic fragmentals and locally there are some obscure indications of its fragmental character. The microscopic evidence is conflicting but seems to point in same direction. But the rock resembles an intrusive igneous rock, and Finlay has named it [where?] *Deception porphyry.* The nature of its contact with the quartz porphyry indicates that one or both of the rocks must be intrusive.

J. L. Fearing, Jr., 1926 (Econ. Geol., vol. 21, pp. 757–773). *Deception quartz porphyry* is a sill of pre-Camb. rock intrusive into greenstone complex in Deception Gulch, Jerome dist., Ariz., and is older than Cleopatra quartz porphyry.

DeCew limestone.

Silurian: Western New York and Ontario.

E. M. Kindle, June 19, 1914 (Sci., n. s., vol. 39, p. 918). *DeCew ls.*, name proposed by M. Y. Williams, in paper read before Geol. Soc. Am. January, 1914. Basal memb. of Lockport dol. Underlies Gasport ls. and overlies Rochester sh.

M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 186). *De Cew ls.*—Fine-grained, dark grey, argill. ls., 2 to 9 ft. thick. Basal bed of Lockport memb. of Niagara fm. in Niagara Peninsula. Well exposed at DeCew falls. Is 9 ft. thick at Niagara River, 8 ft. at Grimsley, and 2 ft. at Hamilton, Ont. At some places shows on weathered surfaces cross-bedding and remarkable churned structure. The material of the beds suggests reworked Rochester sh. to which lime has been added. Heretofore included in the Lockport. Difficult to separate from Rochester memb., which is essentially sh., although toward top some calc. beds appear. Underlies Gasport ls. [Schuchert (Geol. Soc. Am. Bull., vol. 25, p. 307, 1914) stated 5 ft. of DeCew ls. is present at Lockport, N. Y., beneath Gasport ls. and 2 to 5 ft. at Rochester, N. Y.]

†Decewsville formation.

†Decewville formation.

Middle Devonian: Western New York and southeastern Ontario.

E. O. Ulrich and C. Schuchert, 1902 (N. Y. State Mus. Bull. 52, p. 653, chart opp. p. 659). *Decewville fm.*—Coarse ss. filled with late Oriskany fossils, overlain by sandy ls. containing a fauna of marked Onondaga aspect and extending up to where typical Onondaga ls. appears. The latest Oriskany invasion came from SE. and arrived at Cayuga, Ont., at about same time as Onondaga invasion from SW., causing a blending of Onondaga and Oriskany faunas. Remnants seen in cement quarries at Buffalo, N. Y. Named for exposures near village of Decewsville, Ontario.

C. Schuchert in 1903 (Am. Geol., vol. 31) placed the *Decewville* in top of Oriskanian, underlying Schoharie grit and overlying Esopus grit. G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348) used *Esopus* (*Decewville*) in N. Y. C. Schuchert, 1910 (Geol. Soc. Am. Bull., vol. 20, p. 541), correlated *Decewville of Ontario* with Esopus and Glenerie. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22) correlated Schoharie and *Decewville* of western N. Y. with Schoharie of eastern and central N. Y. In 1912 (Geol. Soc. Am. Bull., vol. 23, p. 376) C. R. Stauffer stated that *Decewsville fm.* of Ontario is not an independent unit, but that the upper ss. and aren. material carries an Onondaga fauna and forms basal layers of Onondaga fm., while the basal ss. contains characteristic Oriskany fossils; and that relations of Oriskany and Onondaga are same in Ont. as in N. Y. In 1913 (Jour. Geol., vol. 21, pp. 310–311) E. M. Kindle stated *"Decewsville fm."* has no standing, and that Decewsville section of the "formation" consists of 2 ft. of Onondaga ls., underlain by 17 inches of Oriskany ss., which rests on 30 ft. of ls. belonging to Salina fm.

DeChelly sandstone member (of Cutler formation).

Permian: Northeastern Arizona, southeastern Utah.

H. E. Gregory, 1915 (Am. Jour. Sci., 4th, vol. 40, p. 102). *DeChelly ss.*—Name adopted for forthcoming rept for beds overlying Moenkopi fm. and underlying Shinarump cgl. in Navajo Ind. Res., Ariz. [Not described.]

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380), and 1917 (U. S. G. S. P. P. 93). *DeChelly ss.*—Massive, very cross-bedded light-red or brown ss., 0 to 585 ft. thick, uncon. underlying Shinarump cgl. and overlying Moenkopi fm. in Navajo country. Mapped along Canyon de Chelly, Apache Co., Ariz.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1424–1448), after considerable field work in SE. Colo., NE. N. Mex., SE. Utah, and NE. Ariz., made the following changes in nomenclature of SE. Utah and NE. Ariz.: (1) They identified all red beds (including 2 conspicuous light-colored sss.) btw. base of Shinarump cgl. and above top of "Goodridge fm." as belonging to Cutler fm.; (2) they divided the "Goodridge" into Rico fm. and Hermosa fm.; (3) they divided the Cutler of SE. Utah and NE. Ariz. into (descending) Hoskinini tongue (red), DeChelly ss. memb. (light-colored), Organ Rock tongue (red), Cedar Mesa ss. memb. (white), and Halgaito tongue (red); (4) they restricted the name *DeChelly ss.* in Utah to southern part of San Juan Co. and applied the new name *White Rim ss. memb.* to the 0 to 100 ft. of white ss. in northern part of San Juan Co., of approx. the same age as upper part of typical DeChelly and called DeChelly and De Chelly (?) in previous repts. "NE. from Monument Valley the DeChelly ss. thins out and disappears near San Juan River at Clay Hill Crossing, and the upper and middle red beds merge." "In walls of Canyon De Chelly an incomplete exposure of DeChelly memb. shows a thickness of 800+ ft." This is the present approved nomenclature of SE. Utah and NE. Ariz.

Decker limestone.

Silurian (late): Southeastern New York, northern New Jersey, and northeastern Pennsylvania.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 76–77, 137–141). *Decker Ferry ls.*—Bluish gray, usually brecciated ls., 20 ft. thick, underlying Stormville cement bed (which separates it from the overlying Stormville ls.) and overlying Decker Ferry ss., which rests on Decker Ferry shales. The ls. often becomes slaty in lower portion, and is usually more or less sandy. In Ross Twp, Monroe Co. [Pa.], iron ore occurs at horizon of this ls. and in base of overlying Stormville ls. The Decker Ferry ls., Decker Ferry ss., and Decker Ferry shales are all exposed near Decker's Ferry below Flatbrookville, Sussex Co., N. J.

S. Weller, 1903 (N. J. Geol. Surv. Pal., vol. 3, p. 62), applied *Decker Ferry ls.* to same unit defined by White, stating that it "is quite distinct, both faunally and lithologically from underlying *Decker Ferry fm.* here recognized." Weller's *Decker Ferry fm.* included *Decker Ferry ss.* and *Decker Ferry sh.* of White, which he stated are closely allied.

According to C. A. Hartnagel, 1903 (N. Y. State Mus. Bull. 69), the "Decker Ferry fm. of N. J." is=Cobleskill, Rosendale, and Wilbur lss. of N. Y. In 1905 (N. Y. State Mus. Bull. 80, pp. 342–357) Hartnagel restricted name *Decker Ferry fm.* to the beds (41 ft. thick at Nearpass, N. J.) beneath the Cobleskill and above Bossardville ls., or to equivalents of Rosendale and Wilbur lss. of repts., and stated that *Decker Ferry fm. of Weller* included also the equiv. of the Cobleskill. Hartnagel's Decker Ferry fm. consisted of 15 ft. of lss. and shales, underlain by 2 ft. of red crystalline ls. characterized by *Ptilodictya frondosa*, which rested on 24 ft. of highly fossiliferous hard crystalline ls. designated *Chonetes jerseyensis* zone. In 1908 (N. Y. State Mus. Bull. 107, p. 51) Hartnagel divided the Salina of Ulster Co., N. Y., into (descending): Decker Ferry (=Rosendale cement and Wilbur ls.); Binnewater ss.; and High Falls sh.; the latter two correlated with Longwood sh. (At Port Jervis, Orange Co., N. Y., he identified the Decker Ferry beneath the Cobleskill and above the Bossardville ls.). In Hdb. 19, 1912, Hartnagel stated that *Decker Ferry fm.* is best developed in Pa. and N. J., and that most favorable place for its examination in N. Y. is at Accord [Ulster Co.], where entire thickness is shown.

In 1908 (U. S. G. S. Franklin Furnace folio, No. 161) the name was shortened to *Decker ls.* and was applied to 50 ft. of dark-gray impure siliceous and shaly ls. overlying Longwood sh. and containing fossils which correlated it "with the lower portion of the 'Decker Ferry' ls. on Delaware River and the upper Salina beds of N. Y."

In 1913 (Md. Geol. Surv. Lower Dev. vol., table opp. p. 30) C. K. Swartz, C. Schuchert, and C. S. Prosser correlated *Decker Ferry ls.* of N. J. with *Decker Ferry* of N. Y., and with Cobleskill, Rosendale, and Wilbur lss., the Cobleskill being overlain by Rondout ls. All of these fms. they classified as Lower Dev. The same year, and on pp. 115 to 116 of same volume, E. O. Ulrich assigned the Decker Ferry of N. Y. to Lower Dev., and showed it as underlying the Rondout and as younger than *typical* Manlius ls., which he stated rests on the Cobleskill and which he assigned to Sil. In 1915 (N. J. Geol. Surv. Bull. 14) J. V. Lewis and H. B. Kümmel gave the following sequence of Sil. fms. of N. J. (descending): Manlius ls.; Rondout ls.; Decker ls. (52 ft. of ls. to NE. and calc. sss. to SW., with Salina fossils); Bossardville ls.; Poxino Island sh.; High Falls fm. (=Longwood sh.); Shawangunk cgl.

The age and strat. relations of Decker ls. are still debated.

†Decker Ferry limestone.

†Decker Ferry formation.

See under *Decker ls.*

Decker Ferry shales.

Silurian: Northeastern Pennsylvania (Monroe County) and northwestern New Jersey (Sussex County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 77, 141). *Decker's Ferry shales.*—Greenish shales, often limy, 15 ft. thick. Underlie Decker's Ferry ss. and overlie Bossardville ls. Well exposed at Decker's Ferry [Sussex Co., N. J.].

Decker Ferry sandstone.

Silurian: Northeastern Pennsylvania (Monroe County) and northwestern New Jersey (Sussex County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 77, 140–141). *Decker's Ferry ss.*—A grayish white, pebbly, calc. ss., very fossiliferous, 15 to 25 ft. thick. Underlies Decker's Ferry ls. and overlies Decker's Ferry shales. Forms low cliff just above road leading SW. from Decker's Ferry [below Flatbrookville, on Delaware River, in Sussex Co., N. J.], and is exposed at many places btw. there and Delaware Water Gap.

Decorah shale.

Middle Ordovician (Trenton and late Black River): Southwestern Wisconsin, southern Minnesota, Iowa, western Illinois, and Missouri.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 84). *Decorah (Green) sh.*—Very calc. green sh., with numerous bands and nodules of ls., 25 to 30 ft. thick, forming top shaly memb. of Platteville stage. Overlies Platteville ls. (lower fm. of Platteville stage) and underlies Galena ls. Within city of Decorah [Winneshiek Co., Iowa] and vicinity is everywhere very calc.

Adopted by U. S. Geol. Survey in 1910 as a distinct fm., overlying Platteville ls. restricted and underlying Galena dol. It was understood to have been included in Platteville ls. as originally defined, and to include "glass rock" of miners and here and there a thin layer of "oil rock," but that main "oil rock" of miners was in overlying Galena dol.; also that it is "Green shales" of early Minn. repts. Fauna considered by E. O. Ulrich (1923) to be of late Black River age.

G. M. Kay, 1928 (Sci., n. s., vol. 67, p. 16), divided *Decorah fm.* into 3 members, named (descending) *Ion memb.*, *Guttenberg memb.*, and *Spechts Ferry memb.*, the latter said to include the "glass rock." (See descriptions of these members.) Kay stated upper 2 members are of Trenton age and lower memb. of latest Black River age; also that his Guttenberg memb. is the "oil rock" *at base of the Galena* in NW. Ill. This seems to mean a restriction of *Galena* and an expansion of *Decorah* of previous repts. In 1931 (Jour. Geol., vol. 39, p. 370) Kay redefined his *Spechts Ferry memb. of Decorah fm.* by excluding the "glass rock." In 1932 (Jour. Geol., vol. 40, No. 3, pp. 259–269) V. T. Allen proposed drawing line btw. Platteville and Decorah at base of a 1- to 3-inch layer of metabentonite, which he reported as present 12 to 18 inches above base of Decorah in Minn., Iowa, and Wis.

G. M. Kay and G. I. Atwater, 1935 (Am. Jour. Sci., 5th, vol. 29, Feb., pp. 98–99, 101), continued to include Kay's Spechts Ferry memb. in the Decorah and to classify it as of late Black River age and rest of Decorah as of Trenton age. They stated that Platteville as defined by Bain did not include Ion and Guttenberg members of Kay.

A. C. Trowbridge et al, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1), treated Galena as a *group*, all of Trenton age, and included in it *Decorah sh.* (restricted to beds above the basal or Spechts Ferry memb. of Kay, which they included in Platteville ls.). Page 64, however, excluded all of *Decorah fm.* from the Galena, but included it in the Trenton, and transferred Kay's Spechts Ferry memb. to the Platteville.

G. M. Kay, 1935 (pp. 286–287, 295 of 1935 Conf. rept. cited above), also restricted *Decorah fm.* by transferring to the Platteville his Spechts Ferry memb. restricted and the underlying "glass rock" (which he included in his newly named McGregor memb. of the Platteville), leaving Decorah fm. near Platteville as composed wholly of his Guttenberg memb. But on p. 288 he stated that in Minn. and northern Iowa it is "more convenient to consider the Spechts Ferry as a lowest memb. of Decorah fm." Kay stated (p. 286) his restricted Spechts Ferry memb. includes a thin bed of metabentonite 18 inches above its base. On p. 295 he showed an uncon. btw. his Guttenberg and Spechts Ferry members in Minn. and Ill.

The U. S. Geol. Survey has for many years followed the definitions of Decorah sh. and Platteville ls. that include the "glass rock" in Decorah sh. Its present age designation of Decorah sh. is late Black River and early Trenton. The sh. separating Plattin and Kimmswick lss. in Mo., SW. Ill., and central western Ill. has for several years been called *Decorah sh.* This sh. is now said to correspond to only the Spechts Ferry memb. of Kay. If so, and Kay's Spechts Ferry memb. is transferred to Platteville ls., *Decorah* is no longer an appropriate name for the sh. separating Plattin and Kimmswick lss.

Decota sandstone. (In Kanawha formation.)

Pennsylvanian: West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., p. 292). *Decota ss.*—Grayish brown, medium grained, often current bedded. Thickness 15 to 25 ft. Lies 2 to 5 ft. below Eagle coal and overlies Little Eagle coal. Named for Decota, Kanawha Co.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 206). *Decota ss.* is 20 to 50 ft. thick, and lies 5 to 10 ft. below Bens Creek coal and 5 to 10 ft. above Little Eagle coal.

De Courcy formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 99).

Dederick shale member.

Pennsylvanian: Western Missouri (Vernon County).

F. C. Greene and W. F. Pond, 1926 (Mo. Bur. Geol. and Mines vol. 19, 2d ser., pp. 38–44). *Dederick sh. memb.*—Chiefly dark blue to black sh. containing upper Dederick, middle Dederick, and lower Dederick coal beds, and, locally, a coal bed at top. The coal beds are underlain by clay and locally ss., cgls., and ferruginous ls. appear at base. The black sh. contains numerous thin bands and plates of dark, impure iron carbonate. Thickness 27 to 75 ft. Is basal memb. of Cherokee fm. in Vernon Co. Is overlain by Clear Creek ss. memb. of Cherokee, and uncon. underlain by Miss. rocks. Best exposures in vicinity of Dederick, along railroad in N. part of sec. 26, T. 36 N., R. 29 W., and in NE. ¼ SE. ¼ sec. 36, T. 36 N., R. 29 W. The name is not intended to apply to the Cherokee section outside of the area in SW. Mo.

Dedham granodiorite.

Early Paleozoic (pre-Devonian): Eastern Massachusetts and southeastern New Hampshire.

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers No. 3, with map), mentioned *Dedham granite.*

G. F. Loughlin and L. A. Hechinger, 1914 (Am. Jour. Sci., 4th, vol. 38, p. 49). The *Dedham granite* with associated basic plutonic rocks covers a large area, including NW. corner of Narragansett Basin and almost entire NW. side of Norfolk County Basin. The complete series probably includes all types and gradations, from alaskite and aplite, through common biotite granite, granodiorite, diorite, and gabbro.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 175–177). *Dedham granodiorite* (or the several types of rock mapped under that name) occupies a larger part of eastern Mass. than any other fm. and is more widely distributed than any other rock in State except the Triassic diabase. As mapped it includes several lithologic varieties, the most abundant and typical of which is a rather coarse biotitic granodiorite, composed essentially of microcline, plagioclase (generally andesine), quartz, and chlorite, and commonly more or less epidote and kaolin. Named for typical exposures about Dedham, Mass. Assigned to Dev. (?).

L. LaForge, 1932 (U. S. G. S. Bull. 839), assigned *Dedham granodiorite* to "early Paleozoic, certainly pre-Dev."

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 99–112), definitely assigned *Dedham granodiorite* to pre-Camb.

E. J. Rhodes and W. H. Graves, Jr., 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 371–372), after studying *Dedham granodiorite* in N. part of Dedham quad., Mass., stated: "We would place the Dedham tentatively in Dev., where originally placed by Emerson." "It would not be surprising to find that a pre-Camb. body in R. I. and a post-Camb. body in Mass. have been included under the broad term 'Dedham granodiorite.' "

W. G. Foye and A. C. Lane, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 137). *Dedham granodiorite* is probably Dev.

Deep Canyon fanglomerate.

Quaternary: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 384–385, and map). *Deep Canyon fangl.*—Detrital rocks, consisting largely of angular and subangular boulders derived from older rocks to N. Contain notable proportion of rounded material and many strata of ss. comparable to that in Hathaway fm. Rest on basalt, of probably early Quat. age, on both sides of Deep Canyon. Across upturned and eroded edges of the fangl. and basalt a later fangl. has been deposited. Is older than Coachella fangl. and younger than Pipes fangl.

Named for Deep Canyon, Riverside Co.

Deep Creek division.

Lower Ordovician: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 302–306). *Deep Creek div.*—Siliceous rocks (descending): (1) Fossiliferous largely decomposed cherty beds, 50 to 100 ft.; (2) 10 ft. or less of massive chert beds; (3) 25 ft. of thinly laminated tough cherty dolomites, white to dull gray or chalky, sometimes with interstratified chert beds 1 to 3 ft. thick; (4) 40 ft. of dol., gradually becoming tough and cherty and weathering with deeply pitted surfaces, containing cherty nodules; (5) 50 ft. of gritty, fine-grained, saccharoidal light-gray or slightly yellowish highly siliceous dol. Top div. of San Saba series. Overlies Hinton div.

Named for Deep Creek, San Saba Co.

†Deep Creek beds.

Miocene (middle): Central southern Montana (Little Belt Mountains region).

See under *Deep River beds*.

Deepkill shale. (In Beekmantown group.)

Lower Ordovician: Eastern New York.

R. Ruedemann, 1902 (N. Y. State Mus. Bull. 52, pp. 546–575), recognized within the Beekmantown of Deep Kill section, in vicinity of Albany, three graptolite zones, which he enumerated in table on p. 575, and after each zone inserted, in parens, *Deep Kill*. This is apparently a geographic and not a geologic designation. The lowest zone was said to be underlain by some nonfossiliferous beds, and zones 2 and 3 to be separated by some nonfossiliferous beds.

In 1903 (N. Y. State Mus. Hdb. 19, chart) J. M. Clarke applied *Deepkill sh.* to beds btw. Chazy ls. and Beekmantown ls. In 1912 (N. Y. State Mus. Hdb. 19, p. 34) C. A. Hartnagel stated that *Deepkill sh.* is especially characterized by graptolite-bearing zones, is typically exposed near Grant Hollow, in Rensselaer Co., along the Deepkill, a small eastern tributary of Hudson River, and is of Beekmantown age, as determined by fossils. In the chart he assigned it to a strat. position btw. Normanskill sh. above and Schaghticoke sh. below.

R. Ruedemann and H. P. Cushing in 1914 (N. Y. State Mus. Bull. 169, pp. 66–99 and p. 140) assigned *Deepkill sh.* to position btw. Bald Mtn ls. (uncon. below Normanskill sh.) and Schaghticoke sh., and included it all in Beekmantown. In 1921 (N. Y. State Mus. Bull. 227, 228, p. 130) Ruedemann classified *Deep Kill sh.* as of lower Chazy and Beekmantown age, and assigned it to position btw. Normanskill and Schaghticoke shales.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, No. 2). *Deepkill sh.* is a mass of graptolite sh., 300 or more ft. thick, that corresponds to Beekmantown and probably also to Lower Chazy. [In chart on p. 414 he placed Deepkill below Bald Mtn ls. (which he assigned to Beekmantown) and above Schaghticoke sh.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 272). *Deepkill sh.* is for most part equiv. to Beekmantown ls., but uppermost graptolite zone carries Chazy fauna (Ruedemann).

Deep Lake argillite.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20). *Deep Lake argillite.*—Dark to light-colored calc. argillite, with interbedded bluish-gray fine and coarse bands of argill. ls. showing well-defined stratification. So calc. as to render it difficult whether to map it as ls. or argillite. Thickness 2,500± ft. Exposed along wagon road on E. shore of Deep Lake. To E. of the lake it extends up into steep mtn slopes where it is heavily covered with glacial material.

Deep Lake metaquartzite.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 625). *Deep Lake metaqtzite.*—Coarse to fine, massive to slabby metaqtzites, of grayish-white, dark-gray, light-gray, and brownish-gray colors, with a few beds of fine fluvial cgl. and also scattered pebbles and clay balls; cross-bedding very regular; concealed beds probably schists. Thickness 2,000+ ft. Underlies Headquarters schist, probably conformably. Overlies gneissic complex, but contact not seen and relation unknown. Outcrops around Deep Lake. Assigned to early Algonkian.

†Deep River formation.

†Deep River series.

Triassic (Upper): Central North Carolina (Deep River region).

E. Emmons, 1856 (N. C. Geol. Surv. Rept. of Midland Counties, pp. 255, 273+). *Deep River series* (also *Deep River fm.*).—Trias and Perm. rocks of Deep River region, consisting of (descending): (1) red sss., marls, etc.; (2) black or blue sl. with plants and a coal seam; (3) cgl.; (4) drab-colored sss., calc. and bituminous shales; (5) coal, fire clay, oxide of iron; (6) red ss., sometimes gray and drab; and (7) cgl.

Replaced by Newark group.

Named for exposures along Deep River.

Deep River beds.

Miocene (middle): Central southern Montana (Little Belt Mountains region and Meagher County).

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 287). *Deep Creek beds.*—Still farther E. [of Fort Ellis] along Deep Creek, exist remarkable lake deposits of both "Miocene" and "Pliocene" age, which represent *Ticholeptus* beds of Cope. [Same as *Deep River beds,* the stream having been called by both names and also called *Smith River.*]

W. B. Scott, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 595). *Deep River beds* are upper Mio. [See also Am. Phil. Soc. Trans., vol. 18, pp. 55–63, and other repts of Scott.]

E. Douglass, 1903 (Carnegie Mus. Annals, vol. 2, pp. 150–151). *Deep River beds* restricted to what has previously been called *Upper Deep River,* and *Fort Logan beds* introduced for *Lower Deep River.* Faunas differ. Cope's collections of fossils all came from upper beds.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 76). "Upper part of Deep River sequence (Smith Creek) or *Ticholeptus* zone of Cope," is middle Mio., and (pp. 65, 112) *Fort Logan beds* are lower Mio.

See also †*Smith River lake beds.*

Deep Run member. (In Ludlowville shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 218, 226, 227, etc.). *Deep Run memb. of Ludlowville fm.*—Brittle bluish sh., overlying true Tichenor ls. and underlying Menteth ls. (basal bed of Portland Point memb. of Ludlowville fm.) in Deep Run ravine, near Cottage City, Canandaigua Lake. Contains a variety of pelecypods and great abundance of large specimens of *Tropidoleptus carinatus.* Recognizable from Seneca Lake to Hills Gulch, 5 mi. S. of LeRoy. At type loc. is 55 ft. thick, but diminishes rapidly to W. At Jacox Run, Genesee Valley, it is 9 ft. thick, at Hills Gulch about 3 ft., and from there tapers to feather edge. Also diminishes in thickness E. of type loc., being 49 ft. on Kashong Creek. Not distinguished E. of Seneca Lake, but it evidently forms upper part of King Ferry memb. to E.

Deep Spring formation.

Pre-Cambrian: Eastern California (Inyo Range).

E. Kirk, 1918 (U. S. G. S. P. P. 110). *Deep Spring fm.*—About 1,600 ft. of sss. and dolomitic lss. uncon. underlying Campito ss. and uncon. overlying Reed dol. Named for exposures along W. side of Deep Spring Valley in canyons N. of Antelope Spring.

Deer Creek quartzite.

Pre-Cambrian (Glenarm series): Northern Maryland.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Rept., vol. 1, pp. 130–132). *Deer Creek white cgl. qtzite.*—[Petrographic description given.] Occurs in center of Harford Co., Md., marking a sharp, narrow ridge 300 ft. high, 4 mi. long, and less than a mi. wide. May prove to be a basal cgl. of Peach Bottom phyllite series.

E. B. Mathews, 1898 (Md. Geol. Surv. vol. 2, p. 213). At station known as "The Rocks" the Baltimore and Lehigh R. R. and Deer Creek pass through a ridge of highly metamorphosed hard micaceous sss. in a gorge 350 ft. below summit. This ridge extends in a NE.-SW. direction for 10 or 12 mi. and forms part of the folded phyllite series, which are probably of Camb. age. The ss. of which it is composed lies some distance above base of the series and below bottom of Peach Bottom sl. The ss. is rich in quartz and locally becomes conglomeratic.

According to E. B. Knopf (letter dated Feb. 11, 1937) the relation of the rocks described as *Deer Creek qtzite* to surrounding rocks has not been definitely established, but they are probably strat. equiv. of Cardiff cgl.

Deer Creek limestone member (of Shawnee formation).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, southwestern Iowa, northwestern Missouri, and central northern Oklahoma.

J. Bennett, 1896 (Kans. Univ. Geol. Surv. vol. 1, p. 117). *Deer Creek system.*—Three lss. separated by shales; aggregate thickness 26½ ft. Separated from overlying Topeka ls. by 60 ft. of sh. [Calhoun sh. memb.] and from underlying Lecompton ls. by about 100 ft. of sh. with some thin lss. [Tecumseh sh. memb.].

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 48). *Deer Creek ls.* as originally defined by Bennett included 3 lss. and 2 shales. The following names are proposed for the subdivisions (descending): Ervine Creek ls., Mission Creek sh., Haynies ls., Larsh sh., and Rock Bluff ls. All of these units extend through outcrops in Nebr., Iowa, Mo., and Kans.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), transferred from Calhoun sh. to top of Deer Creek ls. the beds previously named *Jones Point sh.* and *Sheldon ls.*, and restricted *Calhoun sh.* to the beds previously named *Iowa Point sh.*

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11), divided Calhoun sh. into (descending) Iowa Point sh., Sheldon ls., and Jones Point sh.; restricted Deer Creek ls. to the beds btw. base of Jones Point sh. and top of Tecumseh sh.; and divided Deer Creek ls. in section from Forest City, Mo., to DuBois, Nebr. into following members (descending): Ervine Creek ls., Larsh sh., Rock Bluff ls., Oskaloosa sh., and Ozawkie ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), divided Deer Creek ls. of Kans. into (descending): Ervine Creek ls., Larsh-Mission Creek sh., Rock Bluff ls., Oskaloosa sh. (formerly erroneously identified as Larsh sh. but older than true Larsh sh.), and Ozawkie ls. (formerly erroneously identified as Rock Bluff ls.). He stated that his Ozawkie and Oskaloosa members are absent in Nebr.

In Kans. the Shawnee is treated as a group and the Deer Creek as a fm. In northern Okla. the Deer Creek ls. is treated as a memb. of Pawhuska ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Also 1937 entry under *Topeka ls.*

Named for exposures on Deer Creek, E. of Topeka, Shawnee Co., Kans.

†Deerfield diabase.

Upper Triassic: Central Massachusetts (Connecticut River region).

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 451–456). The *Deerfield diabase* rests at its northern and southern ends on Mount Toby cgl.; in its middle upon the Triassic sss. and shales [Sugarloaf arkose, Longmeadow brownstone, and Chicopee sh.].

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 97, 265–271). *Deerfield sheet of Mount Holyoke diabase* is an overflow. It rests on Mount Toby cgl. from Gill Center nearly to Fall River, then on Longmeadow ss. to Deerfield, then on Sugarloaf arkose to the Conn., and on Mount Toby cgl. to S. end of Mount Toby.

†Deer Lake conglomerates.

Pre-Cambrian (Keewatin): Northwestern Michigan (Marquette district).

See under *Kitchi schist.*

Deer Lake argillite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 54; map). *Deer Lake argillite.*—Interbedded quartz-mica schists, dark-gray and grayish-brown qtzites, and thin-bedded argill. shales and slates, the latter prevailing. The subordinate schists and qtzites occur in bands varying in width of thickness from 2 or 3 to over 100 ft. Exposed along shores of Deer Lake. Southern end terminates about 1 mi. S. of Deer Lake. Thickness 4,000± ft. Is in contact with Eagle Mtn qtzite, which it appears to underlie, but it is possible it overlies the Eagle Mtn and is in its present position as result of overturned fold.

Deer Lick sand.

Drillers' term for an Upper Dev. oil sand in western Pa. that is said to lie at about same horizon as Bradford Third sand.

Deer Mountain red shale member (of Hueco limestone).

Permian (?): Western Texas (Hueco Mountains).

P. B. and R. E. King, 1929 (A. A. P. G. Bull. vol. 13, p. 925). [*Deer Mtn red beds,* shown in section of Hueco Mtns as resting on Gym ls. and as=upper part of Hess fm. of Sierra Diablo.]

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–798), called these beds *Deer Mtn red sh. memb. of Hueco ls.* and assigned them to Permian (?).

Deer River shale.

Upper Ordovician: Eastern New York (Black River Valley) and southern Canada.

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 124–126, 130). *Deer River sh.* and Atwater Creek sh., of the black sh. of Black River Valley, the zone of *Climacograptus typicalis posterus* and *Glossograptus quadrimucronatus, forma typica* [respectively]. [Table on p. 130 shows Deer River sh. resting on Utica sh. and overlain by Atwater Creek sh.]

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 49–52, 60, 76, 82, 148). *Deer River sh.* (zone of *Climacograptus typicalis posterus*) is post-Utica in age, but lithologically of character of Utica. Thickness 70 ft. on Deer River, near Copenhagen [Lewis Co., N. Y.]. Was deposited on NW. side of Adirondack mass in an embayment extending southward from Gloucester sea in Canada. Is overlain by Atwater Creek sh. (zone of *Glossograptus quadrimucronatus, forma typica*), which in turn is overlain by Whetstone Gulf sh. Is basal part of Lorraine group. The Whetstone Gulf, Atwater Creek, and Deer River fms. of Black River Valley are=*Frankfort sh. of Utica Basin.* [*In parts of rept the Atwater Creek beds* are included in Whetstone Gulf fm., and in other parts of rept they are excluded.]

Deer River moraine.

Pleistocene: Northwestern New York (Lowville region).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). A group of hills, in Carthage quad., that forms belt about 4 mi. long and 1 mi. wide, from Deer River across to Black River valley.

Deer Trail argillite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 59; map). *Deer Trail argillite.*—Argillites, calc. argillites, phyllites, quartz mica schists, narrow bands of ls., and small discontinuous bands of qtzite; argillites and quartz-mica schist are most abundant. Thickness 3,000± ft. Includes Stensgar dol. memb. Underlies Addy qtzite. [Type loc. not stated, but Deer Trail Mine is in this fm.]

Deerwood iron-formation member (of Virginia slate).

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Cuyuna district).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 212–215+). *Deerwood iron-bearing memb. of Virginia sl.*—Principally iron carbonate where unaltered, but largely altered to amphibole-magnetite rocks, ferruginous sl. and chert, and iron ore. Found in lenses in Virginia sl., presumably near base. Named for development at and near Deerwood.

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 101, 103). Near base of Cuyuna memb. of Crow Wing fm. in Cuyuna dist. is a persistent layer of ore fm. About 500 ft. or more above it is a second layer. Collectively these have heretofore been called *Deerwood ore-bearing memb.* Writer has previously pointed out that he believed Deerwood memb. consisted of two major bands, rather than one, and considered the portion in N. part of North Range (T. 47, R. 29) the lower band, with the South Range band probably its extension or equiv., and the portion in S. part of North Range (T. 46, R. 29) the upper band. The lower band in many respects carries out idea of a gradation from the poorer bands of underlying Emily memb. to the better or upper band of the Deerwood. Adjacent rock fms. support this view.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), changed name to *Deerwood iron-fm. memb.*, and, although including it in Virginia sl., stated that it might be=Biwabik iron-fm., which they assigned to middle Huronian.

Dees horizon.

Dees sand.

Lower Cretaceous: Northeastern Texas (Cass County) and northwestern Louisiana (Caddo County).

J. S. Ivy, 1936 (Oil and Gas Jour., vol. 34, No. 48, April, p. 72). *Dees horizon* (in lower part of Glen Rose fm. of Rodessa field) consists of 95 ft. of beds divided into (descending): (1) Occasional coquina, (2) *Dees sand,* (3) Coquina ls., and (4) oolitic sand or "mealy" ls. The Dees sand varies from that of true quartz sand to sandy ls. interbedded with sandy sh. Its av. thickness is 15± ft. Underlies 55 ft. of mottled red and green ls. and overlies basal black sh. memb. of Glen Rose fm. [Derivation of name not stated.]

Deese formation.

Pennsylvanian: Central southern Oklahoma (Carter County).

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull., vol. 6, No. 1). *Deese memb. of Glenn fm.*—Characterized by a large number of massive sss., cgls., shales, and a few lss. To N. of Ardmore the base is marked by a brown ls. bearing an abundance of *Spirifer condor;* S. of Ardmore this horizon is represented by a bed of chert, and there is a thick cgl. at base. Occurs in a NW.-SE. exposure just E. of Deese. Thickness 6,000 to 8,000 ft. Fossils listed. Underlies Hoxbar memb. and overlies Cup Coral memb.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331–347). Glenn fm. includes only Deese and Cup Coral members of Goldston.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7–21). *Deese fm.*, 5,000± ft. thick, underlies Hoxbar fm. and overlies Dornick Hills fm. (1,500 to 4,000 ft. thick), which rests on Springer fm. Top memb. of Dornick Hills fm. is here named *Pumpkin Creek ls.*, and basal memb. of Hoxbar fm. is here named *Confederate ls. memb.*

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). *Deese fm.*, 3,000 to 7,000 ft. thick, as here defined coincides very nearly with Goldston's Deese memb. of Glenn fm. as mapped by him in type loc., in sec. 33, T. 3 S., R. 1 E., adjoining village of Deese. The village itself lies on the thin edge of red beds overlying Hoxbar fm. The Deese fm. overlies Pumpkin Creek memb. of Dornick Hills fm. and underlies Confederate ls. memb. of Hoxbar fm.

Defiance moraine.

Pleistocene (Wisconsin stage): Northern Ohio and southern Michigan. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53, 1915; also in part in fig. 8 of U. S. G. S. Columbus folio (No. 197), p. 12, 1915; also in fig. 7 in U. S. G. S. Detroit folio (No. 205), 1917. In SE. Mich. is locally double, and *outer ridge of Defiance moraine* is now used to replace "Northville moraine" of Mich. Geol. Surv. Wayne Co. Rept., *inner ridge of Defiance moraine* being used to replace Defiance moraine as described in earlier repts on Michigan. Named for Defiance, Ohio. Replaces "Blanchard moraine."

Degonia sandstone. (In Chester group.)

Mississippian: Southern and western Illinois and western Kentucky.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41). *Degonia ss.*—In typical occurrence a very massive, cliff-making ss., but locally it contains rather thick strata of thinly bedded sss., conspicuously ripple marked, which in places are almost aren. shales. Much of fm. is notably cross bedded. Light brown on fresh surfaces; weathers darker. Thickness 50 ft. or less to more than 100 ft. Rests on Clore ls., with apparent conformity. Overlain, apparently conformably, by Kinkaid ls. Heretofore included in Pottsville, but discovery above it of Kinkaid ls., which carries a Chester fauna, proves it properly belongs to Chester group. Included in Clore fm. *as mapped in earlier repts.*

Named for Degonia Twp, Jackson Co., Ill., where it is a conspicuous cliff maker in bluffs of the Mississippi and sides of tributary valleys.

DeKalb limestone member (of Kansas City formation).

Pennsylvanian: Iowa, northwestern Missouri, southeastern Nebraska, and eastern Kansas.

H. F. Bain, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 437–439). *DeKalb ls.*—Ls., known as *Fusulina* ls., 15 to 30 ft. thick, occurring in sh. interval btw. Westerville ls. above and Winterset ls. below. Included in Bethany ls.

J. L. Tilton, 1913 (Iowa Acad. Sci. Proc., vol. 20, p. 210), applied *Chanute sh.* to the sh. separating *DeKalb ls.* from overlying Westerville ls., and *Cherryvale sh.* to sh. separating the DeKalb from the underlying Winterset ls.

J. L. Tilton, 1921 (Iowa Geol. Surv. vol. 27, p. 186) and 1924 (Iowa Geol. Surv. vol. 29), correlated DeKalb ls. and Westerville ls. with Drum ls., and called the sh. overlying it *Chanute sh.* and the sh. underlying it *Cherryvale sh.* He also called the ls. overlying Chanute sh. the Iola ls., instead of Westerville.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 91). Cherryvale sh. of Kans. divided into following members (descending): Quivira sh., *DeKalb ls.* (erroneously called Drum ls. by Hinds and Greene), Wea sh., Block ls., and Fontana sh.

R. C. Moore and G. E. Condra, Oct. 1932 (revised classification chart of Penn. rocks of Kans. and Nebr.) adhered to latter definition of Cherryvale sh., but discarded *DeKalb ls.* for *Westerville ls.*, a name introduced by Bain at the same time he introduced DeKalb, in rept. cited above.

G. E. Condra, 1933 (Nebr. Geol. Surv. Paper No. 4, p. 29). "DeKalb ls." of Iowa Surv., defined by Bain, is synonym of Winterset [an older ls. than Westerville], and should be discontinued because latter has priority. The Westerville ls., defined by Bain, is "Drum ls." of Kansas City section.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 40). In Oct. 1932, R. C. Moore, G. E. Condra, and F. C. Greene traced so-called Drum ls. of Kansas City area to Winterset, Iowa, and determined that type DeKalb is Winterset ls. As *Winterset* has priority, the term *DeKalb* must be dropped.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for DeKalb, Decatur Co., Iowa.

DeKalb granite.

Pre-Cambrian: Northern New York (St. Lawrence County).

H. P. Cushing, 1916 (N. Y. State Mus. Bull. 191, pp. 13, 17, 19, 23). *DeKalb granite.*—Most of it is a fine-grained red orthogneiss, quite like the granite at Macomb and Alexandria. Is chiefly a feldspar quartz rock, with very little mica, and with inclusions of amphibolite solely. Is pre-Camb., but uncertain whether it belongs to older Laurentian intrusives or to younger "Algoman" intrusives. Occurs in DeKalb [St. Lawrence Co.].

DeKalb moraine.

Pleistocene (Wisconsin stage): Northwestern New York. Named for DeKalb and DeKalb Junction, St. Lawrence Co. (See Jour. Geol., vol. 32, pp. 645, 664, 1924. Also A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 45), who stated that this moraine is prominently developed S. of DeKalb Junction.)

Dekkas andesite.

Middle Triassic: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Dekkas andesite.*—Is generally a dark-gray lava, more or less porphyritic, but not conspicuously so to naked eye. Includes a great mass of lava made up of many separate overlapping volcanic flows and sheets of tuff more or less distinctly bedded, irregularly conformable, and dipping eastward. Along E. border of quad. these rocks are overlain conformably by and to a small extent are interbedded with bottom part of Pit shales. Overlies Nosoni fm. and underlies Bully Hill rhyolite. Thickness approx. 1,000 ft. Named for exposures along Dekkas Creek.

DeKoven formation.

Pennsylvanian (Allegheny): Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 27). *DeKoven fm.*—Shales with thin sss. and thin unworkable coals, and, at base, Sebree ss., a coarse massive ss. 10 to 50 ft. thick. Thickness 100 to 400 ft. Uncon. overlies Tradewater fm. (Penn.) and uncon. underlies Mulford fm. (Penn.) in Webster Co.

Probably named for Dekoven, Union Co.

Delaneys Creek facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 77, 169, etc., 1931) to a lithologic facies of his Carwood fm. in Washington Co., Ind.

Delano moraine.

Pleistocene (Wisconsin stage): Southern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, p. 85). Included in Crow River morainic system. Village of Delano, Wright Co., stands on this moraine.

Delaware limestone.

Middle Devonian: Ohio.

N. H. Winchell, 1874 (Ohio Geol. Surv. vol. 2, pp. 290–302). *Upper Corniferous ls. (Delaware ls.; also Sandusky ls).*—Blue even-bedded argill. ls. 35 ft. thick (the "Delaware stone") forms lower and major part. This div. is extensively quarried at Delaware. Very hard, heavy bedded, pyritiferous dark ls. (Tully ls.), 4 to 9 ft. thick, forms upper part. Rests on Delhi ls., the top bed of Lower Corniferous [Columbus] ls.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3). *Delaware ls.*, the upper part of Corniferous ls., consists of (descending): (1) Thin-bedded ls.; (2) Ferris Quarry ("Delaware stone"); (3) siliceous blue ls.; and (4) bone bed 6 ft. thick. Rests on Columbus ls. (Lower Corniferous) and is overlain by Huron sh. [The bone bed has been included in Columbus ls. since 1890. See under *Columbus ls.*]

In central Ohio the fm. overlying Delaware ls. is Olentangy sh.

Named for exposures at Delaware, Delaware Co.

Delaware flags.

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 73, 76, 77, 80). *Delaware flags.*—Alternating beds of bluish-green and greenish-gray sss. 20 to 40 ft. thick, and greenish sandy shales, with one reddish bed 10 to 15 ft. thick. The sss. are quarried and sold under name of "Blue Stone." Thickness 1,000 to 1,200 ft. Probably represents New Milford ss. group of Susquehanna and Wayne Counties. Overlies New Milford group (consisting of red sh., 20; green ss. 40; and red sh. 15), and is overlain by 50 ft. of red sh. succeeded by 300 ft. of greenish sss. and shales, on which lies Lackawaxen cgl.

†Delaware limestone.

Silurian (Niagaran): Central eastern Iowa.

S. Calvin, 1895 (State Univ. Iowa Lab. Nat. Sci. Bull., vol. 3, pp. 183–189) and 1896 (Iowa Geol. Surv. vol. 5, pp. 49–50). *Delaware stage.*—Cherty dol., 200 ft. thick, including Coralline and *Pentamerus* beds. Underlies Leclaire ls. and forms basal part of Niagara series in eastern Iowa.

Replaced by *Hopkinton ls.* (by Calvin in 1906), because preoccupied.

Named for development in Delaware Co.

†Delaware gravels.

See under *†Delaware River gravels and clays.*

Delaware flag series.

See under *Delaware River flags.*

†Delaware sandstone.

†Delaware formation.

Shortened forms of *Delaware Mtn fm.* (Perm.) of western Tex. that are used by some writers.

Delaware Mountain formation. (Of Guadalupe group.)

Permian: Western Texas (Delaware and Guadalupe Mountains and Sierra Diablo).

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 38). *Delaware Mtn fm.*—Essentially light and dark-colored ss. and ls., though locally includes some sh. At base 200 ft. or more of blue-black thin-bedded ls. Greatest exposed thickness 2,300 ft., but base not seen and relations to Pennsylvanian Hueco fm. not determined. Underlies Capitan ls.

Lower fm. of Guadalupe group.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 921–922, 924, 925). *Delaware Mtn fm.* has been divided into following members: (1) Upper dark ls.; (2) *Delaware Mtn ss.*; (3) basal black ls. (here named Bone Canyon memb. of Leonard fm.). A short distance N. of Bone Canyon, on W. side of Guadalupe Mtns, a wedge of gray ls. (here named Victoria Peak memb. of Leonard fm.) appears beneath the uncon. at base of Delaware Mtn ss. and separates that ss. from Bone Canyon memb. The Delaware Mtn fm. as originally defined is not a natural group, but consists of beds of Leonard and Word age, separated by an uncon. For this reason it is here suggested that if term *Delaware Mtn* be retained it should be restricted to the beds above the basal black ls. [also to the beds above Victoria Peak memb.]. Includes near base a thin bed of gyp. (here named *Dos Alamos gyp.*).

R. E. King, 1931 (Univ. Tex. Bull. 3042, p. 13, chart opp. p. 146). *Delaware Mtn fm.* restricted to beds overlying (uncon.) Bone Canyon ls. [=Bone Spring ls., the approved name].

K. H. Crandall (A. A. P. G. Bull., vol. 13, 1929, pp. 941–943), R. E. King (Univ. Tex. Bull. 3042, 1931, p. 13), W. B. Lang (A. A. P., G. Bull., vol. 19, No. 2, 1935), and other geologists are now satisfied that typical Delaware Mtn fm. of Delaware Mtns includes in its upper part the time equiv. of Capitan ls., and that the beds underlying Capitan ls. and called Delaware Mtn fm. in Guadalupe Mtns are=only lower part of Delaware Mtn fm. of Delaware Mtns.

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–795). *Delaware Mtn fm.* restricted to beds above Bone Spring ls. (here treated as a distinct fm.) and below Castile gyp. in Delaware Mtns, and below Capitan ls. and above Bone Spring ls. in Guadalupe Mtns, the Victorio Peak memb. being here included in Bone Spring ls.

W. B. Lang, 1937 (A. A. P. G. Bull. vol. 21, No. 7). Upper part of *Delaware Mtn fm.* in the reef zone is replaced by Capitan ls., and upper portion of middle part of the Delaware Mtn grades laterally into Dog Canyon ls. The Delaware Mtn rests on Bone Spring ls.

Named for prominent exposures in Delaware Mtns, El Paso Co., Tex.

Delaware Mountain sandstone.

A name that has been applied by some geologists to the basal sandy beds of Delaware Mtn fm. in Guadalupe Mtns, Tex., that overlie the black Bone Spring ls. and underlie the upper dark ls. memb. of Delaware Mtn fm. (See under *Delaware Mtn fm.*)

†Delaware River gravels and clays.

Pleistocene: Southeastern Pennsylvania and northern Delaware.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6). *Delaware River gravels and clays.*—Include alluvium, Trenton gravel [Cape May fm.], Philadelphia brick clay [Cape May and Pensauken fms.], Red gravel [Pensauken fm. in part], Yellow gravel [a part of Bridgeton fm.], and Bryn Mawr gravel.

F. D. Chester, 1884 (Am. Jour. Sci., 3d, vol. 27, pp. 189–199 and map). *Delaware gravels.*—Undiff. Philadelphia clay and underlying Red Gravel.

T. D. Rand, 1900 (Acad. Nat. Sci. Phila. Proc., pt. 1, p. 168). The *Delaware River gravels* occur at much lower level than Bryn Mawr gravel and overlie similar schists and gneisses.

Includes deposits ranging from top of Pamlico fm. to base of Brandywine fm.

Named for development along W. side of Delaware River in northern Delaware.

Delaware River flags.

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 94, 99–101). *Delaware River flags,* 1,200 to 1,430 ft. thick in Pike and Monroe Counties. Underlie Montrose red sh. and overlie New Milford red ss. Include Lackawaxen cgl. and Delaware flags. In Wayne and Susquehanna rept (G_5) these beds were subdivided into several members under head of *Paupack and New Milford ss. groups,* whose combined thicknesses were 585 ft., but these intervals were found to increase so enormously southward that the Wayne and Susquehanna Co. subdivisions could not be followed, hence I deem it best to replace the names *Paupack and New Milford sss.* by a single geographical term which would include both the latter and at the same time suggest the nature of the beds. All the great flagstone quarries along Delaware River are found at different horizons in these beds. Good exposures along Delaware River btw. Narrowsburg and Pond Eddy, where they are 1,430 ft. thick.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7). *Delaware flag series.*—About 357 ft. thick in Wyoming Co. Underlies Montrose red sh. and overlies Lackawaxen cgl.

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1205–1206). *Delaware River flags* (late Portage) is retained, but the beds are older (instead of younger) than New Milford red sh., which at type loc. is upper Chemung. The red sh. [beneath Delaware River flags] is renamed *Analomink red sh.*, after village in Monroe Co., where at least 100 ft. of it is well exposed. The underlying Starrucca ss. of White in Monroe Co. is simply upper part of Trimmers Rock ss. and is dropped.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 586–588). *Delaware River flags* are 1,500± ft. thick on Delaware River N. of Hawks Nest, N. Y., the type region. They *underlie* New Milford fm., and are of upper Portage age, as determined by Prosser, although the fm. itself is nearly unfossiliferous. There is little doubt it is=Oneonta of N. Y. It locally rests on Analomink red sh. (which was mistaken by I. C. White for his New Milford fm.). In part of Pike and Monroe Counties it rests on marine Portage, the Trimmers Rock ss. Beyond the Lehigh the Delaware River and Trimmers Rock fms. have not been closely separated, both being fossiliferous marine Portage. [Table on p. 571 shows following downward succession: Delaware River flags, Analomink red sh., Trimmers Rock ss. Table on p. 606 shows Trimmers Rock ss.=Delaware River and Analomink.]

Delhi limestone.

Middle Devonian: Central Ohio.

N. H. Winchell, 1874 (Ohio Geol. Surv. vol. 2, pp. 296–301). *Delhi ls.*—Light cream-colored, crystalline or saccharoidal, very thin-bedded ls., 28 ft. thick, forming upper memb. of Lower Corniferous [Columbus] ls. in Sandusky, Seneca, Crawford, Delaware, and Marion Counties. Underlain by 10 to 15 ft. of fossiliferous bluish ls. of Lower Corniferous, and overlain by Upper Corniferous or Delaware ls.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3). "Delhi stone" belongs near top of Columbus ls.

C. R. Stauffer, 1909 (Ohio Geol. Surv. Bull. 10, p. 63). The "Delhi beds" of Winchell comprise upper 32 ft. of Columbus ls.

Named for exposures at Delhi, the old name for Radnor, Delaware Co.

Delhi formation.

Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66). *Delhi fm.*—Chiefly a peculiar dark-brown or black hard rock so fine-grained as to be almost flinty and rarely showing either stratification or schistosity. Often has chertlike appearance, but contains less silica than the normal chert. The peculiar petrographic character probably due to regional metamorphism. Very few lenticular ls. masses occur in it. In a few places the rock shows marked schistosity and resembles a dark siliceous clay sl. The fm. corresponds to part of Calaveras fm. Overlies Cape Horn sl. and underlies Clipper Gap fm. Typical exposures near Delhi mine, Nevada Co.

Delicias beds.

Paleozoic: Mexico.

E. Haarmann, 1913 (Deutsche geol. Gesell. Zeitschr., Bd. 65, Monatsber. 1, p. 22).

E Böse, 1921 (Am. Jour. Sci., 5th, vol. 1, pp. 188, 194), assigned these beds to Perm.

Dellville sandstone.

Upper Devonian: Southern central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 77–78, 394). *Dellville ss.*—Heavy bed of green ss., mostly in thin beds; near middle a layer of vegetable matter about 1 inch thick, consisting almost wholly of fossil plant stems. Exposed at Dellville, Perry Co. I have taken it as base of proper Catskill in Perry Co., but some may prefer to include underlying King's Mill shales and King's Mill ss. in the Catskill.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 582). In Susquehanna Valley, in Dauphin and Perry Counties, the Honesdale ss. is a distinctly gray to greenish gray, heavily bedded ss., usually carrying carbonized fragments of plants, probably unidentifiable. At low water it can be seen as prominent ledges in river bed. Possibly this is what Claypole called *Dellville ss.* in Perry Co.

Delmar sand.

Eocene: Southern California (San Diego County).

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). *Delmar sand.*—Sss., shales, and some beds, composed almost wholly of oysters, that might be considered ls. but usually the matrix surrounding the shells is argill. rather than calc. The sss. are both coarse grained and fine grained, and grade into aren. shales. They are of prevailingly brown color, but often have a tinge of green, while a few beds have a reddish and purplish cast. Many shales are well stratified, but others grade into shaly sands. Bedding is irregular. Cross bedding is prominent in many places. Upper part contains more sand than lower part, and the sands are of darker color than overlying Torrey sand, into which the Delmar sand grades. Thickness more than 200 ft. Is basal div. of La Jolla fm. in La Jolla quad. Rests uncon. on Chico Cret. Named for excellent exposures in sea cliff at town of Delmar, San Diego Co.

Delmontian stage.

Tertiary: California.

See under *Zemorrian stage*, R. M. Kleinpell, 1934.

H. G. Schenck, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224). *Delmontian stage* includes uppermost Monterey, upper Santa Margarita fm., etc.

DeLong cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a middle portion of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated.

†Delphi black shale.

Upper Devonian: Northern central Indiana.

R. T. Brown, 1883 (Ind. Dept. Geol. and Nat. Hist. 12th Ann. Rept., p. 84). *Genesee sh. or Delphi black sh.*, uppermost Dev. fm. Named for Delphi, Carroll Co. [See also †Louisville-Delphi black sl.]

Same as New Albany sh., older and better established name.

†Delphi dolomite.

Permian: Southwestern Oklahoma and northern Texas.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 56). *Delphi dol.*—White, drab, gray, or yellowish dol., 3 ft. thick, forming top memb. of Greer div. In places true dol., in places only a mag. ls.; in places aren. and soft, in places of cavernous or honeycombed structure; often firm and solid. Separated from underlying Collingsworth gyp. by 20 ft. of red clay sh.

Replaced by Mangum dol. memb. (of Blaine gyp.), because of prior use of Delphi for a Dev. fm. in Ind.

Named for Delphi, Greer Co., Okla.

Delphi member. (In Skaneateles shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 219+). *Delphi memb. of Skaneateles fm.*—New name proposed for the sh. overlying Mottville memb. of Skaneateles fm. and underlying Pompey memb. of Skaneateles. At base it is soft, dark, and mostly argill., becoming gradually sandier to top, where it is hard, fine, calc. ss. characterized by great abundance of large pelecypods. Type section is Knights Falls, 1 mi. E. of Delphi, where it is fully exposed. Thickness 65 ft. (in Unadilla Valley) to 217± ft. in Bear Mtn ravine, Onondaga Valley.

Del Rio clay. (In Washita group.)

Lower Cretaceous (Comanche series): Southern Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. Nueces folio, No. 42, p. 2; U. S. G. S. 18th Ann. Rept., pt. 2, pp. 236–237). *Del Rio clay.*—Greenish laminated clay, weathering yellow, with beds of ls. Included in Washita div. Overlies Fort Worth ls. [broad sense and=Georgetown ls.] and underlies Shoal Creek [Buda] ls.

Named for Del Rio, Valverde Co.

†Delthyris shaly limestone.

Lower Devonian: Eastern New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 377). *Delthyris shaly ls.*—Underlies Scutella ls. [Becraft ls.] and overlies Pentamerus ls. [Coeymans ls.].

Paleontologic name for New Scotland ls.

Demoiselle formation.

Mississippian: New Brunswick.

G. W. H. Norman, 1932 (Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 171).

†Demopolis (broad sense).

Upper Cretaceous: Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.; no description). [*Demopolis (Rotten ls.)* is applied on map to rocks btw. Eufaula (Ripley) above and Eutaw below. This is first geographic name introduced to replace "Rotten ls.," but in 1894 Dr. Smith introduced *Selma chalk* to replace "Rotten ls.," and in 1903 he applied "Demopolis div." to what he called middle memb. of Selma chalk in Ala.]

Apparently named for exposures at Demopolis, Marengo Co.

†Demopolis division (narrow sense).

Upper Cretaceous: Alabama.

E. A. Smith, 1903 (58th Cong., 1st sess., S. Ex. Doc. 19, pp. 12–20 and map). *Middle or Demopolis div. (of Selma chalk).*—Of more uniform composition than upper div. of the Selma, and freer from clay, being made up of ls., generally containing less than 25 percent of clayey matter. Fossils rarer than in other divisions. The lowermost beds of Demopolis div. are a compact ls. of great purity called horsebone rock. Overlain by Portland div. of Selma chalk and underlain by Selma div. of the Selma. Thickness about 300 ft.

Later workers did not find it feasible to make the 3 subdivisions of the Selma indicated in above-cited rept, and the names have been discarded. (See Ala. Geol. Surv. Spec. Rept. No. 14, 1926, p. 239.)

Named for exposures at Demopolis, Marengo Co.

Dempsey marble.

Name applied, in table, but not defined, by G. I. Adams (Jour. Geol., vol. 41, No. 2, p. 163, 1933) to a memb. of Talladega sl. in Clay Co., Ala.

Denain formation.

Jurassic (?): British Columbia.

J. D. MacKenzie, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, pp. 48, 73).

DeNay limestone member (of Francis formation).

Pennsylvanian: Central southern Oklahoma (Pontotoc County).

G. D. Morgan, 1922 (Okla. Geol. Surv. Circ. No. 12, pp. 9, 10) and 1924 (Bureau of Geol. [Okla.] Bull. 2, pp. 110–115). *DeNay ls. memb.*—Basal memb. of Francis fm. In region N. of Canadian River the bed is rather dense and breaks out in elongated blocks. In road about 1/4 mi. E. of Francis the bed is slightly crinoidal. In region S. of Ada the bed is almost wholly composed of crinoids. In NE. part of T. 3 N., R. 5 E., [Pontotoc Co.] the crinoids become less abundant and the ls. develops a bright yellow color. Average thickness a little more than 1 foot. Is overlain by 30± ft. of dark blue and black shales.

Named for typical development on side of an eastward-facing bluff in sec. 5, T. 4 N., R. 7 E., about 1/4 mi. W. of DeNay School, in Stonewall quad.

Denison formation. (In Washita group.)

Lower Cretaceous (Comanche series): Northeastern Texas and southern Oklahoma.

R. T. Hill, 1889 (Am. Jour. Sci., 3d, vol. 37, p. 290). *Denison beds.*—Alternations of clay, lime, and sand, 100 ft. thick. Top fm. of Washita div. Overlies Vola ls. [not †Vola ls.] and underlies Lower Cross Timber beds [Woodbine sand].

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 517). *Denison beds.*—Laminated aren. clays at base, grading upward into sandy clays and occasional lss., the chalky element of all the underlying Comanche series having finally disappeared. In Grayson, Cooke, and Denton Counties, Tex., and in Indian Territory, is divisible into (ascending): (1) Blue marly clay, weathering brown, with occasional layers of immense, rounded fissile indurations, generally of brown color; (2) more sandy and ferruginous beds, oxidizing into ironstone and almost indistinguishable from Dakota sss.; (3) impure yellow ls. underlying Main Street in Denison. Underlies, uncon., Dakota sss. [Woodbine sand] and overlies Fort Worth ls. Top fm. of Washita div. [This is present generally accepted definition of Denison fm.]

Named for exposures at Denison, Grayson Co., Tex.

Dennis limestone.

Pennsylvanian: Eastern Kansas and Nebraska and northwestern Missouri.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 36). *Dennis ls.*—Fossiliferous ls., 10 to 20 ft. thick, varying from heavy-bedded to thin-bedded, with sh. partings. Overlies Galesburg shales and underlies Cherryvale shales.

In 1912 the equivalency of Dennis ls. of Adams (1903) with Winterset ls. of Bain (1898) was regarded, by E. Haworth, F. C. Greene, and other geologists, as established. The name *Winterset* having priority, *Dennis ls.* was discarded by U. S. Geol. Survey, and *Winterset ls.* was adopted for the ls. underlying Cherryvale sh. and overlying Galesburg sh. This usage was followed by U. S. Geol. Survey and Kans. Survey until 1932, when R. C. Moore revived Dennis, as explained below.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 91, 97). *Dennis fm.* underlies Cherryvale sh., overlies Galesburg sh., and includes (descending) Winterset ls., Stark sh., and Canville ls. The *Canville ls.* is a thin blue bed which has typical "middle" characteristics. The overlying *Stark sh.* is a black, fissile sh. The Winterset ls. is same as previously recognized in Kans. and Mo. Because the Canville and Stark evidently belong with the Winterset, as part of another sedimentation cycle, these terms are combined under name *Dennis fm.*, a name used in early Kans. repts to include these strata. The so-called Galesburg sh. of Kansas City area is mainly Stark sh.

J. M. Jewett, 1932 (p. 102 of rept. cited above). *Dennis fm.* includes Canville ls., Stark sh., and Winterset ls., all of which are present near Dennis, in NE. part of Labette Co., Kans.

R. C. Moore and G. E. Condra adopted this revised definition in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 30, 32, 36). Type Dennis includes more than Winterset ls. The Canville ls. and overlying black Stark sh. [4 to 7 ft.] lie at horizon of upper part of so-called Galesburg sh. of Kansas City region. According to Jewett they both are present at both Galesburg and Dennis. The older writers did not mention any ls. or black sh. in the type Galesburg, and it is almost certain they were grouped with the overlying main ls. under the name *Dennis*, in which they are included in this rept.

See also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936, and also see R. C. Moore, 1936 entry under *Galesburg sh.*

Named for exposures at R. R. station at Dennis, Labette Co., Kans.

Dennis Bridge limestone. (In Millsap Lake formation.)

Pennsylvanian: North-central Texas (Parker County).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept., by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See 1933 entry under *Millsap Lake fm.*) Type loc. not stated.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15, 16). *Dennis Bridge ls.* is included in Lazy Bend memb. of Millsap Lake fm. by Scott and Armstrong. It is 10 ft. thick and lies at base of the section conspicuously exposed on the Brazos at S. end of the bridge at Dennis, Parker Co.

Denny sand.

A subsurface sand in Chester group (Miss.) of Perry Co., Ill.

Dennys formation.

Silurian: Southeastern Maine.

E. S. Bastin and H. S. Williams, 1913 (Maine Water Storage Comm. 3d Ann. Rept., p. 168; Geol. Soc. Am. Bull., vol. 24, pp. 378, 379). [Name mentioned but not defined. Refers to Eastport folio.]

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, pp. 3, 10). *Dennys fm.*—A succession of volcanic rocks and a few small interbedded masses of fossiliferous strata. Principal rock is rhyolite of several types, occurring as flows and tuffs. Interbedded with and otherwise closely associated with the rhyolite are several varieties of andesite, in flows and tuffs. Diabase flows and tuffs also occur. The effusive rocks have been disturbed by intrusion of masses of diabase and andesite and possibly also rhyolite. Underlies, possibly uncon., Edmunds fm. Lower limit of fm. not known. Contact with older Quoddy sh. is almost certainly a fault. Fossils indicate Niagaran age. Named for exposures near Dennysville, Washington Co.

Dense limestone.

Ordovician (Lower): Central northern Oklahoma (Lucien field, Noble County).

B. B. Zavoico, 1934 (Tulsa Geol. Soc. Digest 1934, p. 60). *Dense ls.*, top memb. of Simpson group in Lucien field, is 0 to 20 ft. thick. Underlies Prosser ls. and overlies Simpson dol. [This name is capitalized wherever used in this paper, but origin of name and lithology not stated.]

Denton clay member (of Denison formation).

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

J. A. Taff, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, p. 272). *Denton marl.*—Chiefly friable blue marl, characterized by *Gryphaea pitcheri*, with, at top, 5 ft. of cgl. containing *Gryphaea pitcheri*, and lower down a thin bed of sand and one of ss. Thickness 40 ft. Upper part of Fort Worth ls. Underlies Denison marl.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 384–385). *Denton terrane* underlies North Denison terrane (basal terrane of Denison div.) and overlies Fort Worth terrane.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pls. 18, 19, pp. 114–115, 121–124, 266–276). *Denton subgroup.*—Consists of (descending): (1) breccia of *Ostrea carinata* and *G. washitaensis*, 2 ft.; (2) brown clay marls, less calc. than No. 3, 18 ft.; (3) *Gervilliopsis* beds (marls and fissile indurated layers), 8 ft. Underlies Weno fm. and overlies Fort Worth fm. Is basal div. of Denison beds.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, pp. 140–141). *Denton clay memb. of Denison fm.*—Consists of (ascending): (1) 5 ft. of strongly calc. clay of a decided marly character; (2) 35 ft. of shaly, less calc. clay; (3) 3 to 5 ft. of highly fossiliferous impure ls. composed largely of shells of *Gryphaea washitaensis*, a few echinoid spines and other fossils, including a large number of *Ostrea carinata*, which led to its being called "Ostrea carinata bed."

Named for Denton Creek, Denton Co., Tex.

Denver formation.

Upper Cretaceous and Eocene (?): Eastern Colorado (Denver Basin).

W. Cross, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, pp. 119–133). *Denver fm.*—Upper part predominantly coarse cgls. with minor clay and sandy beds; seen only in Green Mtn, having elsewhere been eroded away. Lower half (including all known strata except those in upper part of Green Mtn) frequent recurring alternations of cgls., grits, sss., sandy clays, and nearly pure clays; pebbles seldom exceed 3 in. in diam.; sss. are cross bedded. Thickness of fm. 1,400± ft. Embraces strata not hitherto distinguished from coal-bearing Laramie Cretaceous. Is of limited extent. Contains dinosaur remains. Uncon. overlies Willow Creek series [Arapahoe fm.] and uncon. underlies Monument Creek beds. Occupies a basin excavated out of Willow Creek fm. [Arapahoe fm.] or even in some parts cutting into underlying Laramie group.

W. Cross, 1889 (Am. Jour. Sci., 3d, vol. 37, pp. 261–282). Upper 525 ft. of *Denver fm.* is mainly coarse cgls. Lower 915 ft. is as a rule fine-grained strata, yellowish brown friable sss. prevailing, with all manner of gradations into clays and cgls.; transitions both lateral and vertical; cross bedded. Local uncon. btw. upper and lower parts.

W. Cross, 1893 (Int. Cong. Geol., Compte rendu, 5th sess., pp. 437–438). *Denver beds* are fresh-water lake deposits of sss. and cgls. and in lower part made up almost exclusively of volcanic rocks representing many varieties of andesite.

C. J. Hares, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 175). The thesis is advanced that upper 525 ft. of Denver fm. should not be classed with lower 915 ft. at type loc. at Green Mtn. The lower part is well stratified sh., ss., and cgl., while upper div. is wholly conglomeratic, with no shales or sss. observable. The cgl. while rather fine at bottom of upper div. becomes coarser toward top, where boulders 2 to 4 ft. diam. are very common; the largest boulder is 6 ft. Absence of good stratification suggests its probable glacial origin. Structurally the 2 divisions are separable, for the lower one dips at high angles, while the upper is almost flat lying. It is believed that 2 distinct lithologic units are classed in Denver fm., one similar to Arapahoe below and the other of entirely different character and seemingly of glacial origin and post-Eocene age.

The age of this fm., which was formerly classified as *Eocene*, was changed, Dec. 1935, to *Cret. and Eocene* (?), as explained under *Lance fm.*, last entry.

Denver mud.

A term that has been applied (according to personal communication of J. B. Reeside, Jr.) to deposits of bentonite, of Cret. and other ages, occurring in the Western States and used in pharmaceutical preparations and for other purposes. For further particulars see Hugh S. Spence, Canada Dept. Mines, Mines Branch, Pub. 626, pp. 27, 28, etc., 1924. Spence states: "As a straight paper filler or loader bentonite is reported to have been used in large quantities by a Denver mill, most of the early production from Wyo. having been used for this purpose."

Denzer tuff.

Pre-Cambrian: South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121, 132). *Denzer tuff.*—Water-laid tuff exposed in a ledge nearly 200 ft. long and 5 to 20 ft. wide on N. bank of a small stream in SE. ¼ of sec. 11, T. 10 N., R. 5 E., about 1½ mi. NE. of Denzer, Honey Creek Twp. In previous repts has been called rhyolite. Assigned to pre-middle Huronian.

A. Leith, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 329). Archean of Baraboo dist. consists of rhyolite, *Denzer tuff*, and granite.

Denzer diorite.

Pre-middle Huronian: South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121, 137). *Denzer diorite* occurs in 2 areas in Baraboo dist., one NW. and one N. of Denzer, in secs. 9 and 10, T. 10 N., R. 5 E. Assigned to pre-middle Huronian.

Departure Bay calcarenites.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 95).

Depass fm.

Middle Cambrian: Western Wyoming (Owl Creek and Wind River Mountains).

B. M. Miller, 1935 (Geol. Soc. Am. Proc. 1934, p. 352). The name *Depass* is here applied to all beds in the Wyo. "Deadwood" below the Gallatin, the type section being in Wind River Canyon, where Big Horn River cuts through eastern end of Owl Creek Range.

B. M. Miller, 1936 (Jour. Geol., vol. 44, No. 2, pp. 123, etc.). As Flathead and Gros Ventre fms. are followed E. through Owl Creek and Wind River Mtns, the Flathead ss. lithology rises gradually and invades lower part of Gros Ventre fm., the ss. and sh. facies interfingering and finally becoming so mixed that the 2 fms. are not separable and are together designated *Depass fm.* Type section is in Wind River Canyon at E. end of Owl Creek Range. The name is taken from the "D" Pass (now spelled "Depass"), near E. end of Bridger Range, and will apply from about middle of Owl Creek Range at least as far E. as E. end of Bridger Range, and probably in part of Big Horns. In Wind River Mtns it will apply from SE. end of the range at least as far NW. as North Fork of Popo Agie River, but not farther N. than Bull Lake Creek. Well-exposed sections of the fm. are not common.

†Depauville waterlime.

Lower Ordovician: Central New York (Jefferson County).

E. Emmons, 1840 (N. Y. Geol. Surv. 4th Rept., p. 324). Birdseye ls. not certainly identified in Jefferson Co., but I have called a ls. btw. French Creek and Depeauville the Birdseye. Is compact, breaks with conchoidal fracture, and contains no fossils. It is the first of the water limes. I have called this the water-lime rock of Depeauville; or *Depeauville water lime,* as it was at this place it was first prepared for use. If I am right the Depeauville water lime occurs in beds, or overlies the Birdseye. Its beds are rarely more than 10 ft. thick at those places where it is quarried.

H. P. Cushing, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 155+), applied *Pamelia ls.* to the beds of Chazy age in Theresa and Alexandria Bay quads., Jefferson Co., of which he stated the Depauville waterlime of Emmons constituted a small part. (See first entry under *Pamelia ls.*)

The village name is spelled *Depauville.*

†Depeauville water lime.

See †*Depauville waterlime.*

De Queen limestone member (of Trinity formation).

Lower Cretaceous (Comanche series): Southwestern Arkansas and southeastern Oklahoma.

H. D. Miser and A. H. Purdue, 1918 (U. S. G. S. Bull. 690, pp. 19, 22). *De Queen ls. memb. of Trinity fm.*—Fossiliferous ls. (usually gray, hard, and compact but much of it is earthy, platy, and yellowish gray) and an equal or greater amount of green clay; gyp. and celestite near base. Thickness 60 to 72 ft. Lies in upper part of Trinity fm., at a higher horizon than Ultima Thule gravel lentil. Passes through De Queen, Sevier Co., Ark., into Okla.

Derby dolomite. (In Elvins group.)

Upper Cambrian: Eastern Missouri.

E. R. Buckley, 1907 (Mo. Bur. Geol. and Mines vol. 10, 2d ser., separate), and H. A. Buehler, 1907 (Mo. Bur. Geol. and Mines vol. 6, 2d ser., p. 231), in tables divided Elvins fm. into (descending) Doe Run, Derby, and Davis, without defining the subdivisions.

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1, pp. 15, 44). *Derby fm.*—Dol., fine-grained, crystalline, slightly calc., light gray to yellowish gray or reddish brown; some alternating soft porous beds. Thickness 38 to 40 ft. Conformably underlies Doerun fm. and conformably overlies Davis fm.

Named for Derby mine (now Federal mine), near Elvins, St. Francois Co.

Desamparados formation.

Cretaceous or Eocene: Costa Rica.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 359).

Descanso granodiorite.

Late Jurassic or early Cretaceous: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 115–141, map). *Descanso granodiorite.*—Almost everywhere light gray, medium grained, with, locally, finer grained varieties. Cuts Alpine quartz diorite and is probably of about same age as Harbison quartz diorite. All assigned to late Jurassic or early Cret. Type occurrence in general vicinity of Descanso, southern Peninsular Range.

Deschutes formation.

Late Tertiary or early Pleistocene: Central northern Oregon (Deschutes Basin).

I. C. Russell, 1905 (U. S. G. S. Bull. 252, pp. 90–91). *Deschutes sand* [in heading].—The material forming the walls of outer canyon of Deschutes and Crooked Rivers and extending eastward, where it underlies Prineville Valley. It also underlies the sheet of basalt exposed here and there beneath the rich wind-deposited soils of a large section of the Haystack country, to N. and E. of Opal Canyon.

Is exposed in wall of Deschutes River for at least 25 mi. upstream from mouth of Crooked River, probably is present for a long distance below that locality, and no doubt underlies several hundred sq. mi. of Deschutes plain. Sufficient attention has not yet been given to the fm. to enable a description of it to be put on record, but such notes as are available show that it was waterlaid, probably by streams. The material forming "Deschutes sand," as the fm. will perhaps be termed when its history is more fully studied, consists largely of black basic and frequently scoriaceous grains and kernels of volcanic rock, forming a coarse sand, mingled with which are lesser quantities of quartz grains. Stratification distinct, beds thinly laminated, but layers can not usually be traced more than a few hundred yards; frequently cross bedded. Some beds are composed of well-worn gravels with pebbles 6 to 8 inches diam. Claylike beds are also present, also a bed of white diatomaceous earth.

E. T. Hodge, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 162–163). *Deschutes sand* consists of several basalt flows and interflow lake and torrential beds. Lies absolutely flat and covers an immense area N. of Bend, E. to Prineville, and extends as embayments into the valleys of the Cascades. Flows higher in Cascade Mtns may be of same age and origin.

E. T. Hodge, 1928 (Pan-Am. Geol., vol. 49, pp. 350–356), proposed *Madras fm.* to "include part of Satsop fm. and all of Dalles beds, Deschutes sands, and Deschutes fm. Latter name objectionable because Deschutes River exposes at least 8 fms., several of which occupy larger sections than Madras fm."

H. T. Stearns, 1931 (U. S. G. S. W. S. P. 637, p. 136). *Deschutes fm.*—Horizontal beds of yellow, brown, and black partly consolidated sand, silt, gravel, and stratified fluviatile deposits of volcanic detritus, mostly basic, intercalated with and in most places capped by basalt flows; in a few places beds of white diatomite with a max. thickness of 40 ft. are included. Thickness 1,000+ ft. Is same as Deschutes sand of I. C. Russell. No fossils found except the siliceous algae skeletons that compose the diatomite deposits. In places rests on Columbia River basalt (Mio.); in other places rests on andesite considered to be of Mio. or Plio. age.

Desdemona sand.

A subsurface sand, of Penn. age, in Desdemona field, Eastland Co., north-central Tex., lying at 2,600 ft. depth.

Desecheo stage.

Quaternary: Puerto Rico.

B. Hubbard, 1923 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 97).

Deseret limestone.

Mississippian (upper): Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Deseret ls.*—Blue-gray cherty ls. in beds averaging 2± ft. thick, with a 6 to 8-foot bed of phosphatic sh. at base. Thickness 650 ft. Conformably underlies Humbug fm., the bdy being arbitrarily placed at base of first ss. or qtzite bed of notable thickness. Rests conformably on Madison ls. Fossils are upper Miss. and correlate with lower part of Brazer ls. Exposed at Deseret mine, Dry Canyon, Stockton quad.

†De Smet formation.

Eocene and, in places, Upper Cretaceous: Northern Wyoming.

N. H. Darton, Nov. 17, 1906 (U. S. G. S. P. P. 51, pp. 13, 62–67, etc.). *De Smet fm.*—Alternating shales (mostly carbonaceous) and soft and massive sss., 5,000+ ft. thick. Overlies Kingsbury cgl. [Long description.] Is Upper Cret. and Eo. (?). May be in part Laramie and may include higher beds. The name *De Smet* (here proposed for this fm.) is from Lake De Smet [Fort McKinney quad.], where it is typically exposed.

See also N. H. Darton, 1906 (U. S. G. S. folios Nos. 141 and 142; and Geol. Soc. Am. Bull., vol. 17, p. 544, Dec. 31, 1906).

In 1910 it was decided that De Smet fm. of Darton was same as Fort Union fm., and De Smet was, accordingly, discarded. Later field work showed that Lance, Fort Union, and Wasatch fms. were all included in original De Smet fm. as mapped.

De Smet formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, with maps). *De Smet fm.*—Garnet schist, alternating light and dark bands, micaceous, fibrous, thinly foliated. Most of schist is green to dark gray. Underlies Homestake fm. and overlies Poorman fm. Thickness 300 ft. Believed to be of Keewatin age.

Named for exposures around N. end of main open cut SW. of De Smet shaft, Lead dist., Lawrence Co.

Des Moines group.

Pennsylvanian: Northwestern Missouri and Iowa.

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 86–114). *Des Moines beds, or Lower Coal Measures.*—Shales sss., lss., clays, and coals underlying Missouri fm., or Upper Coal Measures, and uncon. overlying Lower Carbf. in Iowa. Thickness 400 ft.

Des Moines group was adopted by U. S. Geol. Survey many years ago, for NW. Mo. and SW. Iowa, to include rocks from base of Kansas City fm. to top of Mississippian. This was the commonly accepted definition. The group as defined included Pleasanton fm., Henrietta fm., and Cherokee sh., and was overlain by Missouri group, the basal bed of which was Hertha ls. (See H. Hinds and F. C. Greene, Mo. Bur. Geol. Mines vol. 13, 1915.) Owing to great number of named subdivisions of Penn. rocks in Kans. and SE. Nebr., the U. S. Geol. Survey has been accustomed to treat the major subdivisions of Des Moines and Missouri age as *groups*, and therefore does not use *Missouri group* and *Des Moines group* in its rock classification of those States. These names (*Missouri group* and *Des Moines group*) were not used by Kans. Geol. Surv. in its classification until 1917 (Moore and Haynes). In 1932 Moore redefined the names, as explained below.

R. C. Moore, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 279), divided Penn. "system," as he called it, of Midcontinent region into 4 "series," named (descending): Virgil, Pottawatomie, *Des Moines*, and Bend. He stated: Des Moines series contains a huge thickness of ss., cgl., and sh. in Okla. and Ark., but to N. and S. thickness is much reduced and there are lss. in upper part. The top of the series is marked by an uncon. and by one of most clearly defined paleontologic boundaries in the Penn. A distinct and widespread uncon. marks base of the series. [The limits of this unit differ from those of *Des Moines group* of prevailing usage.]

C. [R.] Keyes, 1932 (Pan-Am. Geol., vol. 57, p. 346). The term *Des Moines*, for a provincial coal-bearing series, is a revival of Owen's early name (Proc. Am. Assoc. Adv. Sci., vol. 5, p. 47, 1851) for the coal measures of Des Moines River Valley, which in pioneer days constituted the most important coal field W. of the Appalachians. The title is not a Keyes proposal, as is so often accredited. [On p. 47 of cited vol. of Proc. A. A. A. S. is a paper by D. D. Owen entitled "On the existence of phosphorus in the carbonates of iron of the Des Moines coal fields," and on succeeding pages Owen referred to the "coal measures of the Des Moines," but nowhere did he apply the name *Des Moines* to any strat. unit. Keyes is therefore the original proposer of name *Des Moines beds*. On this same page Keyes also stated:] Recent suggestion of R. C. Moore to extend term *Des Moines* downward so as to include most of Arkansan delta deposits finds no response from regional diastrophism, or from homonymic correlation. Its paleontological reasons are already demonstrated to be entirely untenable.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936, for Moore's restricted definitions of *Des Moines series*. His 1936 definition (Kans. Geol. Surv. Bull. 22, pp. 41–43) restricts *Des Moines* to beds extending from discon. at top of Nowata (?) sh. down to base of Cherokee sh., and includes overlying rocks in his Missouri series restricted. The Mo. Geol. Surv. 1933 (57th Bien.) and 1935 (58th Bien.) repts continued to use

Des Moines group to include (descending) Pleasanton, Henrietta, and Cherokee fms.

The U. S. Geol. Survey has not had occasion to consider these innovations for its publications.

Named for exposures on Des Moines River, Iowa.

†De Soto beds.

Pliocene (lower): Southern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 126, 133, 141, 157, 158, 324). [In table on p. 157 the term *De Soto beds* is bracketed opposite Alachua clays, Peace Creek bone bed, and Arcadia marl (descending order). The other pages mentioned contain references to "De Soto, a supposed Pliocene lake in Florida, named for the Spanish explorer." Page 324 states that the De Soto beds "include the lower marine Pliocene beds of Peace Creek and the Alachua clays." Page 158 states that 50 ft. "would be a liberal allowance for the De Soto beds."

Replaced by Caloosahatchee marl, the older name.

Detrick sand.

A subsurface sand in eastern central Okla. that is said to correlate with Tyner fm. (Ord.).

Detroit interlobate moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (fig. 7) in U. S. G. S. Detroit folio (No. 205), p. 9; also on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Detroit. Is a water-laid moraine.

Detroit River dolomite.

Lower Devonian: Southeastern Michigan and western Ontario, and northern Ohio.

A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 555). *Detroit River series* here proposed for Upper Monroe, from exposure of all its members along Detroit River. Includes (descending): Lucas dol., 200± ft.; Amherstburg dol., 20 ft.; Anderdon ls., 40 to 50 ft.; Flat Rock dolomites, 40 to 150+ ft. Discon. overlies Sylvania ss.

Deutozoic.

A time (life) term applied by E. Hitchcock (Geol. Vt., 1861, vol. 1, 4 mo., p. 19) to "Triassic"—in which he probably included Lias of Europe (which is now generally classified as Lower Jurassic), because he called the overlying rocks "Oolitic."

Devils Den limestone. (In Graford formation.)

Pennsylvanian: Central northern Texas (Wise County).

E. Böse, 1918 (Univ. Tex. Bull. 1758, p. 17). *Devils Den ls.*—Quite uniform gray or dark bluish hard ls. containing rare crinoids and parts of brachiopods. Thickness in Devils Den, Wise Co., 50± ft., but top is not there visible. Covers W. side of Jim Ned Mtns. Seems to be a lenticular mass which thins out and disappears to N. Not found on N. side of Sand Flat Range. Separated from underlying Rockhill ls. by 140± ft. of sss. with intercalated shales, which compose E. slope of Jim Ned Mtns. "The highest lss. of the section [which would seem to include his Devils Den and Elm Creek lss.] should perhaps be considered as belonging to Canyon div."

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 33). *Devils Den ls.* belongs in Graford fm., and because top of Graford cannot actually be determined in Wise Co., the top of Devils Den ls. is arbitrarily taken as top of Graford fm. To N. of Trinity River this ls. is top tongue of Chico Ridge ls. It is older than Adams Branch ls. Is overlain by Ventioner beds.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105, 111, 112). *Devils Den ls.* is same as Wizard Wells ls., and latter name is discarded.

†Devils Den sandstone.

Upper Devonian or Mississippian: Northwestern Pennsylvania.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 332, 333 (footnote), 335, 336, 339). If, and writer is not averse to this, to succeeding Cussewago, or Knapp, group is transferred top 40 ft. of original Conewango at Warren, the Smethport (subsequently Kushequa) sh. of Caster, carrying therewith the corresponding upper part of the Riceville, and also the *Devil's Den* (*Leptodesma*) *ss.* near Smethport, then some of Miss. element (so called) is subtracted and case for Dev. age of Conewango is by that much strengthened. [Lists fossils from *Devil's Den ss.*, but does not give type loc.]

G. H. Chadwick, 1935 (letter dated Dec. 11). I do not consider Devil's Den ss. as adequately established. It was just a convenience.

Devils Glen dolomite.

Upper or Middle Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 40 and passim). *Devils Glen dol.*—Youngest Camb. fm. in NW. Mont. In type loc. is massive, thick beds of white-gray dol. that weathers dull gray white, usually stained buff, and occasionally with pinkish spots. Lower beds generally thinner and contain less magnesia than upper ones. Thickest (669 ft.) in Dearborn region, thinnest (41 ft.) in Pentagon Mtn region. Top is eroded. Overlies Switchback ls. and uncon. underlies White Ridge ls. memb. of Jefferson ls. (Middle Dev.). Named for Devils Glen, a local feature in S½ sec. 1, T. 17 N., R. 8 W., which is formed of the dol.

Devil's Gulch beds.

See under *Valentine beds* (*Plio.?*), where occur only known usages of this name.

Devils Island sandstone. (In Bayfield group.)

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Ashland, Bayfield, and Douglas Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 38). *Devils Island ss.*—Pink and white pure quartz ss., thin-bedded, with abundant ripple marks. Thickness 300 ft. Middle fm. of Bayfield ss. group. Conformably underlies Chequamegon ss. and overlies Orienta ss. Named for exposures on Devils Island, Ashland Co.

Devils Kitchen member (of Deese formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 14–15). *Devil's Kitchen memb. of Deese fm.*—Comprises 2 massive buff sss., each 60 to 200 ft. thick, separated by a sh. interval with 10 ft. or more of fossiliferous impure ls. and calc. sh.; the upper ss. contains chert grains, and SE. of Ardmore develops into a coarse cgl. of angular to subangular chert pebbles. Lies 800± ft. above top of Dornick Hills fm. and is overlain by a series of blue and tan shales with numerous ss. ledges, which composes rest of Deese fm.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 35–36). *Devil's Kitchen memb.*, about 500 ft. thick, is named for a glen in sec. 10, T. 6 S., R. 2 E., which is sheltered by overhanging cliffs of the chert-pebble cgl.

Devils Lake sandstone.

Upper Cambrian: Central southern Wisconsin (Sauk County).

E. O. Ulrich, 1920 (Wash. Acad. Sci. Jour., vol. 10, pp. 74, 75). [*Devils Lake ss.* shown in diagrams as underlying Mendota dol. and overlying Jordan ss. at Madison and Devils Lake, Sauk Co., and as composing basal fm. of his Ozarkian system.]

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 546). *Devils Lake fm.*—Gray and yellow, more or less glauconitic ss. and qtzite pebble cgl. Thickness not definitely known; max. may be over 100 ft. Known only in a few exposures near the qtzite ranges at Baraboo, Sauk Co. Has never been located in a complete normal section away from the old beaches, and it is not positively known whether all of supposed occurrences are of same age. Possibly some strata here ascribed to Mazomanie fm. are Devils Lake. In best exposure, SW. of Baraboo, it is underlain by glauconitic ss. and purple spotted dol. unlike anything known in normal section outside the qtzite ranges. At other places the fm. has been found resting on Jordan and possibly on other fms. In some places Mendota dol. overlies Devils Lake fm. and in other places Oneota dol. overlies it.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). *Devils Lake ss.* of southern Wis., about 100 ft. thick, underlies Mendota dol. and overlies Jordan ss. Is basal fm. of Ozarkian system in that area. Absent in western Wis.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 24–25). Devils Lake ss. of Ulrich included (1) typical Devils Lake ss. (which is a shore phase of a part of the middle part of Trempealeau fm.), (2) the basal cgl. memb. of Trempealeau fm., and (3) the basal cgl. memb. of Franconia fm. It is recommended the term be abandoned.

W. H. Twenhofel, G. O. Raasch and F. T. Thwaites, Nov. 30, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, p. 1702). In region around Baraboo a fauna near top of Hudson memb. of Franconia fm. has been assigned by Ulrich to his proposed Devils Lake fm., which he placed at base of his Ozarkian system in Wis. This proposed fm. was described by Thwaites (Jour. Geol., vol. 31, 1923, p. 546) on responsibility of Ulrich, but it could not be placed in strat. section except by fossils. Later work by Wanenmacher, Twenhofel, and Raasch (Am. Jour. Sci., 5th, vol. 28, 1934, pp. 1–30) shows that the strata of most localities of Devils Lake fauna underlie Upper Greensand memb. of Franconia fm. At 2 localities a different and higher fauna was apparently confused with that from the Franconia, and at one of these (SE¼ SW¼ sec. 10, T. 12 N., R. 5 E.) it is definitely known the strata are high in Trempealeau fm. Writers understand Ulrich has recently altered his views in regard to supposed Devils Lake fm. and faunas.

Devils River limestone.

Lower Cretaceous (Comanche series): Southwestern Texas (Valverde, Presidio, and other counties).

J. A. Udden, 1907 (Augustana Lib. Pub. No. 6, p. 56). *Devils River ls.*—Mostly thick ledges of white and gray pure ls., moderately coarse grained to almost compact and structureless texture. Thickness 500 ft. Includes what in central Tex. is known as Edwards and Georgetown lss., which are not separated by any well-marked horizon of change but merge gradually. Upper 100 ft. or less corresponds to Georgetown ls.; lower 400 ft.=greater part of Edwards ls. Underlies Del Rio clay. Is exposed along entire distance of Devil's River [Valverde Co.] from Camp Hudson down to the Rio Grande.

In western Tex. the name has in some repts been used to include all beds below Del Rio clay and above Trinity group.

C. P. Ross and W. E. Cartwright, Dec. 1935 (Tex. Univ. Bull. 3401, p. 596). *Devils River ls.* in Shafter dist., Presidio Co., appears to include Comanche Peak ls., true Edwards ls., and Georgetown (?) ls., and was in 1904 called Edwards ls. by Udden.

Devoice moraine.

Pleistocene: Northwestern New York (Lewis and Jefferson Counties).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). In Antwerp and Carthage quads. Named for Devoice Corners, Antwerp quad.

Devonian period (or **system**).

The time (and the rocks) of the next to youngest Paleozoic system, succeeding the Silurian and preceding the Carboniferous. For definition see U. S. G. S. Bull. 769, pp. 78–80.

Devonic.

A variant of *Devonian* employed by some geologists.

Devonshire formation.

Pleistocene: Bermuda.

A. E. Verrill, 1907 (Conn. Acad. Arts and Sci. Trans., vol. 12, p. 75).

Dewdney formation.

Pre-Cambrian: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 7, 117° to 117°30′). *Dewdney fm.*—Banded qtzite with congl. interbeds. Underlies Ripple fm. and overlies Wolf fm.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 153, 178, 194). *Dewdney fm.*—Chiefly qtzite, with two thick congls. in upper part, the upper one 30 ft. thick and the other one (which lies 120 ft. lower) 225 ft. thick.

Conformably underlies Ripple fm., and grades into underlying Wolf fm. Total thickness 2,000 ft. Included in Summit series of Selkirk Mtns. Named for Dewdney Trail, B. C., on both sides of which it is exposed.

Dewdney Creek series.

Jurassic: British Columbia.

C. E. Cairnes, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, pp. 97, 111). *Dewdney series, Jurassic, B. C.*

C. E. Cairnes, 1924 (Canada Geol. Surv. Mem. 139, p. 56). *Dewdney Creek series, Jurassic, B. C.*

Dewey limestone.

Pennsylvanian: Northeastern, central, and central northern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, pp. 30, 37). *Dewey ls. lentil.*—Bluish semicrystalline ls., usually somewhat shaly but often massively bedded, 3 to 15 ft. thick. Stratigraphically 50 to 100 ft. above Hogshooter ls. Is above horizon of Drum ls., but author cannot correlate it. In N. part of area included in Copan memb. of Wann fm.; in S. part of area is basal memb. of Ramona fm.

Some authors have regarded Dewey ls. as=upper part of Drum ls. of Kans., and it is so treated on the 1926 geol. map of Okla., but many geologists now consider it younger than Drum ls. The beds separating Dewey and Hogshooter lss. were in 1925 named *Nellie Bly fm.*

Named for Dewey, Washington Co.

Dewitt formation.

Miocene and Pliocene: Eastern Texas.

A. Deussen, 1914 (U. S. G. S. W. S. P. 335, pp. 28, 74–76). *Dewitt fm.*—All lacustrine and littoral sediments deposited on Coastal Plain of Tex. during Mio. and early Plio. time. Cross-bedded, coarse, gray, semi-indurated, highly calc. sss., with lenses of clay in places. Thickness 1,250 to 1,500 ft. Seaward the time equiv. is represented by marine sands and clays, but these are not included in Dewitt fm. Uncon. underlies Uvalde fm. and overlies Fleming clay.

In U. S. G. S. P. P. 126, 1924, footnotes on pp. 97 and 100, is statement that Dewitt fm. of U. S. G. S. W. S. P. 335 included Oakville, Lapara, and Lagarto fms.

Named for Dewitt Co.

Dexter sand member (of Woodbine sand).

Upper Cretaceous (Gulf series): Northeastern Texas.

J. A. Taff, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 285–298). *Dexter sands.*—Extensive deposit of brown ferruginous ss. heavily laden with siliceous ironstone. Middle div. of Dakota or Lower Cross Timbers fm. Underlies Timber Creek beds and overlies Basal clays of Dakota fm.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7), used *Dexter fm. or Dexter sands* to include Dexter sands of Taff and Basal clays of Taff. Underlies Lewisville beds ("Timber Creek beds") and overlies Grayson marl. [This is generally accepted definition of Dexter sand. It is basal memb. of Woodbine sand.]

Named for exposures at Dexter, Cooke Co.

Dexterville shale member.

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 63–66). *Dexterville sh. memb.*—Middle memb. of Chadakoin stage. Underlies Ellicott sh. memb. and overlies Lillibridge ss. memb. May be regarded as typical Chadakoin, as it is memb. best shown in greater part of Dexterville quarry exposure of the Chadakoin. Named for the brick quarries S. of Chadakoin River in East Jamestown, formerly known as Dexterville. Only upper part of memb. is shown at Dexterville, where it is a blue sh. and flag series carrying the Chadakoin phase of the "C" facies fauna. To E. in Allegheny State Park and about Olean, N. Y., this memb. assumes the chocolate phase of magnafacies "B." [See under *Ellicott sh. memb.* for relations to that memb. On pp. 64–65 detailed section of his

Dexterville memb. is given, aggregating 138 ft. without explanation as to which memb. (Ellicott sh. or Dexterville) the covered interval of 140 ft. belongs.]

†Diabolo sandstone.

Pre-Cambrian: Western Texas (Sierra Diablo region).

W. H. Von Streeruwitz, 1891 (Tex. Geol. Surv. vol. 2, pp. 682, 683). [The red ss. that extends along foot of southern cliffs of Sierra Diabolo is in one place called *Diabolo red ss.* and in another place *Diabolo ss.* It is overlain by grits, and is an inseparable part of Millican fm.]

†Diamond blue limestone.

Term applied by T. C. Hopkins (N. Y. State Mus. Bull. 171, 1914) to 4 to 5 ft. of compact calc. ls. lying 4 ft. below top of Manlius ls. in Syracuse quad., Onondaga Co., N. Y.

Diamond formation.

Recent or late Pleistocene: Southeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Diamond fm.*—Basalt flows and scoria of undet. thickness, typically exposed at Diamond Craters, Harney Co. [See also W. D. Smith, 1927 (Jour. Geol., vol. 35, p. 428), where same definition is given.]

Diamond Head tuff.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 40, 42). *Diamond Head tuff.*—Tuff, 1 to 5 ft. thick, forming Diamond Head. Rests on weathered gravel composed of cobbles of Koolau basalt. Overlain by Kaimuki basalt, 4 to 9 ft. thick.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1. *Diamond Head tuff.*—Palagonitized subaerial brown tuff containing much accessory and accidental ejecta, including appreciable amounts of reef ls. and occasional fragments of Koolau basalt. Included in middle part of Honolulu volcanic series [q. v.]. Is late Pleist. Type loc., Diamond Head. Underlies Kaimuki volcanics.

Diamond Head talus breccia.

Recent: Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 40, 43). Calc. talus breccia composed of angular fragments of tuff cemented into a porous but fairly compact mass, most of which was accumulated wholly under action of gravity. Mantles extensive areas of slopes of Diamond Head with thicknesses of 5 to 25, exceptionally 50, ft. Rests against and on Diamond Head tuff. It is probable that some of this is considerably older than the younger basalts and the black ash, but it seems best to treat it as the youngest rock of Diamond Head region, exclusive of modern alluvium and talus.

Not differentiated by H. T. Stearns in his 1935 rept, in which it is included in Recent sed. rocks. (See Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1.)

Diamond Hill felsite.

Carboniferous: Northeastern Rhode Island.

C. H. Warren and S. Powers, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 461). Assigned to lower Penn.

Diamondian series.

A term introduced by C. [R.] Keyes to designate the Diamond Peak qtzite of Nev.

Diamond Island slate. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Diamond Island sl.*—A graphitic and pyritiferous quartz sl. Included in Casco Bay group.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 170). *Diamond Island sl.*—Chiefly black, pyritiferous, graphitic, and slightly micaceous quartz sl. of very fine grain; but in lesser part a black or bluish black, somewhat graphitic and also pyritiferous quartz-sericite phyllite. Is characteristically studded with small masses and crystals of pyrite, which weather out and give rise to abundant copperas and rust coatings. Equally characteristic are intricate crumpling on a small scale and an abundance of small crumpled quartz veins. Estimated thickness btw. 75 and 150 ft. Included in Casco Bay group. Underlies Scarboro phyllite and overlies Spring Point greenstone. Assigned to Penn. (?). Named for exposures on Great Diamond Island and Little Diamond Island in Casco Bay.

Diamond King member (of Esmeralda formation).

Miocene (upper): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Diamond King memb.*—Chiefly massive, even-grained, porphyritic rhyolite flows and tuff. Upper part is bedded tuff that logically should have been included in overlying Bald Mtn lake-beds memb., but impossibility of making any good separation in field rendered it advisable to include the tuff in Diamond King memb. Thickness of memb. 100 to 800± ft. Separated from older Round Rock memb. by 0 to 80 ft. of thin-bedded quartzose ss., upon which it rests with erosion uncon. For convenience this ss. is mapped with Round Rock memb. The Diamond King memb. is prominent on Diamond King Hill.

Diamond Peak quartzite.

Carboniferous (upper Mississippian): Northern Nevada and Inyo County, California.

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 268). *Diamond Peak qtzite.*—Massive, vitreous qtzite of grayish brown color, passing near summit into brown and green shales and schists, and with firmly cemented cgl. at base. A narrow belt of blue ls. about 500 ft. above base contains Carbf. fossils. Thickness 3,000 ft. Overlies White Pine sh. and is overlain by Lower Coal Measures. Named for exposures on flanks of Diamond Peak, Eureka dist., Nev.

According to G. H. Girty the fossils in the ls. 500 ft. above base of Diamond Peak qtzite are upper Miss. and rest of fm. is not fossiliferous. He would therefore tentatively assign whole fm. to upper Miss.

The Diamond Peak qtzite, with a thickness of 3,500 ft., has been identified by E. Kirk (U. S. G. S. P. P. 110, 1918) in Inyo Range, Calif., where it is separated from underlying White Pine sh. by 500 to 1,000 ft. of ls. carrying Penn. fossils.

Diamond Rock quartzite.

Lower Cambrian: Eastern New York (Rensselaer County) and western Vermont (?).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 67–70). *Diamond Rock qtzite.*—Div. G of [T. N.] Dale's Rensselaer series. Consists of granular qtzite and associated calc. ss., 10 to 40 ft. thick. Named for exposures at the "Diamond Rock," Lansingburgh (North Troy), [N. Y.]. Underlies Troy shales and overlies Bomoseen grit—all Lower Camb.

†Diamond Rock.

A name locally applied to lower 2 ft. of beds called Rich Hill ls. memb. of Cherokee fm. in W. part of Vernon Co., Mo., because of tendency of the rock to break into diamond-shaped or rhomboidal blocks. (See F. C. Greene and W. F. Pond, Mo. Bur. Geol. and Mines vol. 19, 2d ser., pp. 51–52, 1926.)

Diana syenite complex.

Pre-Cambrian: Northwestern New York (Lake Bonaparte and Lowville quadrangles).

A. F. Buddington, 1919 (N. Y. State Mus. Bull. 207, 208, pp. 102–110, map). The syenitic complex of Lake Bonaparte and Lowville quads. is roughly grouped as belonging to 2 masses: the *Diana mass* (which is protoclastic and uniformly has a coarse porphyritic texture) and *Croghan mass* (which is uniformly medium equigranular). Diana mass is on whole more basic than the Croghan. [He also called the rocks *Croghan syenite granite complex* and *Diana syenite complex*. Probably named for villages of Croghan and Diana.]

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 90–92). Thickness of *Diana mass* 25,000 to 30,000± ft. *Croghan mass* is probably somewhat younger than Diana body. Both intrude Grenville series.

See also Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 101–104, 162–164, etc.).

Diana phase.

See 1928 entry under *Conway granite*.

Named for "Diana's Baths," 1 mi. due N. of summit of Cathedral Ledge, North Conway quad., N. H. (Letter from M. Billings dated July 19, 1935.)

Diboll member.

Eocene: Southeastern Texas (Duval County).

I. R. Sheldon, 1933 (A. A. P. G. Bull., vol. 17, No. 7, pp. 819, 820, 822). *Diboll memb. of Jackson fm.*—In Driscoll pool, Duval Co. Top lies at 3,810 ft. depth and bottom at 3,950 ft. depth. Thickness 140 ft. Underlies McElroy memb. of Jackson and overlies "Cockfield" zone, as it is known in South Tex., which rests in Yegua fm.

A. C. Ellisor, 1936 (Gulf Coast oil fields, A. A. P. G., pp. 474–475). The beds btw. the Claiborne and the Olig. can be divided on bases of micropaleontology and lithology into 3 major divisions or fms., which were designated by writer in 1931 (ms. read before Pal. and Min. Div. of A. A. P. G., San Antonio meeting, Mar. 20, 1931) as the Diboll, McElroy, and Fayette. *Diboll* has since been changed to *Caddell*, proposed by Dumble in 1915.

Dickerson member (of Millsap Lake formation).

Pennsylvanian: North-central Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept., by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See 1933 entry under *Millsap Lake fm.*) Type loc. not stated.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15, 16). *Dickerson memb.* of Scott and Armstrong's unpublished ms. on Parker Co., includes all Penn. strata exposed in Brazos River Valley below base of Kickapoo Falls ls. (basal bed of Lazy Bend memb.). [Derivation of name not stated. Fauna is listed.]

Dicob moraine.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 40). Recessional moraine exposed intermittently along a line extending S.-SW. through Dicob School from about ¾ mi. E. of Bush's Corners to S. border of quad.

Dierks limestone lentil (of Trinity formation).

Lower Cretaceous (Comanche series): Southwestern Arkansas.

H. D. Miser and A. H. Purdue, 1918 (U. S. G. S. Bull 690B). *Dierks ls. lentil of Trinity fm.*—Fossiliferous ls. with a smaller amount of green clay. Thickness 0 to 40 ft. Separated from overlying Ultima Thule gravel lentil of the Trinity by variegated clays and from underlying Pike gravel memb. of the Trinity by a great thickness of gray cross-bedded sand with some clay. Named for exposures near Dierks, Howard Co.

Difficulty Creek latite.

Tertiary (Miocene or Pliocene): Southwestern Colorado (Ouray region).

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153). *Difficulty Creek latite.*—Porphyritic latite. Cut by wild canyon of Difficulty Creek. Intrusive into Potosi tuffs [Potosi volcanic series].

Dighton conglomerate.

Carboniferous: Southeastern Massachusetts and Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 184–187, and pl. 17). *Dighton cgl. group.*—The name *Dighton cgl.* is here given to a group of coarse cgls., with alternations of ss., found as highest members of the Carbf. in Dighton, Somerset, and Swansea, in Mass. The coarsest cgl. bed is at base of fm. Thickness 1,000–2,000± ft. Rests on Rhode Island Coal Measures. Correlated with Purgatory cgl. of Rhode Island.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 51–55, and map). *Dighton cgl.*—Long lenses of peculiar cgl. infolded in Rhode Island fm. Regarded same as Purgatory cgl. of Rhode Island.

Dilco coal member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup-Zuñi Basin).

J. D. Sears, 1925 (U. S. G. S. Bull. 767). *Dilco coal memb.*—Light-gray to white lenticular ss. and light-gray clay sh., with valuable coal beds throughout basin. Thickness 240 to 300 ft. Underlies Bartlett barren memb. and overlies Gallup ss. memb.—all belonging to Mesaverde fm. Named for village of Dilco, where 4 of the coal beds have been worked in Dilco mine.

†Dillard series

Lower Cretaceous: Southwestern Oregon.

G. D. Louderback, 1905 (Jour. Geol., vol. 13, pp. 522–555). *Dillard series.*—Marine sss., shales, cgls., cherts, and lss., with abundant igneous rocks at frequent intervals. Thickness 8,000 to 10,000 ft. Mapped as *Myrtle fm.* by Diller, but is older than Myrtle fm. as defined by Diller, and is uncon. with it. Is pre-Knoxville, and made in Franciscan time, and is practically identical with Franciscan. Fossils suggest it is in part at least Jurassic. May lie stratigraphically (even uncon.) below Franciscan, but may be looked upon as a northern extension of the Franciscan. Named for village, on the railroad, which is in midst of largest area of this series in Roseburg quad.

J. S. Diller, 1907 (Am. Jour. Sci., 4th, vol. 23, pp. 401–421). Primarily upon lithological grounds "Dillard series" was proposed for the sediments of Dillard area under impression they were older than Knoxville. The presence of Knoxville fossils at so many points throughout the area demonstrates conclusively that great part if not the whole mass of sediments within Dillard area are really Knoxville, and were properly included in Myrtle fm. as originally defined and still unchanged. The Myrtle has always been regarded as practically = Shasta group of Calif. Writer is of opinion the equiv. of Franciscan of Calif. is most likely in Dothan fm.

Dillard sand.

A subsurface sand, of Penn. age, in Keystone pool, central northern Okla., which is correlated with upper part of Cleveland sand and with a part of Nowata sh.

Dillon gas horizon.

Name proposed by A. F. Crider (A. A. P. G. Structure symposium, vol. 2, 1929, p. 178) for producing horizon of Dillon No. 43 well, Pine Island oil field, Caddo Parish, La., which lies in Trinity group (of Comanche age), 90 ft. above Dixie oil horizon, and lower than Wickett oolitic zone.

Dilworth sand.

Eocene (upper): Southeastern Texas (Atascosa, Karnes, and Gonzales Counties).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1311, etc.). *Dilworth sand.*—Basal zone of Whitsett fm. as here defined. At Dilworth, 0.8 mi. E. of brick schoolhouse, on J. Winclarek 39.5-acre tract in Geo. Blair survey, the *Dilworth sand* consists of (descending): (1) 8 ft. of thin (1 to 2 inches) flaggy, ripple-marked ss. alternating with layers of green sh. and volcanic glass 1 to 2 inches thick; (2) 2 ft. of green clay; (3) 3 inches of thin, flaggy, very fine-grained ss.; (4) 4 ft. of green bentonitic sh.; (5) 2 inches of thin, flaggy, fine-grained ss.; (6) 2½ ft. of loose sand with green clay inclusions; (7) 2 ft. of chocolate thinly laminated sh. with streaks of sand; total 18 ft. 11 in. Underlies Falls City sh. Been traced across Atascosa, Karnes, and Gonzales Counties.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17 and pp. 34–36). *Dilworth ss. memb. of Manning fm.*—In Gonzales Co., ¾ mi. SE. of Dilworth, extending across the E. Kramling 50-acre tract, the Wm. Green 144-acre tract, and the Jno. Sewfera 105-acre tract in George Blair survey, there is a persistent ss. ledge to which Miss Ellisor applied the name Dilworth sand. In Grimes and

Brazos Counties there is a very persistent ss. 50 to 70 ft. below Whitsett fm. [as here restricted] which was used extensively in mapping structure through Grimes, Brazos, and eastern Washington Counties. This ss. was not found in western Washingtor Co. and in most of Fayette Co. On basis of strat. position and interval to base of Catahoula fm., this ss. has been tentatively correlated with Dilworth ss. of Miss Ellisor in Gonzales Co., though it is recognized the ss. designated Yuma may be=Dilworth ss. of Gonzales Co. [The table shows his expanded Manning fm. (250 to 350 ft. thick) as underlying his restricted Whitsett fm. (75 to 132 ft. thick), and divided his Manning into (descending): (1) Same as No. 5, 0 to 25 ft.; (2) Yuma ss., 3 to 25 ft.; (3) same as No. 5, 25 to 40 ft.; (4) Dilworth ss., 2 to 22 ft.; (5) chocolate colored lignitic clay with interbedded tan sand and ss. and gray tuffaceous ss., with thin beds of lignite, some thin fossiliferous marine beds, but mostly nonmarine, thickness not given.]

Dimple limestone.

Pennsylvanian: Southwestern Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 46). *Dimple fm.*—Alternating beds of dark gray ls., black chert, and black sh., with a few beds of chert cgl. The lss. carry marine fossils. Named by Udden. Thickness 925 ft. Overlies Tesnus fm. and underlies Haymond fm.

C. Schuchert, 1927. [See 1927 entry under *Tesnus fm.*]

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). *Dimple fm.* grades into overlying Haymond fm. and grades into underlying Tesnus fm. Thickness 1,100 ft.

Is chiefly ls.

Named for exposures in and near Dimple Hills, Pecos Co.

Dingess limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 165). *Dingess ls.*—Marine, fossiliferous, gray and hard, frequently brown and siliceous, lenticular and ferriferous. Thickness 0 to 5 ft. Lies 1 to 30 ft. below Williamson ss. and 0 to 30 ft. above Williamson coal. Named for Dingess, Mingo Co.

Dingess shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties). *Dingess sh.*—Dark-green sandy sh., 0 to 30 ft. thick. Underlies Dingess ls. and overlies Williamson coal.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., p. 927). *Dingess sh. and ls.*, 20 to 30 ft. of gray to black, limy, and siliceous sh. with ls. lenses, widely persistent in Kanawha, Fayette, Nicholas, Boone, Logan, and Mingo Counties, W. Va., and in Ky. Underlies Williamson ss. and overlies Dingess ss. (0 to 22 ft. thick) or the underlying Williamson coal.

Dingess sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., pp. 926–928). *Dingess ss.*—Lenticular, 0 to 25 ft. thick at Dingess, Mingo Co. Underlies Dingess sh. and overlies or is separated from underlying Williamson ("Dingess") coal by 1 ft. of sl.

Dingus limestone. (In Pottsville formation.)

Pennsylvanian: Northeastern Kentucky (Morgan County).

L. C. Robinson, 1927 (Ky. Geol. Surv., ser. 6, vol. 26, p. 239). *Dingus ls.*—Fossiliferous ls., at some localities so sandy it is impossible to separate it from overlying and underlying sss. Varies in color from light gray, to yellow, and black. Overlies Amburgy coal. Included in Pottsville series of Morgan Co.

Probably named for Dingus, Morgan Co.

Dinoceras beds.

A paleontologic name applied by O. C. Marsh to basal Olig. beds of the West that contain fossil remains of *Dinoceras.*

†Dinosaur sand.

Lower Cretaceous (Comanche series): Texas.

C. A. White and R. T. Hill, 1887 (Phila. Acad. Nat. Sci. Proc. 1887, p. 40; Am. Jour. Sci., 3d, vol. 33, pp. 296–301). *Dinosaur sand.*—Purely siliceous, fine-grained, uncemented pack sands, called *Upper Cross Timbers* in previous repts. Underlies Fredericksburg div. and overlies Carbf. The upper strata abound in Dinosaurian bones and teeth.

Not a geographic name. Replaced by *Trinity group.* The name has also been applied to Travis Peak fm., the basal fm. of Trinity group.

Dinsmore limestone bed. (In Monongahela formation.)

Pennsylvanian: Southwestern Pennsylvania (Washington County) and southeastern Ohio.

W. T. Griswold and M. J. Munn, 1907 (U. S. G. S. Bull. 318, pp. 69–70). *Dinsmore ls.*—Cream-white ls., about 4 ft. thick, in beds 4 to 8 inches thick, the spaces btw. being filled with calc. sh. Lies about 35 ft. above Sewickley coal. Is overlain by about 20 ft. of sh., olive green above and red or yellow below. Named for town of Dinsmore, Washington Co., Pa.

The Dinsmore ls. bed is in lower part of Benwood ls. memb. of Monongahela fm.

Dinwoody formation.

Lower Triassic: Western Wyoming.

D. D. Condit, 1916 (U. S. G. S. P. P. 98, p. 263). In typical development Embar fm. consists of two principal parts, of which the upper is largely shaly and the lower is chiefly ls. but includes phosphatic and calc. sh. and nodular chert. The name Park City has been adopted by U. S. G. S. for lower part, on recommendation of Blackwelder, who identifies these beds with Park City fm. of Utah. [These beds in western Wyo. were later identified as Phosphoria fm.] Blackwelder has also suggested name *Dinwoody fm.* for upper shaly part, from Dinwoody Canyon, in Wind River Mtns, where the fm., 200± ft. thick, consists of pale-green to white clay and shaly ls. weathering brown and containing obscure pelecypod shells. Evidence at hand seems to indicate Dinwoody beds are Triassic. To E. they change to gypseous greenish or brownish shales devoid of fossils. They grade into Park City fm.

E. Blackwelder, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 425). *Dinwoody fm.*—Upper part of Darton's Embar fm. Consists of greenish-gray shales with many thin plates of dense calc. ss. or argill. dol., which weathers brown, tawny, and even black. Conformably underlies Chugwater fm. and conformably overlies Park City [Phosphoria] fm. Thickness 250 ft. at Dinwoody Creek, on N. slope of Wind River Range, but thins to less than 50 ft. near Lander, Wyo. In Owl Creek Mtns it is 75 to 100 ft. thick near Anchor. To E., near Thermopolis, the fm. becomes gypseous and more or less reddish. Thickens to W.; being 350 ft. thick at N. end of Hoback Range. Thickens rapidly in SE. Idaho, where it grades horizontally into Woodside and Thaynes fms. Named for canyon of Dinwoody Lakes, in Wind River Range, where it is completely exposed and has been measured in detail.

†Diplacodon beds.

A paleontologic name that has been applied to uppermost Eo. deposits in Uinta Basin, Utah, or the true Uinta fm. of Marsh and King, to which the U. S. Geol. Survey also refers as "*Diplacodon* zone."

Dirty Creek sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Dirty Creek ss. memb. of Atoka fm.*—Thin to massive bedded ss., fine grained, dark blue; color changes from blue to brown and texture from fine to medium grained as ss. is traced from S. to N. Surfaces of bedding planes covered with fucoidal markings. Fossils. Thickness 5 to 20 ft. Separated from underlying Georges Fork ss. memb. by 60 ft. of varicolored sh. and from overlying Webbers Falls ss. memb. by 40 ft. of sh. Named for exposure W. of Dirty Creek, in secs. 11 and 14, T. 12 N., R. 19 E.

Dismal formation.

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Dismal fm.*—Sh. and ss., with several important coal seams, and, in W. part of quad., a coarse cgl. (*Dismal cgl. lentil,* 0 to 120 ft. thick), near middle. Thickness 490 ft. Overlies Raleigh ss. and underlies Bearwallow cgl. Both the fm. and the cgl. lentil named for exposures on Dismal Creek, Buchanan Co., Va.

Dismal conglomerate lentil. (In Dismal formation.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

See under *Dismal fm.*

†Dismal Swamp formation.

Pleistocene: Coastal Plain of Virginia and North Carolina.

C. K. Wentworth, 1930 (Va. Geol. Surv. Bull. 32, pp. 691+). In 1912 (N. C. Geol. Surv. Bull. 3) L. W. Stephenson applied name *Pamlico* (from Pamlico Sound, N. C.) to the terrace and fm. E. of Chowan fm. and separated from the Chowan by a well-marked sea-facing scarp, which trends almost N. and S. through eastern Gates Co., N. C., and is continuous with Suffolk scarp in Va. The marine part of Pamlico terrace has max. elev. of about 25 ft. at foot of Suffolk scarp, and slopes gently seaward to elevations of 15 to 18 ft. along the coast. Stephenson included in Pamlico terrace the entire Coastal Plain lowland E. of Pamlico-Chowan scarp (Suffolk scarp in Va.). Field work in Va. proves that 2 terraces lower than the Chowan occur on Coastal Plain. These terraces are clearly shown on recent topog. maps of Coastal Plain of Va. The lack of such maps in N. C. makes it still impracticable to discriminate the 2 terraces there. In this rept Pamlico terrace and fm. are subdivided into *Dismal Swamp and Princess Anne terraces and fms.* The *Dismal Swamp terrace and fm.* are named for Dismal Swamp dist., E. of Suffolk scarp, where they are excellently developed. Type area of Dismal Swamp terrace is separated on N. from Princess Anne terrace by a low distinct scarp that trends almost E. and W. south of Oldtown, Norfolk Co., and Bayville, Princess Anne Co. The fm. is chiefly sand, usually clean, white, yellow or light cream; some well-sorted gravel is present. Thickness of fm. 10 to 25 ft. Contains marine fossils, and is largely of marine origin. Remnants of fluvial terraces that merge with the wave-cut Dismal Swamp terraces extend up valleys of principal streams.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 1931), and 1932 (16th Int. Geol. Cong. Guidebook 5, pp. 34–35). As "Dismal Swamp" terrace has identically same shore line (25 ft.) as Pamlico terrace, the name Pamlico, which has many years priority, should be retained.

Disraeli series.

Silurian (?): Quebec.

F. R. Burton, 1931 (Quebec Bur. Mines Ann. Rept. 1930, pt. D, p. 114).

Ditney formation.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84). *Ditney fm.*—Ss. and sandy sh., with thin coal bed; 20 ft. thick. Overlain by Inglefield ss. and underlain by Somerville fm.

This name has been dropped by Ind. Geol. Surv., the beds now being included in upper part of their newly defined unit called *Shelburn fm.* See E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 525).

Caps Big Ditney and Little Ditney Hills, Warren Co.

Divide andesite.

Tertiary (probably upper Miocene): Southwestern Nevada (Divide district).

A. Knopf, 1921 (U. S. G. S. Bull. 715, pp. 151, 155). *Divide andesite.*—Gray porphyritic rock carrying numerous crystals of glassy striated feldspar and biotite. Weathers lilac gray. Intrudes Fraction rhyolite breccia. Is a large mass that lies SE. of Tonopah Divide mine and forms main bulk of largest and highest mountainous area in dist. Is well shown at highest point on Tonopah-Goldfield road—the divide from which the dist. was named. Appears to have no equiv. in Tonopah dist. Believed to be younger than Oddie rhyolite, but the two have not been found in contact.

Divide Peak andesite.

Age (?): Northern California (Lassen region).

H. Williams, 1932 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 21, No. 5, map on p. 71), mapped (but did not describe), in Lassen region, the following units (downward order): Augite andesite, *Divide Peak andesite,* hypersthene basalt, *Brokeoff andesite, Brokeoff andesite (solfatarized),* Brokeoff vents, *pre-Lassen dacites, Loomis Peak dacites, NE. Lassen dacites, Old Lassen mud flow,* dacite tuff, domes, dacite breccias, *Lassen 1915 dacite,* and *Lassen 1914–15 mud flows.*

Divine limestone.

Upper Ordovician: Northeastern Illinois (Grundy County).

J. E. Lamar and H. B. Willman, 1931 (Ill. Geol. Surv. Rept. Invest. No. 23, passim). *Divine ls. memb. of Richmond fm.*—Coarse-grained crystalline fossiliferous ls., usually white, light gray, or buff, although locally pink or brown. Thickness 0 to 44 ft. Overlain in places by 0 to 7 ft. of dark-gray sh. belonging to Richmond fm.; in other places overlain by Penn., Pleist., or Recent deposits. Underlain by 13 to 70 ft. of gray calc. nongritty sh. of the Richmond. Is thickest high-calcium bed in Richmond fm. Top and bottom surfaces of the ls. are uneven. Locally erosion channels are cut deep into the stone. Mapped. Named for occurrence in vicinity of Divine station, on Elgin, Joliet & Eastern R. R., Grundy Co. [Shows picture of outcrop ¼ mi. N. of Divine.]

Dixie sand.

A subsurface sand, 20 to 40 ft. thick, in middle of Goodland ls. (Lower Cret.) of eastern Tex.

Dixie sand.

A subsurface sand, of early Penn. age, in Seminole Co., central Okla. In Wewoka pool it lies at 2,800 ft. depth, and the Smith sand lies at 3,132 ft.

Dixie oil horizon.

Name proposed by A. F. Crider (A. A. P. G. Structure symposium, vol. 2, 1929, p. 179) for the oil-producing horizon of Pine Island oil field, Caddo Parish, La., which lies in Trinity group (of Comanche age), 90 ft. below Dillon gas horizon and 193 ft. above Herndon oil sand.

Dixie shale.

Lower Cretaceous: Southeastern Arizona.

C. [R.] Keyes, 1935 (Pan-Am. Geol., vol. 64, No. 2, pp. 129, 138, 139). *Dixie sh.*—Name proposed for upper part of Cintura fm. of Ransome. Thickness 800 ft. Named for Dixie Canyon, near Bisbee. Overlies Mexican ss.

Dixon earthy limestone member (of Wayne formation).

Silurian (Niagaran): West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 566, 578–582, 681, 694). *Dixon clay.*—Red clays, 30 to 40 ft. thick, overlying Lego ls. and underlying white lss. and clays of Brownsport bed in Tenn. River Valley. Of Niagaran age. Few fossils. Usually no sharp line btw. Lego ls. and Dixon red clay.

Top memb. of Wayne fm. Overlies Lego ls. memb. of Wayne. Underlies Brownsport fm.

Named for Dixon Spring, Decatur Co.

†Dixon sandstone. (In Henshaw formation.)

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Dixon ss.*—Fine-grained variable ss., 10 to 60 ft. thick, forming basal memb. of Dixon [Henshaw] fm. in Webster Co.

Preoccupied in Sil. of Tenn.

Named for Dixon, Webster Co., where it is well developed.

†Dixon formation.

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Dixon fm.*—Chiefly calc. sh., with 20-foot bed of ls. in upper half, Vanderburg ss. (25 ft. thick) in middle, and Dixon ss. (10 to 60 ft. thick) at base. Thickness about 340 ft. in Webster Co. Uncon. overlies Lisman fm. (Penn.), and uncon. underlies Lafayette fm. (Plio.).

Preoccupied in Sil. of Tenn. Replaced by *Henshaw fm.*

Named for Dixon, Webster Co.

Dixon schist.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Dixon schist.*—Feldspathic quartz graphitic schist; upper portion and lower layers usually micaceous. Of sed. origin. Thickness 3 to 30 ft. Included in Grenville series. Probably occurs as two long lenses, which can be regarded as separate beds. Type loc. is Dixon mine, Hague Twp, Warren Co. Underlies Faxon ls. and overlies Hague gneiss. The term "Dixon schist," while open to criticism, because preoccupied, is here used for convenience and should not become an established name in Adirondack geology.

H. L. Alling, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 52–68). *"Dixon" schist.*—Quartz graphite schist. Usually a single stratum, but at American Graphite Co.'s mine at Graphite, Warren Co., it occurs as two distinct layers separated by bands of Hague gneiss. Two mi. E. of Hague it appears as a single fm. In Flake Graphite Co.'s mine, in Saratoga quad., a parting of thin beds of ls. and green qtzite separates the 20-foot seam into two more or less distinct strata. The fm. has been traced, but not continuously, from middle of Ausable quad. S. to Saratoga Springs, a distance of 90 mi., and from Hague, on Lake George, W. to Conklingville, a distance of 40 mi. Name is preoccupied [and therefore quoted]. In places underlies and in places seems to include Faxon ls.

†Dixon chalk or †Dixon limestone.

Upper Cretaceous: Nebraska and western Iowa.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, pp. 147–149). [Described Nicollet's use of "Dixon's group" or "Dixon's bluff," and said:] As a terminal title *Dixon chalk,* or *Dixon ls.,* has manifest priority over all other designations by many years, and as such should be used. If Gilbert's Greenhorn ls. of Colo. be the same fm., as Todd believes, then it, too, is in synonymy. [But on p. 148 he said that it probably is not same as Greenhorn ls.] Independent discovery of dual character of the chalk rock of upper Missouri River region, and subsequent recognition of unlikelihood of lower chalk bed being the continuity of Gilbert's Greenhorn ls. of Colo., 600 mi. away, as Todd and Darton had assumed, was brought forcibly to front after somewhat extended personal examinations of southwestern region. Not knowing of Nicollet's designation, the title of *Crill ls.* was given to this lower chalk fm. in Iowa.

†Dixon's group.

Upper Cretaceous: Eastern Nebraska and western Iowa.

I. N. Nicollet, 1843 (Rept. intended to illustrate map of hydrographical basin of Upper Mississippi River: 26th Cong., 2d sess., S. Ex. Doc. 237, pp. 35, 37). *Dixon's group or Dixon's bluff.*—In ascending order: (A) Argill. ls., containing *Inoceramus barabini* [*labiatus*] in great number and very much compressed, and so arranged as to give the rock a slaty structure; thickness variable up to 20 ft. (B) Gray, grayish-blue, and sometimes yellow calc. marl, generally from 30 to 40 ft. thick, but at Dixon's bluff reduced, by a slide, to 15 or 20 ft.; the few fossils consist of one orbicula and what appears to be a fish scale. (C) A slightly ferruginous clay bank of yellowish color with seams of selenite and affording occasionally rounded masses somewhat resembling septariae. Rests on Carboniferous or mountain ls. (D). [Not certain whether Nicollet meant to include this in his "Dixon's group."] A vast deposit of plastic clay about 200 ft. thick with loose pieces of ls. throughout the clay. [Item D is probably Niobrara ls.]

Includes, exclusive of item D, Greenhorn ls. and probably younger Cret. rocks.

Named for fact that divisions A, B, and C compose Dixon's bluff, in Dixon Co., Nebr., about 12 mi. above Sioux City, Iowa.

†Dixon's bluff.

See †Dixon's group.

Dobbs Valley sandstone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 163). The upper water-bearing sand of Millsap Lake fm. lies near top of the fm. and about 300 ft. below top of Brazos River ss. It outcrops N. of Dobbs Valley and is here named *Dobbs Valley ss.* It supplies good water in deep wells NW. of Brazos River ss. escarpment in Mineral Wells gas field area. Has not been reached in wells outside the gas field, and its extent and productivity are unknown. It lies 200± ft. higher than Buck Creek ss.

Dock Street clay.

Middle Devonian: Northeastern Michigan (Alpena).

A. W. Grabau, 1902 (Rept. Mich. State Bd. of Geol. Surv. for 1901, pp. 178, 192). *Dock Street clay.*—Blue clay exposed in test well on Dock St., Alpena, Mich., where it is 6 or 7 ft. thick. Included in lower part of Traverse upper shales and lss., which overlie Alpena ls. The clay is underlain and overlain by ls.

A. S. Warthin and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, p. 526). Dock Street clay of Grabau is a local clay facies of upper Alpena horizon [restricted Alpena].

Dockum group.

Triassic (Upper?): Panhandle of Texas and southeastern New Mexico.

W. F. Cummins, 1890 (Tex. Geol. Surv. 1st Ann. Rept., p. 189). *Dockum beds.*—Water-bearing cgl., ss., and red clay, 150 ft. thick, uncon. overlying clays and sss. of upper Perm., and entirely unlike anything heretofore seen in Tex. Uncon. underlies Blanco Canyon beds [Blanco fm.].

In Tex. is divided into Trujillo fm. (above) and Tecovas sh. (below). Uncon. overlies Permian (Double Mtn and Quartermaster fms.) and uncon. underlies Blanco fm. (Plio.).

Named for Dockum, Dickens Co., Tex.

Dockuman series.

A term applied by C. R. Keyes to Dockum group and its supposed equivalents.

Doctor Bond sandstone.

Commercial term for a white building stone quarried from basal ss. memb. of Morrison fm. in Boulder dist., Colo.

Documan series.

A term applied by C. R. Keyes to Dockum group and its supposed equivalents.

Dodds Creek sandstone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 97). Galesburg sh. includes *Dodds Creek ss.* [All.]

J. M. Jewett, 1932 (pp. 99, 101, 103 of book cited above). *Dodds Creek ss.* is proposed for the ss. in upper part of Galesburg sh. Named for Dodds Creek, Labette Co. [On p. 102 he stated Dodds Creek ss. consists of ss. and sandy sh. On p. 26 he described it as yellow sandy sh. 5 ft. thick.]

J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, p. 133). Upper part of Galesburg sh. is named *Dodds Creek ss.*

Dodge shale.

Upper Cretaceous or Miocene(?): Western Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 148, 151). *Dodge terrane.*—Reddish or pink shales, 75 ft. thick, accompanying Dodge [Fort Dodge] gyp. Older than Nishnabotna ss. and overlies Carbf. Basal fm. of Dakotan series. [Later rept by Keyes assigned this sh. to Mio.]

Probably named for Fort Dodge, as author stated the sh. outcrops in Iowa farther N. than Fort Dodge.

Dodge gypsum.

A term used by C. [R.] Keyes to designate the gyp. beds at Fort Dodge, Iowa. (See Pan-Am. Geol., vol. 40, 1923, p. 219, fig. 3, and pls. 25, 26.)

Dodge limestone.

Name applied by oil geologists to a thin lime, of Penn. age, in Fairport oil field, Russell Co., Kans., lying at about 2,900 ft. depth and about 100 ft. higher than Oswald lime.

Doe Run limestone.

Pre-Cambrian: Southeastern Pennsylvania (Chester County).

P. Frazer, 1883 (2d Pa. Geol. Surv. Rept. C_4, pp. 70, 304, 307). *Doe Run ls.*—A tract of crystalline mag. ls. extending more than 1 mi. in SW. direction parallel to valley of Doe Run, from near Doe Run village to vicinity of Passmore's mill.

Same as Cockeysville marble.

Doe Run dolomite. (In Elvins group.)

Upper Cambrian: Eastern Missouri.

E. R. Buckley, 1907 (Mo. Bur. Geol. and Mines vol. 10, 2d ser., *separate*), and H. A. Buehler, 1907 (Mo. Bur. Geol. and Mines vol. 6, 2d ser., p. 231), in tables divided Elvins fm. into (descending) Doe Run, Derby, and Davis, without defining the subdivisions.

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1, pp. 15, 47). *Doerun fm.*—Chiefly argill. dol. alternating with finely crystalline dense dol. and soft porous dol. Thickness 50 to 90 ft. Overlies Derby fm. and uncon.(?) underlies cherty Potosi fm., which is characterized by coarse drusy cavities.

Named for Doe Run Lead Co., which owns the lands in St. Francois Co. upon which occurs the type section.

Dog Bend limestone. (In Mineral Wells formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). *Dog Bend ls.* lies in interval btw. Turkey Creek ss. and Lake Pinto ss., in Mineral Wells fm. [This interval is that occupied by Salesville sh. as defined by Moore and Plummer, 1922.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232), defined Salesville sh. as underlying Turkey Creek ss. and overlying Lake Pinto ss.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534), defined Salesville sh. as consisting of gray calc., sandy sh. containing several lentils of ss. and near its base a thin stratum of impure sandy ls., and as overlain by Turkey Creek ss. and underlain by Lake Pinto ss. They did not mention Dog Bend ls. But columnar section on geol. map (of Palo Pinto Co.) accompanying Bull. 3534 shows, in lower part of Salesville sh., 3 lss. separated by sh. beds, and the name *Dog Bend ls.* appears opp. the upper of these 3 lss. The map itself shows a ss. mapped around Dog Bend of Brazos River, btw. towns of Palo Pinto and Mineral Wells.

Dog Canyon limestone.

Permian: Southeastern New Mexico (Pecos Valley region).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Dog Canyon ls.*—Bedded lss. more than 1,000 ft. thick, which grade along their base into the thinning ss. of Delaware Mtn fm. and to S. merge with middle sss. of that fm. and possibly with basal part of Capitan ls. Is of middle Delaware Mtn age. To N. gradually thins out above San Andres ls. Overlain by Queen ss. memb. of Chalk Bluff fm. Exposed on W. flank of Guadalupe Mtns, in Dog Canyon, N. Mex.

Dog Creek shale. (In Cimarron group in Kansas.)

Permian: Central southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 39). *Dog Creek shales.*—Dull red argill. shales, 30 ft. thick, with laminae of gyp. in basal part and one or two ledges of dol. in upper part. Basal fm. of Kiger div. Overlain by Red Bluff sss. and underlain by Shimer gyp. memb. of Cave Creek fm. [In 1897 (Am. Geol., vol. 19, pp. 351–363) Cragin suggested *Stony Hills* as more appropriate name than *Dog Creek* for these beds, which he also removed from his Kiger div. and included in top of his Salt Fork div.]

Adopted as basal fm. of Woodward group in Okla. Overlain by Whitehorse (†Red Bluff) ss. and underlain by Blaine gyp. C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 91), gave thickness as 30 to 400 ft.

Named for Dog Creek, Barber Co., Kans.

Doggett sand.

See *Daggett sand.*

Dog Gulch formation.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). *Dog Gulch fm.*—Cgl. and ss. with a few lenses of red sh.; the cgl. beds best developed near base. Thickness 400± ft. Younger than Mogollon andesite, from which it is separated by erosion interval.

Named for exposures in upper part of Dog Gulch, Mogollon dist.

Dog Head limestone.

Upper Ordovician (Richmond): Manitoba.

A. F. Foerste, 1929 (Denison Univ. Bull., vol. 29, No. 2, Sci. Lab. Jour., vol. 24, pp. 35, 37; and vol. 29, No. 7, Sci. Lab. Jour., vol. 24, p. 130).

A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 211). Dog Head ls. of Manitoba seems to correspond to Lander ss. (basal memb. of Bighorn fm., of Richmond age, in Wind River Mtns, Wyo.).

Dogtown clays. (New Jersey.)

See under *Trenton clays.*

Dogwood coal group.

Pennsylvanian: Central Alabama.

A group of three or four coal beds in Pottsville fm. of Cahaba coal field, occurring within a vertical section of 100± ft., the lower coal lying 500 ft. above Montevallo coal. May be=Straven coal group. Includes Upper Dogwood, Lower Dogwood, and one or two other coals.

Dolgeville shale.

Middle Ordovician: Eastern New York (Herkimer County).

H. P. Cushing, 1909 (N. Y. State Mus. Bull. 126, p. 20). *Dolgeville sh.*—Alternating thin-bedded lss. and shales, transitional in character. Evidently a shaly eastern representative of upper Trenton ls. of type section. Overlain, conformably, by Utica sh. and underlain by Trenton lss. proper, from both of which it is separable throughout Mohawk Valley. Fully exposed, with both contacts shown, in banks of East Canada Creek just below Dolgeville, Herkimer Co. Previously called "Trenton-Utica passage series."

In 1910 (N. Y. State Mus. Bull. 145, p. 97) H. P. Cushing and R. Ruedemann correlated Dolgeville sh. with Cumberland Head sh.

In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27) E. O. Ulrich placed Dolgeville sh. stratigraphically btw. Canajoharie and Snake Hill shales and correlated it with part of Cumberland Head sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 39). [See 4th entry under *Cumberland Head sh.*]

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 100–101). *Dolgeville shales* (passage beds btw. Utica sh. and Trenton ls.) and the directly overlying black sh. as far as fall below Dolgeville, contain fauna of upper Canajoharie sh., although there are present a considerable number of Utica forms.

Dolls Run sandstone. (In Washington formation.)

Permian: Northern West Virginia (Monongalia County).

E. L. Core, 1929 (W. Va. Acad. Sci. Proc., vol. 3, p. 204). In region near Core, Monongalia Co., there occurs quite generally near base of Little Washington coal a massive ss., 10 to 15 ft. thick, very prominent in topog. of region, which is here named *Dolls Run ss.*, from its excellent development along that stream. It is very hard, blue-gray in color, and weathers gray. Beneath Dolls Run ss. comes the siliceous Bristol ls.

Dolly Varden formation.

Jurassic: British Columbia.

G. Hanson, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 10).

Dolores formation.

Upper Triassic and Jurassic (?): Southwestern Colorado.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). *Dolores fm.*—Reddish quartzose sss., grits, and cgls., latter usually containing granitic debris and fragments of Algonkian schists and qtzites; several thin ls. cgls. with small pebbles characterize upper part and contain a few Triassic fossils [listed]. Below the fossiliferous horizons occurs a series of reddish grits, sss., or cgls. in which no fossils have been found. In Rico quad., adjoining on SW., an invertebrate fauna has been found in lower 200 or 300 ft. of "Red Beds," which is assigned by G. H. Girty to Permo-Carbf. The complex of strata characterized by this fauna will be described as *Rico fm.* In absence of fossil evidence the red strata btw. Rico Permo-Carbf. and the beds containing Triassic fossils are grouped with latter in *Dolores fm.* The upper, finer-grained portion of Dolores fm. is usually bright red, and includes ls. cgl. called "Saurian cgl.," 10 to 30 ft. thick, usually of pinkish color, which occurs 30 to 500 ft. below top of fm. Thickness 1,550 to 2,000 ft. Rests uncon. on Algonkian qtzite and is uncon. overlain by La Plata ss. Named for typical exposures of the fossil-bearing strata in valley of Dolores River, at present best known in Rico quad.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). Beds here named *Cutler fm.* compose greater part of "Red Beds" of region. Hitherto provisionally included in Dolores fm. Field work of 1904 in Ouray quad. revealed notable angular uncon. immediately below the most commonly fossiliferous beds of Dolores fm. Through this uncon. the Dolores [as here restricted] can be seen to transgress more than 1,000 ft. of old "Red Beds" and several hundred ft. of Rico and Hermosa. In view of these facts the strata btw. Rico beds and base of Triassic have been distinguished as a fm. and named for exposures on Cutler Creek. The name *Dolores* will continue to be applied to the Triassic strata, embracing the fossiliferous cgl. and overlying beds up to La Plata ss., of Jurassic age. The Dolores is absent in Silverton quad., where the unfossiliferous Cutler fm. is uncon. overlain by Tertiary Telluride cgl.

W. Cross, 1905 (U. S. G. S. Rico folio, No. 130), gave thickness of Dolores restricted in Rico quad. as 400 ft. Later repts give max. thickness in SW. Colo. of 800 ft.

In parts of SW. Colo. the Dolores fm. is overlain (uncon.) by Entrada ss. (Jurassic?). It rests on Cutler fm., as above defined, and includes equivalents of (descending) Kayenta fm., Wingate ss., and Chinle fm. (See A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., U. S. G. S. P. P. 183, 1936.)

†Doloresian series.

A term introduced by C. R. Keyes (Pan-Am. Geol., vol. 41) to cover Dolores fm. and the Chinle fm. (Upper Triassic) of Gregory. (See A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U. S. G. S. P. P. 183, p. 37.)

†Dome formation.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 11). *Dome fm.*—Massive-bedded gray siliceous ls., 355 ft. thick, underlying Swasey fm. and overlying Howell fm. Type loc. at head of Dome Canyon, House Range.

Same as Dome Canyon ls.

Dome conglomerate.

Pre-Cambrian: Ontario.

R. E. Hore, 1911 (Canadian Min. Inst. Quart. Bull. 15, p. 63).

Dome Canyon limestone.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1912, (U. S. G. S. Mon. 51, p. 157). *Dome Canyon ls.*—Massive-bedded cliff-forming, gray, siliceous ls. with small specks of calcite. Layers of brownish-yellow aren. ls., 15 in. to 2 ft. thick, occur 100 ft. below top and for 50 ft. below. Thickness 355 ft. Underlies Swasey fm. and overlies Howell fm. in House Range. See Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, p. 11) [where he called the beds *Dome fm.*].

Domengine formation.

Eocene (middle): Southern California (Diablo Range).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 3, pp. 167–168). *Domijean sands.*—Chiefly yellow sands. Thickness 350 to 1,200 ft. Greatest development in vicinity of Domijean ranch. Overlies Kreyenbagen shales and uncon. underlies Temblor beds. Correlated with part of Tejon fm.

B. L. Clark and R. B. Stewart, 1925 (Geol. Soc. Am. Bull., vol. 36, p. 227), and B. L. Clark, 1926 (Calif. Univ. Pub., Bull. Dept. Geol., vol. 16, No. 5, pp. 99–106). *Domengine horizon (middle Eo.)*.—A newly recognized div. of Eo. of Calif. Contains new fauna in beds stratigraphically below those containing typical Tejon (upper Eo.) fauna and above those of Meganos age. Beds representing this horizon were formerly included in part in Tejon and in part in Meganos. A number of species are common to the Meganos and a few to the Tejon, but taken as a whole the fauna is distinctive. *Domengine fm.* as here proposed rests uncon. on Meganos fm. [as here restricted] throughout Coalinga region. In vicinity of Domengine ranch the Tejon is absent; the Domengine consists of 100± ft. of, largely, yellow-brown, medium fine to coarse fossiliferous ss. with thin bed of well-rounded cgl. at base; and the Meganos [restricted] is 500 to 750 ft. thick, consisting largely of dark clay shales (with calc. lenses that are in places fossiliferous), becoming gradually more sandy toward top, grading into arkosic white ss., which previously was included by F. M. Anderson (1905) in his Domengine sands and by R. Anderson and R. W. Pack in their Tejon. In Simi Valley the Domengine fm. is 1,200 ft. thick. Its fauna (middle Eo.) has been recognized from Oreg. to southern Calif.

R. L. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, pp. 399–402 and map). Eocene of Ventura Co., Calif., divided into (descending):

Upper Eocene
- Tejon fm.

Middle Eocene
- Domengine fm. (gray sh. interbedded with cgl. and brown ss.).
- Santa Susana fm. (fine-grained ss. and sh., fossiliferous).

Lower Eocene
- Martinez group (3 subdivisions).

"The name *Domengine* was proposed by F. M. Anderson and is now used by B. L. Clark for upper part of his Meganos group."

R. B. Stewart, 1926 (Phila. Acad. Nat. Sci. Proc., vol. 78, pp. 299–300). *Domengine* is apparently valid name for certain strata near Domengine ranch, N. of Coalinga, but I do not think it should be used so far away as Simi Valley. Local names should be used.

B. L. Clark and A. O. Woodford, 1927 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 17, pp. 72, 73), gave detailed section of *Domengine fm.* in Mount Diablo quad. aggregating 1,350 ft. in thickness and resting uncon. on Meganos fm., the overlying Tejon being absent.

F. E. von Estorff, 1930 (A. A. P. G. Bull., vol. 14, No. 10, pp. 1321–1336). The 500 ft. of ss. *underlying* typical Kreyenhagen sh. in canyon of Canoas Creek is Domengine ss., of upper middle Eo. age, and the ss. uncon. overlying Kreyenhagen sh. is Temblor ss., of lower middle Mio. age, the Vaqueros ss. (of lower Mio. age) being absent.

In subsequent repts *Domengine fm.* was applied, by different geologists, (1) to rocks on Santa Cruz Island (Santa Barbara Co.) uncon. underlying Vaqueros fm. and overlying Martinez fm.; (2) to rocks in Antioch, Vacaville, and Napa quads. conformably underlying Markley micaceous sss.; and (3) to rocks in Kettleman Hills underlying Kreyenhagen. In 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169) G. C. Gester and J. Galloway stated *Domengine ss.* of Coalinga-Kettleman Hills area is overlain by Kreyenhagen sh. and underlain by Meganos, and is=Avenal ss. to S. of Coalinga. In 1933 McMasters introduced *Llajas fm.* for rocks on N. side of Simi Valley that were said to contain Tejon fauna in upper part, Domengine fauna in middle part, and an older Eo. fauna in lower part, and to rest on Santa Susana fm.

B. L. Clark, July 31, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, pp. 1049–1050), stated that *Domengine ss.* N. of Coalinga is overlain by Kreyenhagen shales and underlain by *Capay fm.* (Meganos of B. L. Clark's earlier rept.), and that Domengine and Capay are=Llajas fm.

Named for development in vicinity of Domijean or Domengine ranch, in NE¼ sec. 17, N. of Coalinga, Fresno Co.

†Domijean sands.

See *Domengine fm.*

Dominion ore bed.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Dominion ore bed.*—Oolitic hematite, fossiliferous; discon. overlain by phosphorite forming basal bed of Wabana series, and underlain by ss. and sh. Is top bed of Bell Island series. [Derivation of name not stated.]

Domino gneiss.

Pre-Cambrian: Labrador.

E. M. Kindle, 1924 (Canada Geol. Surv. Mem. 141, p. 55).

Don beds. (In Toronto formation.)

Pleistocene: Ontario.

A. P. Coleman, 1907 (10th Int. Geol. Cong., Mexico, 1906, p. 1246).

Don limestone.

A name applied by geologists of mining companies, in their company repts, to upper 260 ft. of Syrena fm. (Penn.) of Santa Rita dist., N. Mex.

Donaher sandstones.

Pre-Cambrian (Belt series): Central western Montana (Mission Range).

Name applied by C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, pp. 215, 217), to 4,500 ft. of sss. in Mission Range, shown as overlying Empire sh. and underlying Purcell lava. Derivation of name not stated.

Donald quartzites.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, p. 217). Qtzites, 5,000 ft. thick, forming topmost fm. of Proterozoic era in Mont. Overlie Ross qtzites. [Derivation of name not stated.]

Donald strata.

Lower Cambrian: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1922, pt. A_2, p. 122).

Donegal limestone. (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, Jan.–Feb., 1936 (Jour. Geol., vol. 44, No. 1, pp. 5–9), divided Sumner group into (descending) Wellington [restricted], Donegal, and Nolans fms., but did not define the new names *Donegal* and *Nolans*.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, graphic section on p. 12). *Donegal ls.*—Underlies Wellington sh. [restricted], overlies Pearl sh. [revived], and is divided into (descending): Strickler ls., Newbern sh., and Hollenberg ls. [Derivation of new names not stated. Thicknesses shown: Strickler ls., 2½± ft.; Newbern sh., 5± ft.; Hollenberg ls. 7± ft.]

Doniphan shale. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska, northwestern Missouri, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 47). *Doniphan sh.* is exposed in Mo. and Kans., but probably not exposed in Nebr. Is 14+ ft. thick in Mo. and 7 to 8 ft. thick in Kans. Underlies Big Springs ls. and overlies Spring Branch ls., all in Lecompton ls. Named for exposures in N. part of Doniphan Co., Kans.

Donley limestone member (of Greene formation).

Permian: Southwestern Pennsylvania (Washington County) and eastern Ohio.

W. T. Griswold and M. J. Munn, 1907 (U. S. G. S. Bull. 318, pp. 77+). *Donley ls. memb. of Greene fm.*—Very hard and tough ls. 5 or 6 ft. thick. Fractures unevenly with a dark steel-gray to almost black color; very coarse grain; numerous calcite crystals; peculiar jointing. Lies 18 to 45 ft. above base of Greene fm. in Claysville quad., Pa. Overlain by 15 to 20 ft. of light gray ss., and underlain by 5 to 20 ft. of gray laminated ss. Exposed in vicinity of Donley, Donegal Twp, Pa.

Donnelly iron ore.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Donnelly iron ore.*—The ore at Thomas Donnelly's has been correlated with thin seam at base of upper Irondequoit (Lakeport) ls. in Lakeport well and with that at Tipple's quarry, near Verona; all of which are above the Phoenix and close to Lockport quarries. [In section he located it beneath Lakeport ls. and above Phoenix sh. Belongs in upper part of Clinton fm.]

Don River member.

Ordovician (Upper): Ontario.

A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, p. 52).

Dooley rhyolite breccia.

Tertiary (Miocene ?): Northeastern Oregon (Baker quadrangle).

J. Gilluly, 1937 (U. S. G. S. Bull. 879). *Dooley rhyolite breccia.*—Rhyolitic and subordinate andesitic breccias and flows. Thickness 1,500+ ft. Overlain, probably conformably, by andesite, and underlain, probably conformably, by Tert. gravels. Named for exposures on Dooley Mtn and in Stices Gulch and Mill Creek, Baker quad. May be Eocene, but more probably is Olig. or Mio.

Dorans Cove sandstone.

Mississippian: Northeastern Alabama.

J. J. Stevenson, 1903 (Geol. Soc. Am. Bull., vol. 14, p. 76). *Dorans Cove ss.*—Some deep valleys in western Jackson Co. (on Tenn. line) reach the Bangor, which shows, from 160 to 200 ft. from top, an apparently persistent ss., which is probably the upper Hartselle, the ls. below it being cherty. In Madison, just W. from Jackson, both divisions are shown fully; the Bangor exhibits abrupt variations, being 200 ft. in NE. part of county, but only 100 ft. a little way SE. from Huntsville, while it is 200 ft. at Tennessee River in SE. corner of county, beyond which it passes under the Coal Measures. These abrupt changes and the condition in western Jackson lend countenance to suggestion that Dorans Cove ss. of NE. Jackson may be upper Hartselle.

Named for Dorans Cove, Jackson Co.

Dorchester slate member (of Roxbury conglomerate).

Devonian or Carboniferous: Eastern Massachusetts (Boston Basin region).

W. W. Dodge, 1881 and 1882 (Boston Soc. Nat. Hist. Proc., vol. 21, pp. 208–210), described the geographic distribution of *Dorchester and West Roxbury slates.*

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 56, 57). *Dorchester sl. memb.*—Red and purple slates, in part cross-bedded, interbedded with ss. and fine-pebble cgl. Typically rather coarse grained; consists largely of reworked volcanic sediments. In Dorchester and in southern part of basin this memb. is 100 to 600 ft. thick, but if the sl. exposed in and about Allston Heights is assigned to Dorchester memb. its thickness may be as much as 1,000 ft. Is middle memb. of Roxbury cgl. Underlies Squantum tillite memb. and overlies Brookline cgl. memb. Named for Dorchester dist. of Boston, where it is exposed at several places.

Doré conglomerate.

Pre-Cambrian (Huronian): Western Ontario (Michipicoten region).

A. P. Coleman, 1900 (Geol. Soc. Am. Bull., vol. 9, pp. 109–110). *Doré cgl.*, Archean (Huronian), Ontario.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 154), included this cgl. in Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Doré cgl.* may be Lower Huronian.

Doré series.

Pre-Cambrian: Ontario.

W. G. Miller and C. W. Knight, 1914 (Ontario Bur. Mines Rept., vol. 22, pt. 2, p. 125). Doré series, pre-Camb., Ontario.

W. H. Collins, 1933 (Canada Geol. Surv. map 155 A, Lake Huron sheet, Pub. No. 1553). *Doré series*, pre-Huronian, Ontario.

Dornick Hills formation.

Pennsylvanian: Central southern Oklahoma (Carter County).

J. A. Waters, 1927 (Jour. Pal., vol. 1, p. 129). [Describes Foraminifera from *Dornick Hills fm.* of Ardmore Basin.] The fauna was obtained from the rather pure shales exposed in sec. 30, T. 3 S., R. 2 E., in Carter Co., Okla.—shales which lie btw. *Jolliff* and Otterville lss.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z). *Dornick Hills fm.*—Bluish and tan shales interrupted by lss. and sss., with conspicuous ls. cgls. S. of Ardmore. The pebbles in cgls. consist chiefly of pre-Penn. lss. and chert such as now outcrop in Criner Hills. Basal memb. is Jolliff ls. memb.; top memb. is Pumpkin Creek ls. Also includes (descending) Lester ls., Bostwick ls. cgl., and Otterville ls. Thickness 1,500 to 4,000 ft. Underlies Deese fm. and overlies Springer fm.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). *Dornick Hills fm.* includes Goldston's Otterville and "Cup Coral" members of Glenn fm. and a little more.

Named for Dornick Hills, N. of Ardmore, Carter Co.

Dorothy limestone and shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Raleigh and western Mercer and Summers Counties, p. 353). *Dorothy ls. and sh.*—Dark, shaly, and fossiliferous beds, 1 to 2 ft. thick, underlying Upper Gilbert ss. and lying 5 to 15 ft. above Glenalum Tunnel coal. Exposed at Dorothy, Raleigh Co.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., p. 270). Author now believes *Dorothy ls.* of Krebs is intimately associated with Gilbert sh., instead of correlating with Oceana ls., as tentatively suggested on p. 164 of Rept. on Wyoming and McDowell Counties.

D. B. Reger, 1921 (W. Va. Geol. Surv. Rept. Nicholas Co., p. 292). Gilbert sh. is probable horizon of *Dorothy ls.*

Dorset limestone.

Ordovician and Cambrian: Southwestern Vermont (Rutland and Bennington Counties).

C. H. Hitchcock, 1860 (Proc. Boston Soc. Nat. Hist., vol. 7, p. 237). *Dorset ls.* (Stockbridge ls. of Emmons) is probably upper Sil. or Dev.

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1). [See 1861 entry under †*Eolian ls.*]

E. Hitchcock, 1863 (Elem. Geol., p. 411), assigned this ls. to Dev.

C. H. Hitchcock, 1866, also 1867 (Elem. Geol., pp. 411, 413). Some of the lss. of Emmons' Taconic contain fossils, apparently identical with certain Dev. forms, hence are regarded as Dev.; and as the place in that series is yet uncertain the name *Dorset ls.* may be applied to the group, from Dorset Mtn [Pawlet quad.], Vt., where the whole series is beautifully developed. [This mtn is partly in Rutland Co. and partly in Bennington Co.]

This name has fallen into disuse and the rocks are now generally called Stockbridge ls., which includes rocks ranging in age from Trenton to Lower Camb. (See E. J. Foyles and C. H. Richardson, 16th Rept. Vt. State Geol., 1929, table opp. p. 288, and other Vt. repts. Also see under †*Eolian ls.*)

Dorwin sandstone member (of Amsden formation).

Pennsylvanian: Northwestern Wyoming.

E. Blackwelder, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 422). *Dorwin ss. memb. of Amsden fm.*—Throughout western Wyo. Amsden fm. is divisible into two very distinct parts—an upper div. of shales, sss., and dolomites of weak character, and a lower massive resistant ss. On account of difference in resisting erosion, the upper memb. has generally been stripped off, while the lower remains capping the mtns and ridges of Madison ls. It therefore becomes advisable to map the two members separately. To the lower ss. the name *Dorwin ss. memb.* is given, from Dorwin Peak, in Gros Ventre Range, which is capped by this ss. Rests uncon. on Madison ls. Grades into overlying part of Amsden fm. No fossils. Position indicates probable Penn. age. Averages 60 ft. thickness in Gros Ventre Range; dwindles slowly to SE., and is 15± ft. thick near Lander, Wyo. Has been traced W. to Teton Pass. Ranges N. into Yel. Park and NE. as far as S. part of Bighorn Mtns. Elsewhere it is generally represented by reddish sandy sh.

Dos Alamos gypsum member (of Delaware Mountain formation).

Permian: Western Texas (Sierra Diablo).

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 922, 925). Near base of Delaware Mtn fm. is a thin bed of gyp. for which name *Dos Alamos gyp.* is suggested, from its exposures near Dos Alamos, or Cottonwood Wells, due W. of Guadalupe Point, on W. side of Salt Flat, Hudspeth Co. The gyp. memb. suggests retreat and readvance of the seas, and thus confirms existence of an uncon. at base of Delaware Mtn ss.

Dothan formation.

Upper Jurassic: Southwestern Oregon.

J. S. Diller, 1907 (Am. Jour. Sci. 4th, vol. 23, pp. 401–421). *Dothan fm.*—Chiefly ss., with much interbedded dark sh. Jurassic fossils. Lies uncon. below the Knoxville (Myrtle fm.), and with its occasional beds of chert writer believes it is=in part the Franciscan of Calif. Named for Dothan P. O., on Cow Creek. [Table puts Dothan fm. above Galice fm., but p. 421 says Dothan underlies Galice.]

J. S. Diller, 1914 (U. S. G. S. Bull. 546, pp. 17–18). Jurassic sed. rocks of Galice-Kerby-Waldo region consist of 2 fms.—Galice fm. on SE. and Dothan fm. on NW., separated by an irregular belt of igneous rocks, mainly greenstone and serpentine. Relative position indicates Dothan fm. is younger than Galice. The Cret. is markedly uncon. on Jurassic.

J. S. Diller and G. F. Kay, 1924 (U. S. G. S. Riddle folio, No. 218). Thickness of *Dothan fm.* is 1,000 to 6,000 ft. Knoxville and Horsetown fms. overlap Dothan fm. Is thought to be=Franciscan fm. of Calif.

†Dothan limestone. (In Moran formation.)

Permian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Dothan ls.* occurs in lower part of Moran fm., of Cisco group, about 160 ft. below top of the Moran and 60 ft. above Pueblo fm. Outcrops near Dothan, Callahan Co. Northward it pinches out into sands and shales.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 177–180, charts, etc.). *Dothan ls. lentil of Moran fm.* of Brazos River Valley is approx.=Horse Creek ls. of Colorado River Valley, but it is not certain they are same bed. Is separated from overlying Sedwick ls. by 100 ft. of sh. with ss. lenses, and is underlain by 60 ft. of sandy sh. forming basal memb. of Moran fm.

Moran fm. transferred to Perm. (Wichita group) in 1933.

Dotson black sheety shale.

Mississippian: Northwestern Arkansas.

D. D. Owen, 1858 (First Rept. Geol. Reconn. northern counties of Ark., pp. 101–102). *Dotson black sheety sh.*—Black bituminous sheety sh., 15 ft. of which is exposed on Wharton's [Wharton] Creek at Dotson's farm, Madison Co. Underlies Subcarboniferous flagstones and is lowest bed visible in this part of Madison Co.

Same as lower part of Fayetteville sh. (See U. S. G. S. Eureka Springs-Harrison folio, No. 202, 1916, by A. H. Purdue and H. D. Miser, where the beds along Wharton Creek are mapped as Fayetteville sh., and Chattanooga sh. is apparently absent.)

Dotson sandstone.

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Dotson ss.*—Upper part coarse thin-bedded ss. 120 ft. thick; lower part sandy sh. 60 ft. thick, containing at least one coal seam. Overlies Bearwallow cgl. and underlies Sequoyah fm. Dotson, McDowell Co., W. Va., is located on this ss.

According to H. Hinds, 1918 (Va. Geol. Surv. Bull. 18), and R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co.), typical Dotson ss. is same as typical Bearwallow cgl. (See W. Va. chart I.) The Dotson ss. as mapped in U. S. G. S. Tazewell folio probably included beds to base of Lower Dotson ss. of W. Va. Geol. Surv. repts.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co.), applied *Lower Dotson ss.* to a ss. lying 20 to 52 ft. below Dotson ss., and described as consisting of 50 to 100 ft. of heavy to current bedded, sometimes conglomeratic, grayish white to brown, friable ss., separated from overlying Douglas coal by 0 to 5 ft. of fire clay sh., and resting on Douglas sh.

Dotson (Lower) sandstone.

See Hennen and Teets, 1919, under *Dotson ss.* The so-called *Lower Dotson ss.* is now considered same as McClure ss. memb. of Norton fm.

Double Mer sandstone.

Paleozoic: Labrador.

E. M. Kindle, 1924 (Canada Geol. Surv. Mem. 141, p. 56).

Double Mountain formation.

Permian: Central northern and central Texas.

E. T. Dumble and W. F. Cummins, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxx, 187, 188). *Double Mtn beds.*—Gyp., rock salt, sands, clays, sss., shales and lss. Top fm. of Perm. Conformably overlies Clear Fork beds and uncon. underlies Dockum beds.

Named for Double Mtns, Stonewall Co.

Doublian series.

A term introduced by C. [R.] Keyes to replace *Double Mtn fm.* (Perm.) of northern Tex., "to simplify a clumsy compound name." (See Pan-Am. Geol., vol. 57, pp. 337, 350–356, 1932, and vol. 52, pp. 319–320, 1929.) In 1935 (Pan-Am. Geol., vol. 63, No. 4, p. 287) Keyes used this name in Iowa, to include deposits which he called *Dodge sh.* and assigned to late Carbf.

Douglas amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving 1883 (U. S. G. S. Mon. 5, pl. 18). [Shown as older than North Star cgl.]

Belongs in Central Mine group below Allouez cgl. The mineralized part is the Douglas lode.

Named for occurrence in Douglas mine, Houghton Co.

Douglas flow.

Includes Douglas amygdaloid and underlying trap.

Douglas group (also **Douglas formation**).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3. pp. 93, 94). *Douglas fm.*—The Lawrence shales are so distinct in character, and in connection with Oread ls. overlying them produce so prominent an escarpment, which extends entirely across the State from Leavenworth to southern line, that they, with overlying Oread ls. may well be grouped in one general fm. Overlies Garnett lss.

C. R. Keyes, 1900 (Iowa Acad. Sci. Proc., vol. 7), called the lss. underlying Lawrence sh. the *Stanton lss.*, which he stated are = Garnett ls. He also applied

Weston shales to basal 40 to 75 ft. of Lawrence sh. and *Iatan ls.* to the thin ls. overlying the Weston.

The Iatan and Weston were later (see E. Haworth and J. Bennett, 1908, Univ. Geol. Surv. Kans., vol. 9) excluded from Lawrence sh. and treated as distinct fms. within Douglas group. This definition of Douglas group (to include all beds btw. top of Stanton ls. below and top of Oread ls. at top) persisted until 1931, being the definition used by H. Hinds and F. C. Greene 1915, R. C. Moore 1917 and 1920, J. W. Beede 1922, and geologists generally.

R. C. Moore, Sept. 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), redefined Douglas group by excluding Oread ls. at top and excluding at base the Weston sh., Iatan ls., and basal part (later named *Hardesty sh.*) of Lawrence sh. These 3 units which he excluded from base of Douglas group he transferred to Lansing group, but in 1932 he assembled them into a distinct group called *Peedee group*.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 93, 96). It is proposed to redefine *Douglas group* to include the essentially clastic strata occurring btw. the pre-Virgil uncon. and base of Oread ls. Thus delimited the group will contain 3 formational units (in ascending order): *Stranger fm.* (largely ss. and sandy sh.), *Haskell ls.* (thin, fairly persistent ls. that in many places has been mistaken for the Iatan), and Lawrence sh. [This use of Lawrence sh. is a restriction.] In central Kans., as in Woodson Co., a prominent ss. (*Ireland*) has been developed in Lawrence sh., not far below base of Oread fm. Overlies Peedee group and underlies Shawnee group redefined.

This restricted definition of *Douglas group* was also adopted by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of the Penn. rocks of Kans. and Nebr. and by N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, etc.). *Douglas group* divided into (descending): Lawrence sh. restricted and Stranger fm. expanded to include at top Robbins sh. (new name for basal part of Lawrence sh. of 1932 and 1935 classifications) and Haskell ls. Douglas fm. of Haworth extended from top of Oread ls. down to top of Stanton ls.

These modified definitions have not yet been considered by U. S. Geol. Survey for its publications.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for Douglas Co., Kans.

Douglas shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 183). *Douglas sh.*—Dark to black sandy sh., 5 to 15 ft. thick. Underlies Lower Nuttall ss. and overlies Lower Douglas coal. Carries marine fauna that has not previously been described. Included in New River group. Exposed at Douglas R. R. station, McDowell Co.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co.). *Douglas sh.* and underlying Lower Douglas coal included in Kanawha group. Douglas sh., marine sh. 5 to 15 ft. thick, underlies Lower Dotson ss. and lies a few inches to 15+ ft. above Upper Nuttall ss. [This definition was also followed by D. B. Reger in W. Va. Geol. Surv. Rept. Webster Co., 1920, and in Nicholas Co. Rept., 1921.]

Douglas Canyon formation.

Miocene (late): Central Washington (Douglas County).

A. D. Hoffman, 1932 (Jour. Geol., vol. 40, No. 8, pp. 735–738). *Douglas Canyon fm.*—Well-stratified series of interbedded light-gray to buff arkosic sands and light to very dark shales, 35+ ft. thick (base not seen), containing flora [listed] of late Mio. age. All its species occur in Latah fm. of Spokane, Wash. Exposed in Douglas Canyon (one of side canyons of Moses Coulee), above and below waterfalls about ½ mi. from canyon mouth, NW¼ SW¼ sec. 30, T. 23 N., R. 24 E., Douglas Co. Plants were obtained from a thinly laminated lignitic sh. bed, approx. 1 ft.

thick, lying 11 ft. below overlying Columbia River basalt, with which it is apparently conformable.

Douglas County traps.

Pre-Cambrian (Keweenawan): Northwestern Wisconsin (Douglas and Bayfield Counties).

R. D. Irving, 1874 (Am. Jour. Sci., 3d, vol. 8, pp. 46–56). *Copper-Bearing series* of Douglas, Bayfield, and Ashland Counties is 20,000+ ft. thick and includes (descending) *Douglas County traps*, sss., ss. and sh., cgl., melaphyrs, and hornblendic and syenitic rocks.

Douglas Creek member (of Green River formation).

Eocene: Northeastern Utah (Uinta Basin) and northwestern Colorado (Garfield and Rio Blanco Counties).

W. H. Bradley, 1931 (U. S. G. S. P. P. 168). *Douglas Creek memb.*—Basal memb. of Green River fm. in E. part of Uinta Basin, Utah and Colo. Characteristically buff or yellowish brown beds of marlstone and sh. notably different from rest of Green River fm. Contains large proportions of ss., ls., algae reefs, and oolite, and small amount of oil sh. Thickness 200 to 800 ft. Underlies (with abrupt lithologic change) Garden Gulch memb. and grades into underlying Wasatch fm. (red). In W. part of Uinta Basin the lower Green River interfingers with Wasatch fm. Well exposed at head of Douglas Creek, especially in E. half of T. 5 S., R. 102 W., Garfield Co., Colo.

Douglas Island volcanic group.

Jurassic or Lower Cretaceous: Southeastern Alaska (Douglas Island).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 255–256, chart opp. p. 247, p. 270). *Douglas Island volcanic group.*—Melaphyre flows, tuff, and aggl., possibly 15,000 ft. thick. Overlies Treadwell sl. with apparent conformity. No fossils found in either Treadwell sl. or Douglas Island volcanic group, but their apparent position above Thane volcanic group indicates they are post-Triassic and probably post-Middle Jurassic. Tentatively assigned to Upper Jurassic, but may be Cret.

Forms main mtn mass of Douglas Island.

Douglass.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to upper 350 ft. of shales in Kootenai fm. of Mont. Derivation of name unknown.

Douty gravel.

Pleistocene (pre-Wisconsin?): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Douty gravels.*—Belong to Vashon glacial epoch. Underlie Osceola clays in section exposed in N. bank of Carbon River. Lie 600 to 655 ft. above sea. Named for Douty Station, in canyon near Carbonado, being the nearest point having a specific name and at the level of this bed. Deposited by river flowing from a glacier and sweeping down loaded ice cakes. A local deposit.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), gave thickness of *Douty gravels* as 0 to 55 ft.

†Dove limestone.

Middle Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 277–279). *Dove ls.*—For most part three fossiliferous layers, aggregating 11 ft. in thickness. Upper layer light dove-colored, compact ls., 4 ft. thick, breaking with conchoidal fracture, containing strings of crystalline matter; middle layer mainly common dark-blue crystalline ls., 2 ft. thick; lowest layer 4 ft. thick, resembling upper layer but more or less mixed with blue layers. Included in Nashville fm. Overlies Capitol ls., and underlies 28 ft. of ls. [later named Ward ls.] resembling College Hill ls. but separated from latter by *Cyrtodonta* bed, 11 ft. thick.

Nongeographic name. The beds were formerly included in Bigby ls., but R. S. Bassler, 1932 (Tenn. Dept. Ed. Div. Geol. Bull. 38), included †Dove ls. and overlying Ward ls. of Jones in Cannon ls.

Dover limestone. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 31). *Dover ls.*—Ls., 4 ft. or less thick, in Upper Coal Measures of Shawnee Co. [From statement on p. 28 appears to underlie Rossville shales and ss. and to overlie Dover sh. and ss.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 72, 73, 74, 75, 80, 90, 116, 222). Beede's *Dover sh. and ss., Dover ls.*, and *Rossville sh. and ss.* occupy practically all of interval represented by Admire sh. memb., but only one of these is acceptably defined; it is *Dover ls.*, which extends northward to Nebr. and Iowa. It is composed of one impure massive gray ls. or of 2 lss. separated by a thin sh. It underlies Pony Creek sh. and overlies Table Creek sh., all included in McKissick Grove sh. Thickness 2 to 4 ft. Named for exposures near Dover [Shawnee Co.], Kans.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 94, 96). Btw. Maple Hill ls. memb. of McKissick Grove fm. and overlying Brownville ls. are two, instead of one, persistent lss. The upper one is distinguished by occurrence of coal a few inches to 2 or 3 ft. beneath the ls. The lower ls. is characterized by abundance of large *Triticites* and Cryptozoon, and, except for generally lighter color, very closely resembles Tarkio ls. Both of these lss. btw. the Maple Hill and Brownville have been identified at various places in Kans. and Nebr. as Dover ls. Study of Beede's original description of the Dover and examination in field near Dover convince writer that lower of the 2 lss. is true Dover, and name *Jim Creek*, from a locality in central Pottawatomie Co., Kans., where entire section is well exposed, is selected for the upper ls. just above the coal. Condra's name *Table Creek sh.* (which includes Nyman coal) is restricted to sh. btw. the Jim Creek and the Dover, and the new name *Frenck sh.* (from a creek NW. of Onaga, Kans.) is adopted for the sh. btw. the Dover and Maple Hill ls.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Kans. and Nebr.) transposed the names *Frenck sh.* and *Table Creek sh. restricted*, by applying former name to sh. *overlying* Dover ls. and latter name to sh. *underlying* Dover ls.

G. E. Condra, 1935. (See under *Jim Creek ls.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22). The sh. overlying Dover ls. and underlying Grandhaven ls. in Kans. is here named *Dry sh.* [Moore abandoned McKissick Grove sh. and treated its subdivisions as fms. in Wabaunsee group.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Dover shale and sandstone. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 31). *Dover sh. and ss.*—Nearly unfossiliferous sh., 85 ft. thick, of very aren. texture, of light-yellow to deep brownish-red color, containing much argill. ss. Included in Upper Coal Measures. [From statement on p. 28 appears to underlie Dover ls. and overlie Chocolate ls. of G. C. Swallow. Named for Dover, Shawnee Co.]

See under *Dover ls.*, 1927 entry (G. E. Condra).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 235, 251), adopted *Dover ls.* and discarded *Dover sh. and ss.*

Dovre moraine.

Pleistocene (Wisconsin stage): Minnesota and South Dakota. See W. Upham, 1888 (Minn. Geol. and Nat. Hist. Surv., vol. 2, index). According to C. W. Hall (Geol. and Geog. Minn., vol. 1, pp. 63–73, 1903) this moraine was named for Dovre Hills, Kandiyohi Co., Minn. According to F. Leverett (personal communication) the Dovre moraine is younger than Fergus Falls moraine.

Dowell Hill facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 95, 102, etc., 1931) to a lithologic development of New Providence fm. in Brown and Bartholomew Counties, southern Ind.

†Downs limestone. (In Greenhorn limestone.)

Upper Cretaceous: North central Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 50). *Downs ls.*—Ls., 6 to 12 inches thick, in Russell fm. (lower part of Benton div.), quarried near Downs [Osborne Co.] and extensively used for fence posts, so that it may appropriately be called *Fencepost ls.*

W. W. Rubey and N. W. Bass, 1925 (Kans. Geol. Surv. Bull. 10, pp. 49–51). Cragin proposed "Downs ls." for the "fence-post ls." forming top bed of Greenhorn ls. in Russell Co. Although this bed is unusually persistent, for one so thin, it does not merit classification as a separate memb., and its local name "fence-post ls." is widely known and quite satisfactory.

Dox sandstone. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Dox ss.*—Micaceous shaly ss.; greenish gray in lower part, red-brown and vermilion above. Characterized by ripple marks and cross bedding. Cut by thin sills of intrusive diabase. Thickness 2,297 ft. plus unknown thickness removed by pre-Camb. erosion. Top fm. of Unkar group (Algonkian). Uncon. overlain by Tapeats ss., of Tonto group, and conformably underlain by Shinumo qtzite. Named for Dox Castle, in Shinumo quad., underneath which a typical section is found beneath Tonto group, which makes the castle.

.Doxey member (of Quartermaster formation).

See under *Bessie memb.*

Doyle shale. (In Chase group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 715). *Doyle sh.*—Variously colored shales, 60 ft. thick, including a few thin beds of soft ls. Overlies Fort Riley ls. and underlies Winfield fm., which includes (descending) Winfield concretionary ls.; yellowish shales; and cherty ls. ("Marion flint"). Included in Chase stage. [This definition of Doyle sh. was followed until 1929.]

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12), included in Doyle sh. in Cowley Co., Kans., all beds below top memb. (called Winfield concretionary ls. in early repts) of Prosser's Winfield fm. and above Fort Riley ls.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6. 2d ser.), divided *Doyle sh.* of Prosser into 3 members (descending), Gage sh. Towanda ls., and Holmesville sh., aggregating 66 ft. in thickness, and divided overlying Winfield ls. into 3 members (descending): Cresswell ls. (called "concretionary" ls. in previous repts.), Grant sh., and Stovall ls.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), dropped *Doyle sh.* and recognized Condra's 1931 members as *fms.*

These recent repts (which apparently follow Prosser's definitions of Doyle and Winfield) have not been considered by U. S. Geol. Survey for its publications.

Named for exposures on Doyle Creek, SW. of Florence, Marion Co., Kans.

Dozier sandstone member (of Peacock formation).

Permian: Texas Panhandle (Collingsworth County).

J. W. Beede, 1907 (Kans. Univ. Sci. Bull., vol. 4, No. 3, pp. 142+). [Discusses fossils collected from Whitehorse ss. of Okla. and from Quartermaster fm., and says:] The fossils collected from Quartermaster div. of the Perm. are from the ss. rolled down on W. side of "Dozier Mtns", E. of Mr. Caperton's place (then Dozier post office), 15 mi. S. or SW. of Shamrock, in Panhandle of Tex. [Fossils discussed. Mentioned "the gastropods of the *Dozier beds*" on p. 143, and farther along on same page mentions one species "from the Whitehorse and *Dozier sss.*" Under the fossil descriptions the different species are not assigned to any fm. but are said to have been collected at *Dozier, Tex.* All there is about the *Dozier ss.*]

N. H. Darton, 1932 (U. S. G. S. geol. map of Tex.). *Peacock fm.*—Red ss.; includes *Dozier* ("*Memphis*") *ss. memb.* [which he mapped separately].

See under †*Memphis ss.*

R. Roth, 1932 (Jour. Geol., vol. 40, No. 8, p. 703), believes Memphis ss. is a continuation of Dozier Hills, which are channel deposits, and that it marks base of his Custer fm., which he assigned to Lower Triassic.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 180). Eskota gyp., Dozier ss., and Claytonville dol. are members of Whitehorse-Cloud Chief interval (Perm.).

Draco moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Draco, St. Louis Co. Included in Nickerson morainic system.

Dracut diorite.

Late Carboniferous or post-Carboniferous: Northeastern Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 221–223 and map). *Dracut diorite.*—A dioritic rock, with associated tonalitic and noritic phases, which seems to be closely related to Ayer granite. Named for occurrence at Dracut, N. of Lowell. Believed to be slightly older than Ayer granite.

Dracut norite.

Pre-late Carboniferous (?): Northeastern Massachusetts.

E. E. Fairbanks, 1927 (Boston Soc. Nat. Hist., vol. 38, pp. 397–407). *Dracut norite.*—A stock-like mass of norite approx. 27 sq. mi. in area. Intrudes Merrimack qtzite. Occurs at Dracut.

†Dragoon quartzite.

Cambrian (Middle): Southeastern Arizona (Dragoon Mountains).

E. T. Dumble, 1902 (Am. Inst. Min. Engrs. Trans., vol. 31, pp. 696–715). *Dragoon qtzite.*—Consists of 400 ft. of sss. and qtzite. Underlain by ls. in Dragoon Mtns and overlain by ls. containing Middle Dev. fossils. In Mule Mtns it underlies Dev. ls. and overlies a bed of porphyritic andesite which rests on schists.

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, p. 28). It is probable the so-called Dragoon qtzites of Dragoon and Mule Mtns are stratigraphically the same, but Dumble not only omitted to establish this correlation, but has rather obscured it by several statements revealing misconceptions of geol. structure not altogether surprising considering the rapid character of his reconnaissance. If, for example, the two Dragoon qtzites are properly correlated by Dumble, the reported occurrence of 40 ft. of ls. underlying the qtzite in Dragoon Mtns seems, in light of work in Mule Mtns, to require confirmation, since in latter range the so-called Dragoon qtzite rests with a basal cgl. upon pre-Camb. schists. As base of these schists is nowhere exposed, and as the only granitic rocks in Bisbee quad. are post-Carbf., Dumble's statement that the schists have a thickness of only 300 ft. and rest upon granite is misleading. It was at first intended to use in this rept the term *Dragoon qtzite* for the basal sed. fm. of Bisbee quad., but for reasons just indicated this name has been reluctantly abandoned and that of *Bolsa qtzite* adopted in its stead.

Dragoonan series.

A term introduced by C. [R.] Keyes for lower part of Camb. rocks of N. Mex. and Ariz. Named for Dragoon Mtns, SE. Ariz. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 6.)

Draney limestone. (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 83). *Draney ls.*—Fairly massive ls., compact, gray; weathering dirty white. Thickness 200± ft. Underlies Tygee ss. and overlies Bechler cgl.; all in Gannett group. Named for exposure on top of ridge about 1¼ mi. E. of Draney Ranch, on Tygee Creek, sec. 10, T. 8 S., R. 46 E., Boise meridian. May be Jurassic.

Draytonville conglomerate member (of Kings Mountain quartzite).

Cambrian (probably Lower): Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1931 (U. S. G. S. Gaffney-Kings Mtn folio, No. 222). *Draytonville cgl. memb.*—Hard, heavy-bedded cgl., now almost a gneiss. Thickness 25 to 50 ft. Basal memb. of Kings Mtn qtzite.

Named for exposures on Draytonville Mtn, Cherokee Co., S. C.

Dresbach sandstone.

Upper Cambrian: Southern Minnesota and Wisconsin, Iowa, and northwestern Illinois.

N. H. Winchell, 1886 (Minn. Geol. Nat. Hist. Surv. 14th Ann. Rept., pp. 334–337). *Dresbach ss.*—Gray micaceous ss. which is known recently as Dresbach ss., from a town in Winona Co., Minn., where it is wrought for construction. Lies 200 ft. below St. Lawrence ls. in vicinity of Winona. Is separated from underlying Hinckley ss. by shales [which he both included in and excluded from his St. Croix fm., and which he later named ***Dresbach sh.***].

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2), assigned thicknesses of 50–82 ft. to ***Dresbach sandrock*** of Minn. and applied ***Dresbach sh.*** to underlying sh. He described Dresbach sandrock of Dakota Co., Minn., as consisting of 60 ft. of sandrock resting on 20 ft. of gray sandy sh., and as overlying Dresbach sh., the upper 70 ft. of which consists of blue sh.

C. D. Walcott, 1914 (Smithsonian Misc. Coll., vol. 57, p. 354, from *Ulrich's mss., 1914*). *Dresbach ss.* overlies Eau Claire ss., newly defined fm., named for exposures at mouth of Eau Claire River, Wis.

F. W. Sardeson, 1916 (U. S. G. S. Minneapolis-St. Paul folio, No. 201). *Dresbach ss.* is named for Dresbach, Minn., where about 200 ft. of friable white and light greenish gray ss. belonging to the fm. is exposed beneath Franconia ss. There is still difference of opinion as to lower limit of Dresbach ss., but it includes lowermost of coarse white, cross-bedded water-bearing sss. that are penetrated by deep borings in these quads.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93), defined *Dresbach ss.* of SW. Wis. as underlying Ironton memb. of Franconia ss. and overlying Eau Claire sh. [The Ironton memb. had previously been included in Dresbach ss.]

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, p. 709). At Dresbach, Minn., the *Dresbach fm.* underlies Franconia ss. (which is 102 ft. thick) and consists of (descending): (1) Ss., often massive but usually sandy shales, 28 ft.; (2) ss., massive, white to yellowish or brown, with *Dicelomus politus* and *Hyolithes primordialis* common, 19′8″; (3) ss., massive, gray to white or yellowish to buff and brown, well shown in old quarry, very fossiliferous, and 18 ft. thick; (4) ss. and sandy sh. alternating, white to bluish, often cross-bedded, well exposed along river bank or in lower quarry, very fossiliferous, 22′6″.

E. Peterson, 1929 (Buffalo Soc. Nat. Sci. Bull., vol. 14, No. 2). *Dresbach fm.*—Underlies Franconia ss. with suggested conformity, but there is some evidence of erosion interval btw. deposition of the two fms., and initial Franconia deposits are believed to be reworked Dresbach sands. Thickness of Dresbach btw. 300 and 400 ft., but apparently considerably thinner at some localities. At surface the lower limit of characteristic fauna usually indicates base of Dresbach. In wells the base of blue shales present in lower part of fm. is usually taken as lower limit. The Dresbach fm. of Minn. has been traced horizontally and vertically into the "Eau Claire" of Wis. The lack of either a lithological or paleontological break btw. them makes it evident they are really one strat. unit. Although the outcrops in and around Dresbach are at slightly higher horizon than those in vicinity of Eau Claire, the similarity of faunas is too great to warrant separation into two fms. Confusion would be avoided by dropping name "Eau Claire" for a part of the fm., and retaining only the original name—*Dresbach*. The unfossiliferous coarse ss. of subaerial origin referred by Ulrich and others to the Dresbach may or may not be a shore phase and contemp. with part of true Dresbach of type area. However, no such deposit is present in type section. Renaming this subaerial deposit would help to avoid confusion.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 38–45, 79). *Dresbach fm.* should include all beds btw. base of Mount Simon ss. and base of Ironton memb. of Franconia ss. The upper ss. of this series of beds (which is 60–86 ft. thick and has heretofore been called *Dresbach ss.*) is here renamed

Galesville memb.; the underlying 200 ft. of ss. and sh. are here called *Eau Claire memb.;* and the basal 200 ft. of ss. are called *Mount Simon memb.* The Dresbach as thus defined includes all beds exposed at Dresbach, Minn. and it rests (uncon.?) upon the red clastic series. It would include some beds that have been called *Hinckley ss.,* but we believe these beds are the Mount Simon ss. and that type Hinckley is older and belongs to red clastic series. If future work should prove that type Hinckley is same as Mount Simon ss., then latter name should be abandoned, as Hinckley has priority.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 10). The differentiation of Mount Simon ss., "Eau Claire trilobite beds," and the upper ss. is extremely questionable, as all are composed of ss. and no uncon. has been detected in the sequence. Writers incline to view that there is only a single fm., which they propose to designate *Dresbach.* The Dresbach would include topmost ss., Eau Claire silty ss., and Mount Simon ss.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 83, 88–90). *Dresbach fm.* is here used to include (descending) Galesville memb., Eau Claire memb., and Mount Simon memb. The Galesville and Eau Claire members are exposed at Dresbach, Minn. The Franconia of Minn. Survey in places includes upper part of Galesville memb. and their Dresbach includes in places the lower part of Galesville memb. and all of Eau Claire memb. and in other places is Galesville and Eau Claire. [Trowbridge's sections describe all of Franconia and Dresbach at Dresbach as composed of ss., with shaly beds at base of his Eau Claire memb. Fig. 1 of this 1935 rept. shows Dresbach of Ill. Geol. Survey= Galesville memb. of Trowbridge et al, and that Dresbach ss. of Wis. and Minn. Surveys includes his Galesville, Eau Claire, and Mount Simon members. The section of Dresbach fm. at Galesville (by Twenhofel and G. O. Raasch) divides it into 86 ft. of Galesville memb. and 81 ft. of Eau Claire memb. On pp. 127 and 139 are statements: In central Wis. the Dresbach ss. fm. is recognizable but Mount Simon, Eau Claire, and Galesville members can be distinguished only with difficulty if at all. It is this fact which led Trowbridge and Atwater, Twenhofel and Raasch to demote the fm. names proposed by Ulrich to memb. names. (See also paper by Twenhofel, Raasch, and Thwaites, Geol. Soc. Am. Bull., vol. 46, No. 11, 1935, pp. 1687–1744.)]

The U. S. Geol. Survey at present applies *Dresbach ss.* to the beds overlying Eau Claire ss. and underlying Ironton memb. of Franconia ss., or to unit which Trowbridge and Atwater have renamed *Galesville memb.*

†Dresbach shale.

Upper Cambrian: Southeastern Minnesota.

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2, p. 364). *Dresbach sh.*—The lowest sh. seen at Dresbach [Winona Co.] consists of 40 ft. of gray sh. underlain by 35 ft. of green sh. Is overlain by Dresbach ss. and underlain by so-called Potsdam ss. [On p. 82 he defines *Dresbach sh.* of deep well at Hastings, Dakota Co., as consisting of (descending): Blue sh., 70 ft.; sand and pulverized green sand, 20 ft.; and dolomitic grit with gray sh. and sand, 5 ft.]

See also under *Dresbach ss.* and *Franconia ss.;* also see *Eau Claire ss.* In some early repts these shales have been called "St. Croix shales." In later repts they have been named *Eau Claire.*

Dresden sandstone. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1884 (Ohio Geol. Surv. vol. 5, pp. 919, 920, 991). *Dresden ss.,* 10 to 20 ft. thick, lies in interval btw. Upper Mercer clay and Lower Mercer ore, in Hocking Valley field. [On p. 991 is said to be same as Upper Conoquenessing ss., and is shown as occurring below Lower Mercer coal, as overlain by Union Furnace block ore, and underlain by Quakertown coal.]

Probably named for Dresden, Muskingum Co.

Dresden amphibolite.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). A para-amphibolite, 120 ft. thick, included in Grenville series. Lies stratigraphically beneath Hague gneiss. Type loc. is Dresden Twp, Washington Co.

Drews Lake granite.

Carboniferous (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 106–107, 148–149). *Drews Lake granite.*—The granite from Ludlow quarry is considered typical for Drews Lake dist. It exhibits two well-marked varieties in different parts of quarry. The highest rock exposed by the workmen has a grayish-white color in hand specimen and its surface is sprinkled inconspicuously with dark specks; quartz is prominent. In bottom of quarry the granite becomes a dark-gray variety, in which the dark components assume a leading rôle and the quartz is scarcely noticeable under microscope. Transitions btw. these two types occur. Both types are of medium grained uniform texture, with no porphyritic tendency. Named for exposures near Drews Lake, W. of Houlton, Aroostook Co.

On the 1933 geol. map of Maine, by A. Keith, the granite W. of Drews Lake is mapped as Carbf. and the sediments surrounding the lake as Sil.

Dripping Spring quartzite. (Of Apache group.)

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Dripping Spring qtzite,* 400 ft. thick, is top fm. of Apache group in Globe copper dist. It overlies Barnes cgl. and is overlain by Globe ls. Lower 175 ft. consists of massive beds of streaked buff and pink qtzite. Upper part consists of thinner-bedded, hard, laminated, rusty-colored qtzite.

F. L. Ransome, 1911 (Min. and Sci. Press, June 3, 1911). Recent work in Ray quad., which adjoins Globe quad. on S., has revealed that Dripping Spring qtzite as mapped in Globe quad. included two qtzites, each 400 ft. thick, separated by 250 ft. of cherty ls. The name *Dripping Spring* is restricted to the lower qtzite.

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380–385). The ls. overlying Dripping Spring qtzite restricted is here named *Mescal ls.* and the overlying qtzite is here named *Troy qtzite.* The upper part of Dripping Spring qtzite consists of thin flaggy and rusty beds; the middle part consists of fairly massive beds of even-grained buff or pinkish qtzite with flaggy variegated red, brown, and gray beds and some layers of red and grayish sh.; lower third is hard, fine-grained arkosic qtzite striped by alternating bands of dull-red, dark-gray, and nearly black colors. Thickness 400 to 500 ft.

Named for Dripping Spring Mtns, Globe quad., which owe their boldly scarped outlines to these qtzites and the underlying Barnes cgl.

Driscoll sand.

A subsurface sand in Fayette ss. of Driscoll pool, Duval Co., Tex.

Driving Creek formation.

Pre-Cambrian: Ontario.

R. G. McConnell, 1926 (Ont. Dept. Mines 35th Ann. Rept., pt. 2, p. 13).

Droop sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 415). *Droop ss.*—Usually white, very coarse and soft, weathering into white sand. Thickness 5 to 60 ft. Overlies Talcott sh. and underlies Possumtrot sh.; all members of Bluefield group [fm.]. Type loc. on Droop Mtn, Pocahontas Co., W. Va., in vicinity of Spice, Mt. Zion Church, and West Droop School. Also observed in Mercer, Monroe, and Summers Counties, W. Va., and in Giles Co., Va.

Drum limestone. (In Kansas City group, Kansas.)

Drum limestone member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, pp. 37, 63, 66). *Drum ls.*—Fossiliferous ls., 25 to 40 ft. thick, overlying Cherryvale sh. and underlying Chanute sh.

In Kans. the Kansas City is treated as a group and the Drum as a fm. The terms "Drum group" and "Drum ls." have been used in central northern Okla. to include (descending) Dewey ls., Nellie Bly fm., and Hogshooter ls., but that usage has been discontinued.

The Drum ls. of Hinds and Greene (1915 rept.) at Kansas City is now stated (N. D. Newell, Kans. Geol. Surv. Bull. 21, 1935, p. 40, and R. C. Moore, Kans. Geol. Surv. Bull. 22, 1936, pp. 104–105) to be an older ls., the type Westerville. The Cherryvale sh. has been subdivided by R. C. Moore into 5 members, the upper one of which he has named *Quivira sh.* The true Drum is now divided by Kans. Geol. Surv. (R. C. Moore, Bull. 22, 1936) into 2 members, Corbin City ls. (oolitic) above and Cement City ls. (nonoolitic) below. According to Newell (1935) these 2 members are uncon. R. C. Moore states (Bull. 22, 1936) Drum is 2 to 60 ft. thick, has been traced from Okla. line to Kansas City, and has been identified at various places in northern Mo., Iowa, and Nebr. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Named for Drum Creek, Montgomery Co., SE. Kans.

†Drum group.

Pennsylvanian: Northeastern Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, pp. 73–74), used *Drum group* to include (descending) Dewey ls., Nellie Bly fm., and Hogshooter ls., and this usage of name was followed in several subsequent repts but has now been discontinued.

Drumlummon porphyry.

Tertiary (late?): Western central Montana (Marysville district).

J. Barrell, 1907 (U. S. G. S. P. P. 57). *Drumlummon porphyry dikes.*—Younger than Marysville batholith. [Mapped on Drumlummon Hill, just S. of Marysville. The Marysville batholith is probably late Cret. or Tert. and may be as young as Mio. (Personal communication from J. T. Pardee.)]

Drummond.

Name applied by C. [R.] Keyes (Pan.-Am. Geol., vol. 46, 1926) to "50 ft. of clays of Mid Tertic age" in Mont. Derivation of name unknown.

Drury shale and sandstone member. (In Pottsville formation.)

Pennsylvanian: Southwestern Illinois (Carbondale quadrangle).

J. E. Lamar, 1925 (Ill. Geol. Surv. Bull. 48, pp. 23, 91–95, and map). The *Drury sh. and ss. memb.* of Pottsville fm. is composed of sh., sandy sh., shaly ss. and ss., with the first three predominant. Most characteristic lithologic features are the sandy shales and shaly sss. which weather to a plastic buff, cream or gray, sandy clay. Another typical feature is the fine and very fine-grained, thin, irregularly bedded ss. which weathers white with pink blotches commonly mottling the white surface. Clay inclusions, irregular current ripple marks, and mica are common. The ss. is locally qtzitic and not micaceous. Carbonaceous material occurs throughout as thin partings or laminae. Small lenses of coal are present in W. part of quad. Thickness 50 to 120 ft. Lies conformably on Lick Creek ss. memb. of Pottsville and is conformably overlain by Makanda ss. memb. Named for excellent exposures along Drury Creek, particularly in bluffs S. of Makanda, Jackson Co.

†Dry bone limestone.

A descriptive term originally applied to Neva ls. by Swallow, according to C. N. Gould (1925).

Dry shale. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 22, 236, etc.). *Dry sh.* is here applied to shaly beds, 5 to 20 ft. or more thick, that separate Dover ls. from next higher (Grandhaven) ls. Is bluish gray and for most part clayey, but sandy beds appear in places. In southern Kans. a thin coal occurs near top. Is well-defined unit from Shawnee Co., Kans., S. to Okla. line, but to N. it coalesces with Friedrich sh. above and Grandhaven ls., which disappears, although it is possible the Grandhaven beds grade laterally into the sh. Where the sh. btw. Dover and

Jim Creek lss. cannot be subdivided it may be called *Dry-Friedrich sh.* Type loc., Dry Creek, SW. of Emporia, in sec. 5, T. 20 S., R. 11 E.

This name appears to have first appeared in print, without definition, in a table by R. C. Moore published opp. p. 14 of Univ. Kans. Bull. 20, May 1, 1935.

Dry Creek shale.

Upper Cambrian: Central southern and western central Montana.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Dry Creek shales.*—Shales or shaly calc. sss. which rest on the glauconitic or pebbly layers that cap the mottled lss. of Gallatin fm. in Threeforks region and are overlain by the pebbly lss. forming top memb. of the Gallatin. Outcrops obscure in most places. Best exposure seen is on Dry Creek [NE. corner of Threeforks quad.], where thickness is 30± ft. Here they consist of brownish-yellow, red, and pink sss., saccharoidal, breaking into thin laminae, with streaks and seams of calcite. No fossils.

A. C. Peale, 1896 (U. S. G. S. Threeforks folio, No. 24). *Dry Creek shales*, consisting of 30 ft. of brownish, yellow, red, and pink saccharoidal shales and thin-bedded sss., are overlain by 145 ft. of light-colored laminated lss., pebbly throughout and glauconitic. [Type loc. of Dry Creek sh. is in NE. corner of Threeforks quad.]

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). The brick-red shales and lss. constituting Dry Creek sh. are overlain by 100 ft. of Yogo ls.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). The reddish argill. or aren. beds of Dry Creek sh., usually about 40 ft. thick, are underlain by Pilgrim ls. and overlain by Yogo ls., which consists of gray or mottled ls. with a few layers of interbedded sh.

A. Knopf, 1913 (U. S. G. S. Bull. 527, p. 91). *Dry Creek sh.* of Helena dist. [NW. of Threeforks quad.] consists of 40 ft. of light-colored brownish-yellow, red, and pink shales and calc. ss. Correlated on basis of lithology and strat. position with Dry Creek sh. of Threeforks and Little Belt regions.

C. F. Deiss, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 8, pp. 1258–1342), proposed that Yogo ls. be discarded, and defined Dry Creek sh. as uncon. overlain by Dev. rocks. In upper part of his Dry Creek sh. he included a great thickness of lss.

Dry Creek formation.

Eocene: Northern California (Chico quadrangle).

V. T. Allen, 1929 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 18, No. 14, pp. 367–369, 400, 401, 403). Above the Chico ss. (Cret.) of Oroville Table Mtn are gray shales with flakes of biotite and casts of Eocene fossils, overlain conformably by 80± ft. of light-colored biotite sands containing fragments of wood and leaves. Apparently it was from these shales that Turner collected casts of *Corbicula*. Best section is exposed in steep-walled valley formed by a tributary of Dry Creek. Thickness of fm. probably over 180 ft. The name *Dry Creek fm.* is suggested for these beds, from the tributary along which the section is displayed. Conformably underlies Ione fm., which here consists of white quartz-anauxite sands and clays, cross-bedded.

Dry Creek sandstone member.

Mississippian: Southern Indiana (Washington, Lawrence, and Jackson Counties).

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 238, 243, 246). *Dry Creek ss. memb. of Edwardsville fm.*—Persistent bed of heavy ss., not far above middle of Edwardsville fm., of sufficient areal extent to be considered a memb. Lies higher in Edwardsville fm. than Brownstown Hills ss. memb., its strat. position being 60 to 65 ft. below top of Edwardsville. It is very fine-grained ss., with some clay, and of gray to buff color. In ravine tributary to Dry Creek and along road S. center sec. 35, T. 6 N., R. 2 E., 3 mi. S. of Norman Station, it is 4 ft. thick; on road W. of Norman Station it is 2 ft. thick; and S. of Norman Station it is 5 ft. thick. It rests on a blue to blue-gray, very sandy sh. or shelly ss. Named for prominence along Dry Creek, both E. and W. of Jackson-Lawrence Co. line.

Dry Fork erosion cycle.

Name applied by G. R. Mansfield (Jour. Geol., vol. 32, 1924, p. 485) to a Pleist. erosion cycle in SE. Idaho.

Dublin blue shale.

Middle Devonian: Central Ohio.

E. Claypole, 1903 (Am. Geol., vol. 32, pp. 19, 20, 34, 35). ***Dublin blue sh.***—Thin shaly beds, known as blue lss., 32 ft. thick; fossiliferous in lower part but barren and flinty above. Overlain by thin-bedded blue Corniferous-Hamilton ls., and underlain by "Bone bed" [p. 34 states lies few ft. above "Bone bed"], which rests on Columbus ls. Of Marcellus age.

Forms lower part of Delaware ls.

Named for exposures along Scioto River near Dublin, Franklin Co.

Dubois greenstone.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). *Dubois greenstone.*—A series of metamorphosed basic rocks of class called metabasites by Hackman, comprising hornblende gneisses, amphibole schists, chlorite schists, and basic associates that extend in a zone of varying width (1 to 4 mi.) and persistency from Lake Fork of Gunnison River on W. to beyond South Beaver Creek on E. Belong to the metamorphic complex of Gunnison River region, and believed to be younger than most of the schist and gneiss complex. Named for exposures at old mining camp of Dubois, on Goose Creek. Assigned to Archean.

On 1935 geol. map of Colo. this fm. was included in Gunnison River series, which comprises the oldest exposed pre-Camb. rocks of Colo. The terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey, the Dubois greenstone is now classified as pre-Camb.

Du Bois limestone. (In Topeka limestone.)

Pennsylvanian: Southwestern Iowa, southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). *DuBois ls.*—One or two dark blue, dense, fossiliferous lss. forming large flat blocks. Thickness 2⅝ ft. near DuBois, Nebr., 1′ 1″ in Kans. and Mo. Underlies Holt sh. and overlies Turner Creek sh., all included in Topeka ls. Named for exposures on Turner Creek SE. of DuBois, Nebr. [This is definition followed by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr. and by R. C. Moore in his 1936 classification (Kans. Geol. Surv. Bull. 22).]

Dubose sands and clays.

Eocene (Jackson): Southeastern Texas (Gonzales County).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1314, etc.). *Dubose sands and clays.*—Series of sands and fossiliferous green and brown shales with beds of volcanic ash and glass, also beds of ashy, peaty shales; numerous septaria and cone-in-cone concretions. One exceptionally definite boulder horizon is exposed on Sandies Creek, Dubose Ranch, Gonzales Co., where Catahoula "rice sands" lie uncon. on Dubose zone. Lies stratigraphically above Stone's Switch sand and below Callihan sand, all zones in Whitsett fm. as here defined.

Dubuque formation. (In Richmond group.)

Upper Ordovician: Eastern Iowa, southeastern Minnesota, southwestern Wisconsin, and northwestern Illinois.

F. W. Sardeson, 1907 (Geol. Soc. Am. Bull., vol. 18, p. 193). *Dubuque fm.*—Irregular ls. and interlaminated carbonaceous shales, 10 ft. thick at Dubuque, Iowa, extending from "cap rock" below up to blue shales of Maquoketa memb. of Maquoketa series. Coincides with *Triplicia* bed or zone, and forms basal part of Maquoketa series or stage. Overlain by Maquoketa fm. proper and underlain by Galena fm.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). *Dubuque ls.* is basal Richmond, and older than Fernvale ls. [which to S. underlies Maquoketa sh.], and older than Maquoketa sh. In western Wis. and Iowa the Maquoketa overlies Dubuque fm. where Dubuque is present.

See also under *Volga shales.*

A. C. Trowbridge et al, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, p. 61, etc.), classify *Dubuque* as of Trenton age and include it in *Galena group,* as they call the Galena dol. On p. 27 Trowbridge stated Prosser, Stewartville, and Dubuque can be seen in Jo Daviess Co., Ill.

Named for Dubuque, Dubuque Co., Iowa.

Dubuque terrane.

Quaternary: Iowa.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 186). *Dubuque terrane.*—Clays (geest), 10 ft. thick, of pre-Nebraska age. Assigned to early Quaternary or Epicene series.

Probably named for Dubuque, or Dubuque Co.

Duchesne limestone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 300). *Duchesne ls.*—Shales and ls., 250 ft. thick, underlying Bishop ss. in Utah. Stratigraphically uncon. above McElmo fm., and compose basal fm. of Flaming Gorge series. May correspond exactly to the similar Sundance shales and limestone. [Derivation of name not stated.]

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 40), the Bishop ss. and Duchesne ls. of Keyes are=Entrada ss. and Carmel fm., both Upper Jurassic.

Duchesne formation.

Oligocene: Northeastern Utah (Uinta Basin).

O. A. Peterson, 1932 (Carnegie Mus. Annals, vol. 21, No. 2, pp. 61–63, pl. 1). *Duchesne fm.*—Name proposed (upon suggestion of Prof. W. B. Scott of Princeton Univ.) for the Olig. fm. named "Upper Uinta" by Peterson and Kay in Carnegie Mus. Annals, vol. 20, pp. 293–305, 1931. This Olig. horizon, 1,372 ft. thick, rests upon Upper Eocene (Horizon C) in Uinta Basin. Duchesne River (in Duchesne Co., Utah, which has its source on S. side of Uinta Mtns.) traverses these Basal Olig. beds before its confluence with Green River ½ mi. below Ouray, Utah. The area covered by these Olig. strata has an E.-W. extent of approx. 80 mi., and seldom exceeds 12 to 15 mi. in N.-S. direction along N. margin of Uinta Basin. From Randlette westward, along Duchesne River, these Olig. beds are quite clearly defined from underlying Uinta series (Horizon C). They consist of ss. that weather out to reddish brown cliffs, which rest on softer clays (Horizon C of the Uinta) along the streams and on the divides btw. Lake Fork, "Dry Gulch," Duchesne, and the course of other rivers. Although a tentative division was made by Peterson and Kay btw. the Duchesne beds and the underlying Uinta strata eastward from Randlette, the distinction btw. the two horizons is not so clear toward eastern end of basin. The relationship of fauna of Duchesne Olig. is less sharply defined from that of underlying Uinta (Horizon C) than is usually the case in superimposed horizons of other localities, but there is an advance corresponding to that of the lithological change noted. The Olig. may thus be regarded as a horizon perfectly transitional btw. Upper Eocene and Chadron horizon of White River series of S. Dak. But the Sage Creek beds of Mont. may have to be placed btw. the Chadron of Nebr. and Dakota and the Duchesne series of Utah. The Duchesne Olig. is overlain by talus of Bishop cgl.

J. L. Kay, 1934 (Carnegie Mus. Annals, vol. 23, pp. 357–359, map, pls. 45, 46). *Duchesne fm.* (proposed by Prof. W. B. Scott) is preoccupied by Keyes' name for a Jurassic ls. A new name is required for Olig. fm., but writer feels that there will be less confusion if "Duchesne" is retained in the new term. At Prof. Scott's suggestion the name *Duchesne River* is now proposed for the lower Olig. fm. of Uinta Basin, Utah. To S. the fm. lies conformably on horizon C of Uinta Eocene, but with greater or less uncon. on older rocks along its N. border. The fm. is divided into 3 named horizons. [For definitions of these 3 horizons see under *Randlett horizon.*]

Duchesne River formation.

Oligocene: Northeastern Utah.

See 1934 entry under *Duchesne fm.*

Duck Creek formation. (In Washita group.)

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 516). *Duck Creek chalk.*—Crumbling white chalky ls. alternating with chalky marls. Thickness 100 ft.

Overlies Kiamitia clays and underlies Fort Worth ls. in Ind. Ter. and Grayson and Cooke Counties, Tex. Included in Washita div. [group].

W. M. Winton and W. S. Adkins, 1919 (Univ. Tex. Bull. 1931), divided Duck Creek fm. into several members and proposed a restriction of name to basal 2 members. (See 1919 entry under *Fort Worth ls.*)

The U. S. Geol. Survey still uses the original definition of this name. Named for Duck Creek, Grayson Co., Tex.

†Duck Creek limestone.

†Duck Creek limy marl.

†Duck Creek marl.

†Duck Creek marly lime.

See 1919 entry under ***Fort Worth ls.***

†Dudley limestone.

†Dudley series.

Ordovician: New York.

T. A. Conrad, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 58–59), applied *Dudley ls.* and *Dudley series* to ls. exposed at Dudley, which he originally believed, from contained fossils, to be younger than Trenton ls., but which he finally concluded corresponds in age to Trenton ls.

Dudley shale. (In Pleasanton group, Kansas.)

Dudley shale member (of Pleasanton formation, Missouri).

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 34). *Dudley sh.*—Shales, about 150 ft. thick, with some ss. and some thin ls., overlying Parsons ls. and underlying Hertha ls. Top fm. of Pleasanton group in Kans. In SE. Kans. is basal memb. of Coffeyville fm. Underlies Hertha ls. and overlies Parsons fm.

This definition of Dudley sh. was followed for many years.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 89). Name *Dudley sh.* is now to be applied to sh. above the Lenapah and beneath the pre-Missouri uncon., which lies at base of Bourbon group [new name]. [This is a *restriction* of Dudley sh. (to lower part). This definition was also adopted by Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 19). Because Des Moines-Missouri bdy lies within and probably near base of Dudley sh. it is advisable to abandon *Dudley*.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 67). *Dudley sh.* discarded. It presumably includes upper Des Moines beds and lower Missouri sh. and ss. equiv. to Bourbon fm. New name *Memorial sh.* introduced for *Dudley sh.* as defined by Moore in 1932.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. The U. S. Geol. Survey has not had occasion to consider these modified definitions.

Named for Dudley, Neosho Co., Kans.

Duffin limestone.

Upper Devonian: East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, p. 97). *Duffin layer.*—Brownish-yellow ls., 2 inches to 12 ft. thick, having brecciated appearance, forming top of Dev. ls. in Lincoln, Montgomery, Boyle, Clark, and Garrard Counties. Overlain by Ohio sh. and underlain by other Dev. lss. [See also under *Boyle ls.*]

T. E. Savage, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 112), stated that Duffin fossils suggest Tully (Upper Dev.) time.

T. E. Savage, 1930 (Ky. Geol. Surv., ser. 6, vol. 33, pp. 1–21), transferred *Duffin layer* to New Albany sh., because at many places in Ky. lenses and layers of a ls. or dol. similar in composition to Duffin layer and in some places carrying similar fossils, are interbedded in the black sh. for 9 to 15 ft. above its base, and stated that this indicates that basal sandy dolomitic Duffin layer belongs with New Albany period of deposition rather than with underlying Middle Dev. ls.

T. E. Savage, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 218, 234). *Duffin ls.*—In Estill and Powell Counties has furnished a Tully fauna, which was also present in lenses or bands of similar ls. that was interbedded with the black New Albany sh. for several ft. above base of that fm. Fauna listed.

Named for Duffin cut, ¾ mi. N. of Junction City, Boyle Co.

Dugout clay and gravel.

Miocene and Pliocene: Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 68). *Dugout clays and gravels.*—Nonfossiliferous clays, silts, sands, and gravels, chiefly the finer sediments; 100 to 300 ft. thick. Overlie Cret., and are undoubtedly older than alluvial deposits in valley of Rio Grande, for they lie at higher level and have suffered extensive erosion. Possibly an old alluvial drift laid down by Tornillo Creek. Assigned to Mio. and Plio.

Named for Dugout wells, near Boquillas, Brewster Co.

Dugout beds.

Pennsylvanian: Trans-Pecos Texas (Marathon Basin).

C. L. Baker and W. F. Bowman, 1917 (Univ. Tex. Bull. 1753, pp. 104–105) listed fossils from beds exposed in vicinity of Dugout Creek at Payne's ranch westward to "Permo-Carbf." contact, which they assigned to Tesnus fm.

C. L. Baker, 1928 (A. A. P. G. Bull., vol. 12, No. 11, pp. 1111–1116). [Discusses recent papers by C. Schuchert (Am. Jour. Sci., 5th, vol. 14, 1927, pp. 382-401) and P. B. and R. E. King (Univ. Tex. Bull. 2801, 1928, pp. 109–145), and criticises their reference to Gaptank fm. of the beds on Dugout Creek, W. of town of Marathon. He states:] Lithologically the strata show more differences than resemblances. The strata W. of Marathon have no coarse heavy cgls.; the sss. are different and have none of the typical gray ls. beds of development comparable with those of true Gaptank. Greatest resemblance is in the shales. Impossible to trace Gaptank westward into the strata W. of Marathon, because of wide belt of alluvium. Writer originally included these strata with the Tesnus because they lithologically resemble that fm. more than any other known fm. He still thinks it possible they may be a marine equiv. of the Tesnus, although of late years he has been more inclined to consider them, at least in part, the equiv. of the Strawn of central Tex., which they faunally and lithologically resemble more than any other known fm. in central Tex. Although originally reluctant to publish a new name for these strata, the writer, who was first to describe them and to collect and identify fossils from them, will now propose for them the name *Dugout beds,* his original field name. Writer still believes them to be older than Gaptank fm.

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 31, 45–46, 49). Evidence obtained by writer and R. E. King indicate "Dugout beds" of Baker are of Gaptank age. Their Gaptank age was originally announced by Schuchert and was restated by R. E. King and writer. The beds contain diagnostic fossils, which indicate Canyon and Cisco age. Differences in lithology btw. type Gaptank and Dugout beds is explained by fact that movements inaugurating the Caballos disturbance had already begun in mid-Gaptank time, but these early phases were essentially local, so that the cgls. at Gap Tank are of Canyon age, while those W. of Marathon are somewhat younger and of different composition. The beds on Dugout Creek consist of 1,500± ft. of alternating sss. and shales, with one, perhaps two, thin beds of gray ls., and, at base, 20 ft. of gray, granular, in places conglomeratic, ls. passing upward into fine-grained sandy ls. This basal ls. contains *Chaetetes milleporaceus and Fusulinella meeki,* and is considered to = the Chaetetes ls. that forms base of Gaptank fm. in type area. It is underlain by shales and sss. assigned to Haymond fm. Along Dugout Creek overthrust the Gaptank has been overriden by great mass of pre-Carbf. rocks.

Dukes boulder bed.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard) and southeastern Rhode Island (Block Island).

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52, p. 163). *Dukes boulder bed.*—A remarkable bed of glacial bowlders entirely free from clay; locally cemented by limonite. Overlies Aquinnah cgl. and underlies Weyquosque fm. Occurs only at Gay Head Cliffs fold on Marthas

Vineyard and at Clay Head on Block Island. Named for occurrence in Dukes Co., Mass. Correlated with early part of Nebraskan stage of Mississippi Valley region.

Duley Lake group.

Pre-Cambrian: Labrador.

J. E. Gill, C. Tolman, and H. M. Bannerman, 1935 (Geol. Soc. Am. Proc. 1934, p. 78).

Duluth gabbro.

Pre-Cambrian (middle or late Keweenawan): Northeastern Minnesota, northern Wisconsin, and northern Peninsula of Michigan.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pp. 124, 134), described very coarse gabbros (Bad River gabbros and *Duluth gabbros*) at base of Keweenaw series.

J. M. Clements, 1903 (U. S. G. S. Mon. 45, p. 397). *Duluth gabbro.*—Varies from coarse-grained granular rock to relatively fine-grained rock; also in places possesses a gneissic structure. Named for development near Duluth, Minn. Is intrusive.

This intrusive fm. is now regarded as middle or late Keweenawan.

†Duluth group.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 134, 142–146, 185; also U. S. G. S. Mon. 5, p. 266). *Duluth group.*—Succession of heavy but sharply defined beds of very fine-grained but aphanitic rocks belonging to ashbed type of diabases and diabase porphyrites, and including a few beds of rather coarse-grained orthoclase free gabbro and a little interleaved detrital material. Thickness 5,000 ft. Included in Keweenaw series. Exposed along N. side of St. Louis River up to Duluth.

A. H. Elftman, 1898 (Am. Geol., vol. 21, pp. 90–109, 175–188, and map). Part of Duluth group of Irving is included in my Temperance River memb. and part of it in my Beaver Bay diabase.

Duluth granite.

Trade name of stone quarried from Duluth gabbro.

Duluth.

Name applied to a glacial lake, of Pleist. age, and to its beaches, in Lake Superior region.

Dumble beds.

See *Swallow belt, terrane, or fms.*

Dun limestone.

Pennsylvanian: Southeastern Kansas.

Robt. Hay, 1887 (Kans. Acad. Sci. Trans., vol. 10, p. 7). *Dun ls.*—Ls., 100 ft. thick, in middle of interval btw. Fall River ss. and Neodesha lss. in Wilson Co. Probably same as thick Humboldt ls. of Neosho Valley, having same irregularity of structure and apparently same fossils. Separated from underlying Neodesha ss. by 80 to 100 ft. of sh. and from overlying Fall River ss. by 145 ft. of sh., ls., and ss.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 124). †Dun ls. of Hay included Plattsburg, Vilas, and Stanton fms.

Named for Dun, Wilson Co.

Dunbar series.

Carboniferous (Mississippian ?): Nova Scotia.

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 324).

Duncan chert.

Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66, p. 2). From Duncan Peak there extends across North Fork of American River to vicinity of Monumental Hill a belt of gray or brown chert, referred to as *Duncan chert*. It is well exposed in canyons near Canada Hill and in canyon of the main river. This chert is in all probability not of clastic origin, and may have been derived from ls. by a process of silicification. Included in Blue Canyon fm.

Duncan formation.

Cretaceous (?): British Columbia.

C. H. Clapp, 1917 (Canada Geol. Surv. Mem. 96, p. 232). [Assigned to Cret.; but M. F. Bancroft (Canada Geol. Surv. Summ. Rept. 1917, pt. B, p. 36, 1918) assigned *Duncan series* to pre-Camb., B. C.]

Duncan sandstone.

Permian: Central southern and southwestern Oklahoma.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, pp. 324–341, map). *Duncan ss.*—Consists of two, sometimes three, ledges of white or buff ss., sometimes dolomitic, separated by shales. Thickness 75 to 250 ft. To N. of its max. development it is difficult to trace. Underlies Chickasha fm. and overlies Lower Enid. The Chickasha and Duncan correspond to Upper Enid. The presence or absence of a continuous uncon. at its top and base is still a mooted question. Forms an escarpment just N. of Duncan, Stephens Co. [This is approved definition of Duncan ss. On p. 313 of publication above cited R. W. Sawyer applied name *Duncan ss.* to Gould's Duncan ss. and overlying Chickasha fm.]

This ss. (which has been mapped on 1926 Okla. geol. map from its type loc., in Stephens Co., Okla., to Red River) is now known to be same as San Angelo ss. of Tex., which has many years priority and has been traced from its type loc. (in Tom Green Co., Tex.) to Duncan, Okla. (See 1926 entry under *San Angelo ss.*) On 1932 prel. ed. of Tex. geol. map San Angelo ss. has been mapped up to Red River.

Duncan greenstone.

Pre-Cambrian: Ontario.

R. G. McConnell, 1926 (Ont. Dept. Mines 35th Ann. Rept., pt. 2, p. 14).

Dundas formation.

Upper Ordovician: Toronto, Ontario.

W. A. Parks, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 103–104). The strata at Toronto, Ont., lying btw. black Utica shales and red Queenston shales are divisible into an upper series comparable with the Richmond and a lower series showing affinities with both the Pulaski of N. Y. and the Maysville of Ohio. It is proposed to name the lower div. *Dundas fm.* and to divide it into four members (descending): *Credit, Humber, Davenport, Rosedale.* [Fauna discussed.] While many species range throughout the fm., each memb. has its distinctive fauna; these faunas are as difficult to correlate as that of the fm. as a whole. The prevailing gray shales contain many hard, discontinuous layers. These are of two kinds—fossiliferous lss. and calc. sss., generally without fossils. Both types vary from apparent beds to small lenses. [Type loc. not stated.]

In 1927 (Geol. Soc. Am. Bull., vol. 38, p. 229) Parks stated that *Dundas fm.* rests conformably on Utica sh. See also Hume (Canada Geol. Surv., Econ. Geol. ser., No. 9, p. 23, 1932) and Coleman (Ont. Dept. Mines 41st Ann. Rept., pt. 7, p. 3, 1932).

Dundee limestone.

Middle Devonian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *Dundee ls.,* 40 to 160 ft. thick, underlies Traverse group and overlies Monroe beds.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2). *Dundee ls.*—Buff, yellow, or almost white calc. rocks, 40 to 160 ft. thick. Underlies Traverse group and overlies Monroe beds.

Named for exposures at Dundee, Mich.

Dunderberg shale.

Upper Cambrian: Eastern Nevada (Eureka district and neighboring regions).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1812, p. 184, footnote). As result of conference with Mr. Arnold Hague, *Dunderberg sh.* is introduced to replace *Hamburg sh.*, the name *Hamburg* being retained for Hamburg ls.

Named for exposures opposite Dunderberg mine, Eureka dist.

Dunderbergian series.

A name applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 78), to Dunderberg sh. of Nev.

Dunham dolomite.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Dunkard sand.

Name applied by drillers to Mahoning ss. memb. of Conemaugh fm. (Penn.), from fact that oil was struck in it near mouth of Dunkard Creek, Greene Co., Pa., in 1860. The name has also been applied to Saltsburg and Mahoning sss. combined. In Ohio the term has been applied to the 300-foot sand, in Allegheny fm.

Dunkard group.

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 22). *Dunkard Creek series.*—On Dunkard Creek, Greene Co., Pa., includes 165 ft. concealed beds above Gilmore ss. and extends down to base of Cassville shales.

The above accords with present definition of Dunkard group, which is now divided into Greene fm. (above), extending down to top of Upper Washington ls. memb., and Washington fm. (below). The U. S. Geol. Survey classifies the Dunkard deposits as a *group* within Perm. *series*, but present Pa. Geol. Survey classifies them as a *series* within Perm. *system.*

†Dunkard Creek series.

See under *Dunkard group.*

Dunkirk shale (also **Dunkirk sandstone**).

Upper Devonian: Western New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 24 and chart). In Lake Erie section the succession [of Naples beds] is varied by introduction of a third band of black sh. lying above horizon of Westhill flags. This is *Dunkirk sh.* Overlain by Portland sh. and underlain by Angola sh., both of which contain an abundance of Naples fossils.

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1019–1029). *Dunkirk black sh.*, 53 to 55 ft. thick, underlies Portland gray shales and overlies Silver Creek shales. Included in Portage group of Lake Erie region.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 78 and chart). The *Dunkirk sh.* is a black sh. occurring next above horizon of Grimes ss., apparently within basal Gardeau. [In chart, however, he placed it beneath Gardeau flags.] The fm. is regarded as local, not having been observed outside of Chautauqua Co. The term "Portland" has been used locally to designate certain shales and flags lying above Dunkirk sh. As this term is preoccupied, and it is now evident that these beds are embraced in upper Gardeau, the name *Gardeau* will be used to include these beds. [In chart the underlying fm. is called *Hanover.*] Included in Portage. Named for Dunkirk, Chautauqua Co.

F. Houghton, 1914 (Buffalo Soc. Nat. Sci. Bull., vol. 11, pp. 4, 7–65). *Dunkirk sh.* excluded from Gardeau sh. of Erie Co., because it is distinct enough to warrant our excluding it. Overlain by Gardeau sh., and underlain by Hanover sh. Included in Portage.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157). *Dunkirk black sh.* included in Chemung. Overlain by Gowanda ("Portland") beds and discon. underlain by Hanover shales.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Dunkirk sh.* of Chautauqua Co. is overlain by Gowanda sh. and underlain by Hanover sh.; in Cattaraugus Co. *it is overlain by Gowanda beds and underlain by Wiscoy sh.* (in part=Hanover sh.). Assigned to Chemung. Equiv. to upper part of Cayuta sh. memb. of Chemung.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 149–157). *Dunkirk black sh.* extends from Van Buren Point, on Lake Erie, to Holland, where it is over 160 ft.

thick. Two characteristic (and unlike) septarian zones divide it into three members, throughout this distance, the upper of which was included by Luther in his overlying Portland shales. Included in Chemung group. Underlies Gowanda beds and overlies Hanover sh.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included in the Chemung the Dunkirk sh. and all overlying beds up to top of Chadakoin of Chadwick.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60), included Fall Creek cgl. in Dunkirk sh., making it basal bed of the Dunkirk. He repeated this classification in Geol. Soc. Am. Bull., vol. 46, No. 2, p. 323, 1935. In both repts he transferred to his Canadaway group (q. v.) Dunkirk sh. and all overlying beds up to top of Northeast sh.

In Steuben and adjacent counties of south-central N. Y. the Dunkirk is a ss. and is called *Dunkirk ss.* To W. the fm. is sh. and is called *Dunkirk sh.*

†Dunlap limestone.

Pennsylvanian: Eastern Kansas.

M. Z. Kirk, 1896 (Kans. Univ. Geol. Surv. vol. 1, pp. 81, 82). *Dunlap ls.*—Two lss., separated by 9 to 20 ft. of sh. Separated from overlying Cottonwood Falls ls. by 25 to 30 ft. of sh. and from underlying Americus ls. by 50 ft. of sh.

For many years considered same as later but better-established name *Neva ls.* According to Condra (Nebr. Geol. Surv. Paper No. 1, 1933, p. 8) it includes more than true Neva ls. and is = his Grenola fm. See under *Grenola fm.* and *Neva ls.*

Named for Dunlap, Morris Co.

Dunlap formation.

Lower Jurassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Muller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Dunlap fm.*—Upper part dominantly red to brown ss. containing much volcanic material and probably considerable water-laid tuffs, cgls. (principally of ls. pebbles), and varying amounts of volcanic rocks. In Gabbs Valley Range and central part of Excelsior Mtns volcanic rocks predominate in upper part, but elsewhere they are subordinate; they consist of andesite, quartz latite, and rhyolite flows and breccias, and are generally much altered. Lower part of fm. is commonly conglomeratic, and a characteristic feature is presence of enormous fan cones of unsorted angular material from fm. against which it rests. In places these fangls. contain lenses of ls., sh., ss., and bedded cgl. Thickness of fm. 4,000+ ft. Assigned to Lower Jurassic and correlated with middle (?) Liassic of Europe. Few fossils. In New York Canyon it locally rests on Sunrise fm. (Lower Jurassic) with apparent conformity. Elsewhere it rests uncon. on all older fms. of the section. Named for Dunlap Canyon, in Pilot Mtns, in upper part of which a considerable thickness of lower part of fm. is exposed.

Dunlap sand.

A subsurface sand, of Ord. age, in Healdton field, Carter Co., southern Okla., which lies at 2,716 to 2,749 ft. depth.

Dunlap Quarry sandstone member.

Miocene ? (lower ?): Southeastern Texas.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and p. 64). *Dunlap Quarry ss. memb. of Catahoula fm.*—A massive conglomeratic noncalc. ss. present in lower part of Catahoula fm. from eastern Grimes Co. to northern Fayette Co. Consists of coarse rice sand, tuffaceous sand, grit, and cgl., and locally grades into tuff. Where present is 4 to 25 ft. thick. Well exposed in large quarry on G. W. Dunlap 165-acre tract, in SE. part of E. M. Millican survey, 2.4 mi. S. 17° E. of Millican, Brazos Co.

†Dunnellon formation.

Pliocene (lower): Northern Florida.

E. H. Sellards, 1910 (Fla. Geol. Surv. 3d Ann. Rept., pp. 22–35). *Dunnellon fm.*—The hard-rock phosphate in Suwannee, Columbia, Alachua, Marion, Citrus, and

Hernando Counties. A mixture of materials, largely residual, from several fms., from Lower Olig. to at least as late as Plio. Consists of sands, clays, boulders, cgls., pebble cgl., and phosphate rock. Although exceedingly variable from place to place, the prevailing phase of fm. is feebly coherent, more or less phosphatic light-gray sands. Overlies Ocala ls. and underlies the red clayey sand stratum known to miners as hardpan.

In a later (1914) publication Sellards abandoned the name "Dunnellon fm.," stating that it was not separable from Alachua clay, which has priority. O. P. Hay, however, in 1919 (Am. Jour. Sci., 4th, vol. 47, pp. 373–375) expressed opinion that Sellards' Dunnellon fm. is probably early (Nebraskan) Pleist. According to studies of Julia Gardner these deposits are same as Alachua fm.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). The deposits to which Sellards applied name "Dunnellon fm." are included in Alachua fm., and "Dunnellon fm." has been abandoned.

Named for exposures at Dunnellon, Marion Co.

Du Noir member (of Gallatin formation).

Upper Cambrian: Western Wyoming (Wind River Mountains and Owl Creek-Bridger uplift).

B. M. Miller, 1936 (Jour. Geol., vol. 44, No. 2, pp. 124–127, etc.). *Du Noir memb.*—Lower div. of Gallatin fm. in Wind River Mtns and Owl Creek-Bridger uplift. Largely massive, dark-gray ls. mottled with yellowish brown and filled with brown oolites. In most sections contains 1 to 3 ft. of calc. ss. in middle and usually has 10± ft. of laminated ls. and glauconitic pebbly ls. at base. Av. thickness of memb. 40± ft. Fossils. Type section is along Warm Springs Creek, 2 mi. W. of Du Noir, in NW. part of Wind River Mtns. The name is not applied in Gros Ventre and Teton Mtns, where the lower lss. of the Gallatin are twice as thick as in Wind River Mtns. Overlies Gros Ventre fm. (or, in some areas, Depass fm.) and underlies middle shaly memb. of the Gallatin.

Dunvegan sandstone.

Upper Cretaceous: British Columbia and Alberta.

G. M. Dawson, 1881 (Am. Jour. Sci., 3d, vol. 21, p. 392; and Canada Geol. Surv. Rept. 1879–80, p. 15B). *Dunvegan ss.*—Sandstones in Peace River region, Canada, correlated in part with Belly River beds.

Du Page limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

See under *Aux Sable ls.*

Duplin marl. (In Chesapeake group.)

Miocene (upper): Coastal Plain of North Carolina (south of Hatteras axis), South Carolina, and along Savannah River in eastern Georgia.

W. H. Dall, 1898 (U. S. G. S., 18th Ann. Rept., pt. 2, p. 388; published in 1897 as 55th Cong., 2d sess., H. Doc. 5). *Duplin beds.*—Late Mio. marls of Duplin Co., N. C. See Conrad, Am. Jour. Sci., 1st, vol. XII [XLI], 1841, pp. 335–343. [Conrad described the deposits but did not name them.]

W. B. Clark, B. L. Miller, and L. W. Stephenson, 1912 (N. C. Geol. and Econ. Surv., vol. 3, pp. 236–249, 297–298, 321–323). *Duplin fm.*—Unconsolidated sands, aren. clays, and shell marls representing latest phase of Mio. deposition in region S. of Neuse River. North of Neuse River the Yorktown fm. occupies same strat. position that Duplin strata do in S. part of State, and the two fms. may be in part contemp. The differences in faunas, however, render it inadvisable to include them in a single fm. In regions where Duplin strata occur no other deposits of Mio. age have thus far been recognized, and wherever the basal beds are exposed the fm. is seen to rest uncon. on Cret. or Eo. strata. In vicinity of Mount Olive the Duplin fm. rests on the Trent [now proved to be of lower Mio. age], with which it is markedly uncon. In vicinity of Wilmington the Duplin beds are found immediately overlying Castle Hayne deposits. The fm. is uncon. overlain by either Waccamaw marl (Plio.) or by Pleist. deposits. Thickness about 100 ft. In vicinity of Lake Waccamaw an unusual phase of Duplin fm. is developed. Outcropping along bluff on N. shore of lake there is a compact fossiliferous ls. that contains many casts of Molluscan shells, *Crepidula* being especially abundant. This ls. is overlain by a loose characteristic shell marl and underlain by yellowish-brown sand that at base contains some phosphatic pebbles and water-worn casts of Cret. fossils. This phase of Duplin fm. is not known to occur elsewhere in State, though it is well developed along Peedee River in S. C., particularly in vicinity of Bostick.

Is now considered to be=upper part of Yorktown fm. to N. and upper part of Choctawhatchee fm. of Fla. (See C. W. Cooke, U. S. G. S. Bull. 867, 1936.)

Named for exposures in Duplin Co., N. C., especially in Natural Well SW. of Magnolia.

Duquesne limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania.

M. E. Johnson, 1929 (Pa. Topog. and Geol. Surv. Atlas, No. 27, Pittsburgh quad., pp. 31, 60, 61). *Duquesne ls.*—A thin fresh-water ls. which occasionally appears in Pittsburgh quad. directly below or within a few ft. of base of Duquesne coal, which lies just below Birmingham sh. Is most conspicuous in that part of bluff on N. side of Allegheny River which faces Herrs Island, attaining its greatest thickness (3½ ft.) directly opp. N. end of the island. Overlain by Duquesne clay. [Apparently named for Duquesne, which is in Pittsburgh quad. The name *Duquesne clay* applies to clay beneath Duquesne coal.]

Durango till.

Durango glacial stage.

Pleistocene (pre-Wisconsin): Southwestern Colorado.

W. W. Atwood and K. F. Mather (U. S. G. S. P. P. 95, p. 14, map, 1915; Geol. Soc. Am. Bull., vol. 35, p. 122, 1924; U. S. G. S. P. P. 166, 1932). *Durango till.*—Glacial drift of a Pleist. stage intermediate btw. Wisconsin stage and Cerro stage (the oldest Pleist. stage in SW. Colo.). The time covered by the drift to be called *Durango glacial stage.* Replaces "Bighorn glacial epoch," "Bighorn moraine," etc., the name *Bighorn* being preoccupied. Named for Durango. It seems to us likely that this stage is=Iowan stage.

Durango sand member (of Taylor marl).

Upper Cretaceous (Gulf series): Eastern Texas.

C. H. Dane and L. W. Stephenson, 1928 (A. A. P. G. Bull., vol. 12, p. 51). The base of the sandy beds within the Taylor is a definite, sharply marked contact most of way from southern Hill Co. to Bell Co. line, about 350 to 400 ft. above top of Austin chalk, and above this contact in McLennan and Falls Counties is a sand of recognizable continuity and importance, to which name *Durango sand memb.* is here given. In Falls Co. it is thick, and 1.2 mi. S. of Chilton it consists of: (1) 50 ft. of soft calc. sand with some layers of hard gray calc. ss. and a few interbedded layers of irregular gray clay, underlain by (2) 15 ft. of thin-bedded calc. ss. and softer chalky cross-bedded sand, with, in lower half, thin beds carrying many comminuted shells, larger shell fragments, subangular grit-sized grains of black phosphatic material, and a few fish teeth. From this locality the sand extends SW. through Durango to small settlement of Theo, on Bell-Falls Co. line. In vicinity of Durango it is apparently transitional into underlying marl of the Taylor.

Durazno formation.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], p. 16).

Durbin formation.

Silurian (Niagaran): Southwestern Ohio.

A. F. Foerste, 1917 (Ohio Jour. Sci., vol. 17, p. 187). *Durbin fm.*—Proposed to include all of dolomitic series—the Euphemia, Springfield, and Cedarville dolomites (ascending order). Named for exposures at Mills quarries, about 1 mi. E. of Durbin and about 1 mi. SW. of Springfield, O. The Springfield and Cedarville dolomites are also well exposed immediately NE. of Durbin. [In 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 136–137) Foerste stated these rocks are of Lockport age.]

Durham quartz diorite.

Devonian (?): Southeastern New Hampshire.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, p. 149). *Durham quartz diorite.*—An elongated body that extends from 2 mi. SW. of Exeter, N. H., to within ¼ mi. of Rollingsford, N. H. Chiefly quartz diorite, but grades from a basic margin to an acidic interior. Includes a marginal phase of gabbro, quartz norite, quartz gabbro, quartz augite gabbro; an intermediate phase of quartz augite diorite, quartz diorite, and quartz biotite diorite; and a central phase of granodiorite, granite, and granite aplite. Age, Dev. (?). Named for exposures through Durham Twp, Strafford Co.

Duskin formation.

Same as Duskin Creek fm.

Duskin Creek formation.

Pennsylvanian (early Pottsville): Southeastern Tennessee (Rhea County).

W. A. Nelson, 1925 (Tenn. Dept. Ed., Div. Geol. Bull. 33A). [*Duskin fm.* used on pp. 30, 39, 63, and in headings on pp. 68, 170, 179; *Duskin Creek fm.* used in heading on p. 53, where occurs first description.] Top fm. of Lee group in Southern Tenn. coal field. Its top memb. is a heavy, thick-bedded, very hard, yellowish ss., of which 75 ft. remains uneroded. Underlying part of fm. consists of about 150 ft. of sh. with a few thin-bedded, shaly, impure sss. The sh. is usually of dark-blue or gray color and contains several coal beds. In some places the sh. is iron-stained and weathers into long, thin slivers. The fm. varies in thickness from 0 to 250 ft. It rests on Rockcastle ss. Well exposed on Duskin Creek, a tributary of Piney Creek, which flows by Spring City, Rhea Co.

Dutch Creek sandstone.

Middle Devonian: Southwestern Illinois and eastern Missouri.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 170–171, 175). *Dutch Creek ss.*—Iron-stained, reddish-brown or yellow, rather coarse grains of quartz sand cemented with iron oxide, in layers 10 to 24 inches thick. Thickness 0 to 30 ft. Grades into overlying Grand Tower ls. and rests conformably on Clear Creek chert. Outcrops at many places in Union and Alexander Counties, Ill., and is present in eastern Mo. Named for exposures along Dutch Creek, in SW. part of Union Co., Ill. Fossils (Onondaga) listed.

Dutch Creek formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 7).

Dutcher sand series.

A series of subsurface sands, of early Penn. (Cherokee) age, in Okla., lying lower than Bartlesville and Burgess sands. Thickness 0 to 200± ft.

Dutchman's conglomerate lens.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, 84). *Dutchman's cgl. lens.*—Local cgl. lens in Amity sh. of Warren area. Named for good exposures along Dutchman's Run, a tributary of Allegany River in Mead Twp, Warren Co.

Dwale shale.

Pennsylvanian: Eastern Kentucky (Floyd County).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, p. 296). The lowest and oldest fossiliferous bed that was studied in the region [stretching from Tug Fork of Big Sandy River at Borderland on E. to North Fork of Kentucky River at Copeland on W.] may be designated *Dwale shales*, from town of Dwale, where they are associated with Prestonburg No. 1 coal, which underlies them. They lie 45 ft. below Elkins Fork shales. The fossils came from the dump of the abandoned mine of Dwale Coal Co. ½ mi. NW. of Dwale, Floyd Co. They belong to *Lingula carbonaria*, and hence the shales may represent brackish-water deposits rather than marine.

Dyberry glomerate.

Upper Devonian or Mississippian: Northeastern Pennsylvania (Susquehanna, Wayne, Bradford, and Wyoming Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 578, etc.). White reported "ls." in lower part of Cherry Ridge group [and named it *Cherry Ridge ls.*]. The term is misleading, but the stratum (or strata) is important. His description is excellent: "An agglomeration of chips of sl. and sh.—fishbone fragments—pieces of fossilized wood—and often a large quantity of sand—all cemented together with lime." It is light-gray when fresh; weathers black, pitted. Probably more than 1 such bed exists in Cherry Ridge fm. Be it one or several, the name *Dyberry glomerate* is proposed for it, from Dyberry Creek and Twp, in Wayne Co., where residual boulders are scattered over surface. Probably in place in headwaters of creek near Cold Spring, Lebanon Twp. Writer has found this glomerate a valuable guide to Cherry Ridge fm. in Susquehanna, Wayne, and parts of Bradford and Wyoming Counties. It is lost in eastern Bradford Co. and may give out in northern Monroe Co. [Table on p. 571 shows Dyberry glomerate *above* Pimple Hill cgl., but text (p. 578) says Dyberry glomerate is in *lower* part of Cherry Ridge and Pimple Hill cgl. in *upper* part.]

Dyer dolomite member (of Chaffee formation).

Upper Devonian: Central Colorado.

C. H. Behre, Jr., 1932 (Colo. Sci. Soc. Proc., vol. 13, No. 3, p. 60). *Dyer dol. memb. of Chaffee fm.*—Light-gray sugary dolomitic ls. with a few dark-gray and ocher-colored beds, forming top memb. of Chaffee fm. Thickness 75 ft. in Weston Pass dist. Formerly included in Leadville ls. (Miss.), but fossils collected by Kirk establish its Dev. age. Typical exposure on West Dyer and Dyer Mtns, 5 mi. E. of Leadville. Overlies Parting qtzite memb. of Chaffee fm. and underlies Leadville ls. (now restricted to the upper "Blue ls." of earlier repts), the Dyer being the lower "Blue ls." of earlier repts.

Dyer Bay dolomite lentille (of Cabot Head shale member).

Silurian (early): Ontario (Bruce Peninsula and Manitoulin Island).

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser., p. 35 and chart opp. p. 18). *Dyer Bay dol. lentille.*—Impure argill., rather thin-bedded dol., 15 to 17 ft. thick, occurring in lower part of upper half of Cabot Head sh. memb. on Bruce Peninsula and Manitoulin Island. Is older than St. Edmund dol. lentille. Type loc. Dyer Bay.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 334–336). Fauna of Dyer Bay dol. is of Niagaran age, and not of Medinan age, as stated by Williams.

†Dyestone group.

Silurian: Tennessee.

J. M. Safford, 1856 (Geol. Reconn. Tenn., 1st Rept., pp. 149, 156–158, and map). *Dyestone and Gray Limestone Group.*—Includes several distinct fms. In East Tenn. consists of sss., calc. shales, including dyestone, and some ls.; in middle and western Tenn. is almost entirely ls. Includes (ascending): Clinch Mtn ss., variegated shales containing iron ore, and Sneedville ls. Underlies Carbf. black sl. and overlies Nashville memb. of Central ls. and sh. group.

In 1869 (Geol. Tenn., pp. 151, 161, 302) Safford defined "Dyestone group" as consisting of 200 ft. of variegated shales, with some thin, smooth sss., overlying White Oak Mtn ss., and underlying Meniscus ls., or beds later included, with his White Oak Mtn ss., in Rockwood fm.

Named for presence of dyestone iron ore among the strata of one of its divisions.

Dykstra sand.

A subsurface sand in Carbondale fm. (Penn.) of SW. Ill., in Centralia region, SW. corner of Marion Co. (See Ill. Geol. Surv. Bull. 54, table 5, etc.)

Eager formation.

Cambrian: British Columbia.

S. J. Schofield, 1922 (Canada Geol. Surv. Bull. 35, p. 12).

Eagle limestone. (In Kanawha formation.)

Pennsylvanian: Southwestern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 140, 141, 177). *Eagle ls.*—Dark, fossiliferous impure ls. 1 foot thick, with "cone-in-cone" structure. Lies 75 ft. below Eagle coal and 55 ft. below Little Eagle coal. Rests on dark marine shales. Named for fine exposures in cuts of Chesapeake & Ohio R. R. at mining village of Eagle, Fayette Co. May be same as Ferriferous ls. Included in Lower Coal Measures or Allegheny River series.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A), abandoned the correlation with Ferriferous ls. and transferred *Eagle ls.* and Eagle coal to "Lower Kanawha group," placing them strat. higher than Upper Nuttall ss.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties). *Eagle ls.*, 0 to 2 ft. thick, is overlain by 15 to 20 ft. of Eagle sl. (black, laminated, and containing marine fossils), and is underlain by 10 to 25 ft. of Eagle sl. (black, marine sl. with iron ore nodules), which rests on Little Cedar coal. Occurs in basal part of Kanawha fm. [This definition is followed in all subsequent repts of W. Va. Geol. Survey.]

Eagle bed.

Upper Cretaceous (Gulf series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 733, 735). *Eagle bed.*—Local name for Lower Cross Timber or Dakota sand. Calc. sand above and yellow clay sh. below. Thickness 360 ft. Underlies Eagle Ford or Benton sh. (Carpenter bed) and overlies Washita div.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745), mapped these beds as Trinity.

Apparently named for Eagle Spring, at NE. end of Eagle Mtn, El Paso Co.

Eagle sandstone. (Of Montana group.)

Upper Cretaceous: Montana and central northern Wyoming (Elk Basin region).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Eagle fm.*—Basal part consists of thinly laminated sss. stained light brown by lignitic material and containing concretions and nodular masses of iron ore. These grade up into very pure white ss., which forms bluffs 75 to 100 ft. high along Missouri River. Upper part of fm. consists of less shaly sss. with interbedded lignite seams. Total thickness 200 to 235 ft. Overlain by 2,000 ft. of marine beds, designated as *Montana fm.* Underlain by Colorado fm., 1,850 ft. thick. Named for type exposures along Missouri River about mouth of Eagle Creek [40 mi. below Fort Benton].

J. B. Hatcher and T. W. Stanton, 1903 (Sci., n. s., vol. 18, pp. 211–212), divided the beds of Montana age overlying Eagle ss. into (ascending): Claggett fm., 400 ft.; Judith River beds, 500 to 600 ft.; Bearpaw sh., 600 ft. The Eagle ss. as now defined underlies Claggett fm. and in most areas overlies Colorado sh. In Yellowstone-Bighorn Counties region of Mont., however, the 350± ft. of transition beds underlying Virgelle ss. (basal memb. of Eagle ss.) and containing a fauna of predominantly Montana types, are now known as *Telegraph Creek fm.* In that area the Telegraph Creek fm. separates the Eagle from deposits of unquestioned Colorado age, containing Niobrara fossils and designated as *Niobrara sh.*

Eagle granodiorite.

Jurassic: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 108).

Eagle sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 202). *Eagle ss.*—Massive, fine grained, bluish gray, micaceous. Thickness 20 to 50 ft. Named for association with underlying Eagle coal, from which it is separated by a few inches to 15 ft. of beds. Underlies Eagle A coal.

Eagle shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 211–215). *Eagle ls. and sh.*—The upper sh. or sl. is 15 to 20 ft. thick, black, laminated, and carries marine fossils. It underlies Grapevine ss. and overlies Eagle ls. The lower sh. or sl. is 10 to 25 ft. thick, black, carries iron ore nodules and marine fossils, and underlies Eagle ls. and overlies Little Cedar coal. These represent the Eagle. [In Boone Co. Rept. of W. Va. Geol. Surv. the beds above and below Eagle ls. are called *Eagle sl.* In Lewis and Gilmer Counties Rept., 1916, the *Eagle sh.* is described as 108 ft. thick and as occupying interval btw. Decota ss. and Lower War Eagle coal. But in all later repts *Eagle sh.* (or *sl.*) is applied to the beds above and below Eagle ls.]

Eagle sand.

Name locally applied to the subsurface second gas sand in Pierre sh. of Cedar Creek anticline, SE. Mont., which appears to lie at approx. horizon of Eagle ss.

Eagle diorite.

Cretaceous: British Columbia.

C. E. Cairnes, 1924 (Canada Geol. Surv. Mem. 139, p. 89).

Eagle Bridge quartzite.

Lower Cambrian: Eastern New York (Washington County).

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 277–278). *Eagle Bridge qtzite.*—Compact, gray, granular ss., in places dolomitic, that weathers dark and somewhat rusty. Thickness 10 to 30 ft. Underlies Deepkill sh. with apparent conformity. Conformably overlies black sh. of Schodack fm., and ½ mi. SE. of Post Corners it overlies thin beds of fossiliferous ls. of Schodack fm. Its strat. position below sl. that carries Beekmantown graptolites and above Lower Camb. ls. indicates that it is probably Lower Camb. Is well exposed in vicinity of village of Eagle Bridge, on Hoosic River, N. Y.

Eagle City beds.

Mississippian: Central northern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 52, 92–94). *Eagle City beds.*—Alternating beds of brownish dol. and gray ls.; some ls. beds oolitic. Thickness 76 ft. The lss. contain brachiopods of upper Kinderhook age. Is a fm. in Kinderhook group. Underlies Iowa Falls dol. and overlies Mayne[s] Creek fm. Named for exposures in banks of Iowa River at Eagle City, Hardin Co.

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, p. 404). *Eagle City memb. of Hampton fm.* is defined as embracing all strata btw. and including the banded brown ls. at base and the oolitic ls. at top. The central part of Eagle City memb. is made up of a massive soft yellow dol. Underlies Iowa Falls memb. and overlies Maynes Creek memb. Thickness 80 ft. Divided into 4 faunal zones.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 243, 245). Eagle City ls. and Iowa Falls dol. are with little question Burlington. They contain Burlington fossils, as identified by both Van Tuyl and Laudon, mingled, it is true, with forms of Kinderhook aspect.

Eagle Cliff porphyrite.

Jurassic (?): Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 142, 146–148). *Eagle Cliff porphyrite.*—The most widespread of all igneous rocks of San Juan Islands region. Consists of intrusive dikes of porphyrite, which forms all or most of many islands [listed] of San Juan group. At Eagle Cliff, on N. end of Cypress Island, these dikes cut Fidalgo fm. and Leech River group. Probably intruded intermittently during a great lapse of time in late Triassic or early Jurassic. Assigned to Jurassic (?).

Eagle Creek formation.

Tertiary (lower Miocene or Oligocene): Central northern Oregon (Multnomah County) and southwestern Washington.

I. A. Williams, 1916 (Oreg. Bur. Mines and Geol. Min. Res. Oreg., vol. 2, No. 3, pp. 95–96). *Eagle Creek cgl.* occurs a little W. of Carson [SW. Wash.], and, what is less common, a flow or lava-filled variety of it. Overlain by Carson lava as Carson Creek is approached.

R. W. Chaney, 1918 (Jour. Geol., vol. 26, No. 7, pp. 577–592). *Eagle Creek fm.*—Volcanic cgl., ash, and tuffs; cgl. most conspicuous near top. Exposed along Columbia River gorge from Warrendale to Viento, on Oreg. side, with corresponding distribution on N. side of river. Oldest fm. recognized in region. Is 500 ft. thick at Bonneville, Oreg., and 2,700 at Red Bluffs, Wash. Base not exposed. Tentatively upper Eocene. Uncon. underlies Columbia River lava.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, pp. 97–98). *Eagle Creek fm.*, Mio., is preoccupied by Eagle Creek fm. of Triassic, and is replaced by *Warrendale fm.* [They did not give reference to publication that constitutes priority of Triassic fm., and compiler has been unable to find it.]

R. W. Chaney, 1920 (Univ. Chicago, Contr. Walker Mus., vol. 2, No. 5). *Eagle Creek fm.*—Flora (listed and described) is considered Olig.

F. H. Knowlton, 1926 (U. S. G. S. P. P. 140, p. 19), assigned Eagle Creek flora to Mio. J. P. Buwalda and B. N. Moore (Carnegie Inst. Wash. Pub. 404, 1930) assigned Eagle Creek fm. to Olig. or lower Mio.

†Eagle Creek formation.

Upper Triassic: Northeastern Oregon (Wallowa Mountains region).

W. D. Smith and E. L. Packard, 1919 (Oreg. Univ. Bull., vol. 16, No. 7, pp. 88, 105, 108). *Eagle Creek series* (also *Eagle Creek fm.*) [synonymous terms].—Calc. shales, lss., aggls., basalts, andesites, and tuffs. Nearer the batholithic core of Wallowa Mtns they are altered to slates, schists, and marble. Farther W. basalts, andesites, and tuffs comprise dominant part of the series. Farther in Wallowa Mtns masses of greenstone occur that may belong to this series. Thickness 4,550 ft. Uncon. overlies Carbf. rocks. Is older than Silvies River beds (Lower Jurassic). Top eroded. Contains Upper Triassic fossils at Martin's Bridge; meager fauna.

Preoccupied. Replaced by *Martin Bridge fm.*

Eagle Ford shale (also clay).

Upper Cretaceous (Gulf series): Texas, western Louisiana, and southeastern Oklahoma.

R. T. Hill, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 298). *Eagle Ford shales.*—Argill. shales, varying from blue at top to yellow in middle and blue at base, with marked faunal zones. Overlies Timber Creek group [Woodbine sand] and underlies Dallas ls. [Austin chalk].

In most early repts the name *Eagle Ford clay* was used to include Bonham clay and Blossom sand of present nomenclature, but it is now restricted to the beds beneath Ector tongue of Austin chalk. According to L. W. Stephenson (A. A. P. G. Bull., vol. 13, Oct. 1929), the Eagle Ford is uncon. with overlying Austin chalk and with underlying Woodbine sand.

Named for exposures at Eagle Ford, Dallas Co., Tex.

Eagle Gulch latite.

Tertiary: Southwestern Colorado (Bonanza district, Saguache County).

H. B. Patton, 1916 (Colo. Geol. Surv. Bull. 9, pp. 21–63). *Eagle Gulch latite.*—Gray massive rock with fine-grained groundmass and usually recognizable phenocrysts of orthoclase, also smaller plagioclase phenocrysts. Forms country rock on both sides of Eagle Gulch.

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Eagle Gulch latite.*—Gray porphyritic quartz latite. Intrudes Bonanza and Hayden Peak latites.

Eagle Hill rhyolite.

Tertiary (Eocene?): Central northern Utah (Mercur district).

J. E. Spurr, 1895 (U. S. G. S. 16th Ann. Rept., p. 377). *Eagle Hill porphyry.*—Named for exposures in vicinity of Eagle Hill, just S. of Mercur.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, pp. 58–59 and map). The Eagle Hill "porphyry" of Spurr is intrusive rhyolite and is here called *Eagle Hill rhyolite.*

Eagle Mountain quartzite.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 56; map). *Eagle Mtn qtzite.*—Hard, massive, crystalline to vitreous qtzite that breaks with an angular to conchoidal fracture. In places it locally becomes schistose by finely divided white mica. Chiefly grayish white, which grades into grayish yellow and yellowish brown. Is sufficiently homogeneous to constitute a definite lithologic unit, but of character very difficult to distinguish from Addy and Colville qtzites. It may be an E.

extension of Addy qtzite. Thickness 1,200± ft. Lies in apparent conformity beneath Chewelah argillites. Named for occurrence on Eagle Mtn, 5± mi. NE. of Chewelah.

Eagle Pass formation.

Upper Cretaceous (Gulf series): Southwestern Texas.

C. A. White, 1891 (U. S. G. S. Bull. 82, pp. 116, 117, 124, 126, 127, 130, 138, 139). *Eagle Pass beds.*—Coal-bearing strata conformably underlying Laramie fm. in Rio Grande Valley and overlying "Ponderosa marls" [Taylor marl]. Correlated with Ripley fm. and Fox Hills. [An uncon. is now recognized at top of this fm., and the overlying beds are referred to the Midway (Eocene).]

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 224, 230). *Eagle Pass div.*—Great series of clays, sands, and greensands, with more or less impure ls. and coal beds, overlying Pinto ls. and underlying Webb Bluff Tert. in Rio Grande section. Divided into (descending): Escondido beds, 3,300 ft.; Coal series, 900 ft.; San Miguel beds, 800 ft.; and Upson clays, 700 ft. Is Upper Cret. [This is a much larger unit than Eagle Pass beds of C. A. White.]

T. W. Vaughan, 1900 (U. S. G. S. Bull. 164, p. 21), restricted definition of *Eagle Pass fm.* so as to exclude Upson clay at base, and that definition was used by J. A. Udden in 1907 (Augustana Lib. Pub. 6), the last recorded use of the name.

These Upper Cret. rocks of Eagle Pass region (which overlie Austin chalk) are now divided into (descending) Escondido, Olmos, San Miguel, and Upson fms., and the inclusive unit "Eagle Pass" is no longer used.

Named for Eagle Pass, Maverick Co.

Eagle River porphyry.

Eocene: Central Colorado (Tenmile district).

S. F. Emmons and W. Cross, 1886 (U. S. G. S. Mon. 12, pp. 80, 188, 193, 330, 591). A sheet of porphyry closely allied to Lincoln porphyry. Named for occurrence at headwaters of Eagle River, Tenmile region, Eagle Co.

Eagle River group.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 690). *Eagle River group.*—A group of basic lava flows, with frequent beds of sediment (10 or more sss. and cgls.). Marvine's group C. Thickness 1,417 to 2,300 ft. Underlies Great cgl. and overlies Ashbed group.

Named for exposures on Eagle River, Keweenaw Co.

Eagle Rock tuff.

Pliocene? (lower Pliocene?): Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Eagle Rock tuff.*—Well-defined sequence of rhyolite tuffs, 35± ft. thick, exposed at base of American Falls and at Eagle Rock, NE. of Massacre Rocks, Power Co. Older than Massacre volcanics and younger than Neeley lake beds.

†Eangua limestone.

Lower Ordovician (?) and Upper Cambrian: Central Missouri (Camden, Hickory, and Dallas Counties).

H. King, 1844 (Am. Jour. Sci., 1st, vol. 47, p. 129). *Eangua ls.*—Mag. ls., of light brown or ashy color, very compact or hard, but decomposing rapidly on exposure. Thickness not determined, but at Prairie du Chien, Wis., rises 100 ft. above river level, and in vicinity of Eangua River, Mo., it rises much higher. Basal part of immense Mag. ls. deposit. Overlain by siliceous ss. and underlain by upheaval deposit of very ancient character, probably gneissoid.

The 1926 geol. map of Mo. shows that the rocks along and near *Niangua* River, central Mo., consist of Jefferson City dol., Roubidoux, Gasconade, and Proctor.

J. Bridge, 1930 (personal communication), states that this ls. probably extended from base of Bonneterre dol. to top of Gasconade dol., but may have extended up only to base of Gunter ss.

†Earlham limestone. (In Kansas City formation.)

Pennsylvanian: Western Iowa and Missouri and eastern Kansas.

H. F. Bain, 1897 (Iowa Geol. Surv. vol. 7, pp. 511–517). The first heavy ls. above Fragmental ls. (No. 3 of exposure in sec. 22, Lincoln Twp [Madison Co., Iowa]), is=beds quarried at Earlham and hence may be called *Earlham ls.*

Same as Bethany Falls ls., the older name.

Earlsboro sand.

Subsurface sand, of Penn. age and 16 ft. thick, in Earlsboro field, Pottawatomie Co., central Okla., which is reported by T. E. Weirick to lie at horizon 100 ft. above base of Boggy sh. In Earlsboro pool (Seminole Co.) this sand lies at 3,500 ft. depth.

†Earlton limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv., vol. 3, pp. 51, 103). *Earlton ls.*—Name proposed by G. I. Adams, for ls. near summit of Thayer shales, which in local areas is relatively prominent, developing into prominent ledge to W. and NW. of Earlton [Neosho Co.]. Separated from overlying Iola ls. by shales. [Some later repts stated this ls. is Iola ls.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 127, 251). †*Earlton ls.* abandoned for Plattsburg ls.

Early Bird formation.

Carboniferous or pre-Carboniferous: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60).

Earnest sand.

A subsurface sand, of Penn. age, in Earnest field, Eastland Co., north-central Tex., lying at 1,900 ft. depth.

Easly Creek shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 229–237). *Easly Creek sh.*, in Garrison sh., consists of (descending): (1) Sh., in blue, gray, greenish-gray, and reddish bands, in part quite calc., 12 ft.; (2) gray ls., 2 to 4 ft.; (3) sh., with one ls. band 2 to 3 inches thick, 10 to 12 ft. Total thickness 26 ft. Overlies Eiss ls. and underlies Sabetha ls. Named for outcrops on Easly Creek, Richardson Co., Nebr.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., pp. 19, 21). Easly Creek sh. of Condra (1927) is here divided into (descending): *Easly Creek sh. restricted*, Middleburg ls., and Hooser sh. The Easly Creek sh. as now constituted is about 14 ft. thick in Nebr. and northern Kans. and about 11 ft. near Okla. line. At places there is a bed of gyp. in this memb., as in vicinity of Blue Rapids, Kans. Type loc. on Easly Creek, in Richardson Co., Nebr., in NE¼ sec. 35, T. 1 N., R. 13 E., which is 10 mi. S. and 1¼ mi. E. of Humboldt, Nebr. It underlies Crouse ls. (same as "Sabetha ls." and has 10 yrs. priority).

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Eastend formation.

Cretaceous: Alberta.

L. S. Russell, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 132).

†Eastern sandstone.

Upper Cambrian: Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 62). The *Eastern ss.* is uncon. with the trap series and dips gently to E.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 351–365). By term *Eastern ss.* is meant that ss. which fills valley btw. Keweenaw or Main Trap Range of Mich. and so-called South Range. The sss. are red and often highly argill. Same as fossiliferous Camb. or Potsdam ss. of Mississippi Valley, which forms base of Paleozoic.

Replaced by geographic name *Jacobsville ss.* For many years was believed to be same as Keweenawan †Western ss. (Bayfield group).

Eastern basalts.

Age (?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub. Bull. Dept. Geol. Sci., vol. 21, No. 8, pp. 214–376, map). *Eastern basalts.*—Pyroxene basalts. Extend along E. margin of Lassen Park, from slopes of Bonte Peak to vicinity of Butte Lake. Lie on Juniper lavas.

Eastern Head formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Eastern Head fm.*—Ferruginous ss. with oolitic hematite and some shales; fossiliferous. Overlain by unnamed grits and shales and underlain by Beach fm. Included in Bell Island series. [Derivation of name not stated.]

Eastford granite gneiss.

Late Carboniferous or post-Carboniferous: Northeastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 127, and map). *Eastford granite gneiss.*—In general a light- or dark-gray gneiss, fine-grained or in places even porphyritic. Extends through towns of Woodstock and Eastford. Perhaps best exposure is in SE. corner of Eastford. Intruded before the metamorphism that reconstructed the rocks of the entire State.

East Fork formation.

Pre-Cambrian: Central Idaho (Hailey region).

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10–17). *East Fork fm.*—Upper 750 ft. chiefly blue-gray lss. with beds of thinly banded gneiss in upper 400 ft. This is underlain by 0 to 350 ft. of massive vitreous qtzite, which can be traced from a locality N. of Devils Bedstead a little S. of E. for 7± mi. The lower 530 ft. consists largely of beds of nearly pure ls. alternating with beds that contain diopside, with subordinate beds of qtzite intercalated in places. Age probably Algonkian. These rocks form a belt on W. side of area of metamorphosed rocks as far S. as divide btw. Hyndman Creek and East Fork of Big Wood River. Best exposed on E. side of headwaters area of Hyndman Creek.

†East Gallatin group.

Pre-Cambrian: Central southern Montana (Threeforks quadrangle).

F. V. Hayden, 1885 (U. S. G. S. 6th Ann. Rept., p. 50). A complete section of Camb. rocks exposed near mouth of East Gallatin River was made by Dr. [A. C.] Peale, and two lithologically well-defined groups (separated by a qtzitic ss. [Flathead qtzite?]) were studied. To the lower one, which was carefully searched, without success, for organic remains, the name *East Gallatin group* has been provisionally applied. It consists of a series, 2,300+ ft. thick, of alternations of green and greenish-gray micaceous sss. and clay slates (almost argillites), with thin bands of laminated lss. The central part of Bridger or Gallatin Range, from Reese Creek to N. end, is composed almost entirely of East Gallatin group. Rests on gneissic rocks. [As thus defined this name appears to have been applied to the Belt series, which has been mapped at mouth of and for some distance along East Gallatin River, although the Camb. rocks are exposed to N. of the river. See U. S. G. S. Threeforks folio.]

F. V. Hayden, 1888 (U. S. G. S. 7th Ann. Rept., p. 86). The *East Gallatin group* (probably middle Camb.) forms the foothills on the W. and a considerable part of main portion of Bridger Range itself. [Both Belt series and Camb. have been mapped over large areas in Bridger Range. See Threeforks folio.]

A. C. Peale, 1893 (U. S. G. S. Bull. 110, p. 16). *Belt fm.*—The series of beds in vicinity of Three Forks which was in U. S. G. S. 6th Ann. Rept. provisionally called *East Gallatin group*, from well-exposed outcrops along N. side of East Gallatin River near its junction with the West Gallatin, where a detailed section of 2,300 ft. has been measured. In Bridger Range the section is carried lower than on the East Gallatin. In Big Belt Range the fm. is 10,000 to 12,000 ft. thick.

†East Greenwich granite group.

Late Carboniferous or post-Carboniferous and Devonian (?): Southern Rhode Island.

B. K. Emerson and J. K. Perry, 1907 (U. S. G. S. Bull. 311, pp. 58–65 and map). [The rocks mapped as *East Greenwich granite group* in Bull. 311 were mapped by B. K. Emerson, 1917 (U. S. G. S. Bull. 597), as Quincy granite, Sterling granite gneiss, and porphyry, and *East Greenwich granite group* was not used.]

East Haven granite.

Pre-Cambrian: Central Connecticut.

E. Hitchcock, 1823 (Am. Jour. Sci., 1st, vol. 6, pp. 3–86), applied ***East Haven granite*** to rocks in East Haven and Branford, Conn., which were mapped as ***Branford granite gneiss*** by H. E. Gregory and H. H. Robinson in 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7).

†East Iowan stage of glaciation (Pleistocene).

A name originally applied by T. C. Chamberlin (Great ice age, by James Geikie, 3d ed., 1894, pp. 724–775) to time covered by deposition of *second* drift of Laurentide ice sheet, but which he in 1895 (Jour. Geol., vol. 3, pp. 270–277) shortened to *Iowan*, at Upham's suggestion, and in 1896 (Jour. Geol., vol. 4, pp. 872–876) replaced by *Kansan*, the name by which it is now generally known. In 1894 book cited Chamberlin called this drift deposit *East Iowan fm.*

†East Iowan formation.

See under *†East Iowan stage of glaciation.*

East Kane shale member.

Devonian or Carboniferous: Northwestern Pennsylvania (McKean County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 61, 112). *East Kane sh. memb.*—Middle memb. of Knapp formational suite. Fissile, chocolate to olivaceous colored sh. underlying Cobham cgl. memb. and overlying Wetmore cgl. memb. Thickness varies, since it is dependent upon amount of scour that preceded deposition of Cobham cgl. In some places along Kinzua Creek it is apparently lacking, and Cobham and Wetmore cgls. are in discon. contact. This explains abnormal thickness attributed to "Sub-Olean" cgl. of that area in old repts. Is well exposed in brick sh. quarries at East Kane [McKean Co.]. Replaces *Ridgway sh.* (preoccupied), proposed by writer in 1933.

†Eastland formation. (In Canyon group.)

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). ***Eastland fm.*** includes all strata from top of Ranger ls. memb. of Ranger fm. to top of Eastland ls. (top memb. of Eastland fm.). Thickness 100 to 175 ft. Is top fm. of Canyon div. Underlies Jacksboro fm. and overlies Ranger fm.

Replaced by Caddo Creek fm.

Named for Eastland, Eastland Co.

†Eastland limestone member (of Caddo Creek formation).

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). ***Eastland ls.***—More commonly called by Tex. geologists *Caddo ls.*, but as that name is preoccupied by a ls. in Kans. the name *Eastland* has been chosen for this Tex. ls. Is top memb. of Eastland fm. Well exposed in creek bed ½ mi. E. of Caddo and in Caddo oil field. In southern Jack Co., where Eastland ls. is expected in the section, a calc. ss. and cgl. appear, so that top of Canyon in this area is less clearly defined.

Same as Home Creek ls. memb., older name, and "Eastland" is preoccupied. (See 1921 entry under *Home Creek ls. memb.*)

Named for Eastland, Eastland Co.

Eastland shale lentil (of Bonair sandstone).

Pennsylvanian: Central Tennessee.

C. Butts and W. A. Nelson, 1925 (Tenn. Geol. Surv. Bull. 33D, pp. 9–12, pl. 4). *Eastland sh. lentil.*—Mostly greenish clay sh. with some thin ss. layers. The Clifty coal beds occur in lower 20 to 30 ft. at Clifty. Best exposed, and apparently thickest (120 ft.), on Pilot Knob. Wedges out in some and probably all directions from Clifty. Lies in midst of Bonair ss. In some places there is distinct angular uncon. btw. this sh. and overlying ss. memb. of the Bonair. Mining town of Eastland, 1 mi. W. of Clifty, White Co., is built on this sh.

Eastland sandstone. (In Graham formation.)

Pennsylvanian: Central Texas (Eastland County).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 62). *Eastland ss.* is here defined as first continuous ss. bed above Home Creek ls. Is well exposed in R. R. cut 1± mi. NW. of Eastland, Eastland Co., and the main escarpment lies N. and NE. of Lake Eastland. It caps escarpments W. of Finis in Jack Co., and many elevations along Caddo Creek NE. of Caddo in Stephens Co. Is memb. of Graham fm., and consists of 10 to 15 ft. of dark grayish brown, massively bedded ss., thin-bedded at top. Underlies Gonzales Creek sh. and overlies Finis sh.

†East Lee limestone.

A name applied by B. K. Emerson (U. S. G. S. Bull. 159, pp. 50–51, 1899), to †Hinsdale (Coles Brook) ls. as exposed at East Lee, Mass., and vicinity.

†East Lee gneiss.

Pre-Cambrian: Western Massachusetts.

See definition under *Lee quartz diorite.*

Named for exposures in hill overlooking East Lee on NE.

East Lynn sandstones. (In Allegheny formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1913 (W. Va. Geol. Surv. Rept. Cabell, Wayne, and Lincoln Counties, p. 183). *East Lynn ss.*—Massive cliff-forming ss., 50 to 100 ft. thick, underlying Upper Kittanning coal and separated from underlying Middle Kittanning coal by 0 to 5 ft. of sl. At East Lynn, Wayne Co., it forms massive cliffs 40 to 60 ft. high.

R. V. Hennen and R. M. Gawthrop, 1917 (W. Va. Geol. Surv. Rept. Braxton and Clay Counties, p. 237). *Upper East Lynn ss.*—Massive to current-bedded, medium-grained to coarse-grained, highly siliceous, grayish white, conglomeratic, frequently almost a mass of white and ovoidal-shaped quartz pebbles ¼ to 1 inch diam. Forms cliffs. Thickness 50 to 80 ft. Underlies Upper Kittanning coal and overlies Middle Kittanning coal. The name *East Lynn ss.* is herein limited to the ledge, 25 to 70 ft. thick, lying btw. Middle Kittanning coal and Lower Kittanning coal.

L. C. Robinson, 1927 (Ky. Geol. Surv., ser. 6, vol. 26, p. 240). The only representative of the Allegheny that was observed in Morgan Co., Ky., was the basal memb., which is called *East Lynn cgl.* It is a true cgl., and where it caps the hills is cliff-forming.

East Mountain shale member (of Mineral Wells formation).

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, p. 77 and charts). *East Mtn sh. memb. of Mineral Wells fm.*—Chiefly dark bluish gray sh., about 300 ft. thick. Contains near top a lentil of fossiliferous ls. and near base a bed of massive ss. Underlies Lake Pinto ss. memb. and overlies Brazos River ss.; all included in Mineral Wells fm. Named for exposures in high escarpment E. of Mineral Wells.

F. B. Plummer, 1929, and R. W. Cumley, 1930 (Tex. Univ. Econ. Geol., geol. map of Palo Pinto Co.), applied this name to a small part of East Mtn sh. as originally defined.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 108). *East Mtn sh. memb. of Mineral Wells fm.* is 300± ft. thick, includes a thin ls. near top, and is in places highly fossiliferous.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 31, 35). *East Mtn sh.* (basal memb. of Mineral Wells fm.) consists of gray and black calc. and siliceous sh., containing in upper part the Village Bend ls. and near its base the Hog Mtn ss. lentil. It underlies Lake Pinto ss. and uncon. overlies Brazos River ss. memb. of Garner fm. Type loc. is the extensive exposure on S. end of East Mtn in Mineral Wells.

East Mountain schist.

Pre-Cambrian (?): Southwestern Vermont (Rutland County).

E. J. Foyles, 1931 (17th Rept. Vt. State Geol., p. 249, in description of East Mtn, Mendon Twp, Rutland quad., in Rutland Co.). *East Mtn schist;* oldest rock; is pre-Camb. or possibly basal Camb. Underlies Cheshire qtzite [Lower Camb.].

Easton schist.

Carboniferous (?) or pre-Ordovician (?): Central Washington (Snoqualmie quadrangle).

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Easton schist.*—Typically a silver-gray or green rock, composed chiefly of quartz and micas. Extremely crumpled and gashed, and seamed with veins and stringers of quartz. Associated with this quartz-mica rock are other schists containing hornblende or epidote; qtzite also is found in close association with the schists, which is believed to indicate sed. origin of the schist. Is probably oldest rock in central Wash. Occupies a few sq. mi. in SW. part of Mount Stuart quad. and extends W. into Snoqualmie quad. Is pre-Eocene, Carbf. (?).

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Easton schist* is probably sedimentary. Is oldest rock in Mount Stuart region; older than Hawkins fm. Forms S. wall of Yakima Valley as far as Easton [Kittitas Co.]. Is older than Peshastin fm.

W. S. Smith, 1916 (Jour. Geol., vol. 24, pp. 559–570). *Easton schist* is oldest terrane in Skykomish Basin. No definition of its age can be suggested except that it is pre-Ord.

Eastport formation.

Silurian (late): Southeastern Maine.

E. S. Bastin and H. S. Williams, 1913 (Maine Water Storage Comm. 3d Ann. Rept., p. 168; Geol. Soc. Am. Bull., vol. 24, pp. 378, 379). [Name mentioned but not defined. Refers to Eastport folio, in press.]

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, p. 7). *Eastport fm.*—The latest Sil. rocks in Eastport quad. Includes several kinds of sed. and volcanic rocks. The volcanic rocks comprise both rhyolitic and diabasic varieties occurring as flows and associated tuffs. Some intrusive rhyolite is probably mapped as part of fm. because it can not everywhere be distinguished from extrusive rhyolite. In bulk volcanic rocks greatly exceed detrital sediments, among which are ls., shales of several sorts, and very small amounts of cgl. Thickness probably about 8,000 ft. Conformably overlies Pembroke fm. Uncon. underlies Dev. (Perry fm.). Fossils indicate latest Sil. Named for exposures at Eastport, on Moose Island.

East Wellington formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 97).

†East Wisconsin stage of glaciation (Pleistocene).

A name applied by T. C. Chamberlin (Great ice age, by James Geikie, 3d ed., 1894, pp. 724–775) to time covered by deposition of drift sheet now called *Wisconsin drift*, but which Chamberlin in 1894 called *East Wisconsin fm.* Named for thick development of the drift in eastern Wis. Now called *Wisconsin stage of glaciation.* Chamberlin stated (Jour. Geol. vol. 3, 1895, pp. 270–277) that he changed his name *East Wisconsin fm.* to *Wisconsin fm.* upon suggestion of Upham.

†East Wisconsin formation.

See under †*East Wisconsin stage of glaciation.*

Eaton beds.

Name listed on p. 147 of U. S. G. S. Bull. 191 was casually applied by A. F. Foerste (Denison Univ. Sci. Lab. Bull., vol. 3, p. 8, 1888) to Springfield ls.

Eaton greensand lentil. (In Claiborne group.)

Eocene (middle): Eastern central Texas (Robertson County).

B. C. Renick and H. B. Stenzel, 1931 (Univ. Tex. Bull. 3101, pp. 78, 90–91). *Eaton greensand lentil.*—South of Eaton, in the vicinity of Shiloh School, in southern Robertson Co., in the A. W. Rowlett, Geo. W. Cox, NW. corner of the Lavina Rollison, and S. part of the Jose Maria Viesca surveys, there are marine beds interlaminated with Sparta sand memb. of Cook Mtn fm. These marine lenses consist of fossiliferous glauconitic sand, red clay, and ferruginous ironstone, all interbedded with gray sand of Sparta lithology. Max. thickness (50 ft.) is exposed along Wheelock-New Baden road, and interval from topmost marine bed in Eaton lentil to base of overlying Crockett memb. is 15 to 50 ft.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 612), showed *Eaton lentil* lying at base of the Crockett and lower in section than Moseley ls.

H. B. Stenzel, Jan. 1935 (Univ. Tex. Bull. 3501, p. 277). *Crockett* redefined to include only the 100 ft. of beds above Moseley ls. The Moseley ls. and underlying beds down to top of Sparta sand are here named *Stone City beds*. Latter includes Eaton lentil (marine) and are 85± ft. thick. They discon. underlie Crockett restricted.

Eau Claire grit.

Upper Cambrian: **Southwestern Wisconsin (Eau Claire County).**

L. C. Wooster, 1878 (Wis. Geol. Surv. Ann. Rept. 1877, p. 37). *Eau Claire grit.*—These layers mark upper limit of the coarse sss., almost cgls. [Older than Eau Claire trilobite beds.]

L. C. Wooster, 1882 (Geol. Wis., vol. 4, p. 110). *Eau Claire grit.*—Very coarse ss. exposed at mouth of Eau Claire River. So coarse it has been termed *cgl.* Thickness 9 ft. Lies 100 to 260 ft. above the granite, in lower part of Potsdam ss., and 240 ft. below Eau Claire trilobite beds.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 1693). Mount Simon memb. of Ulrich is equiv. of "Eau Claire grits" of Wooster, and underlies Eau Claire memb. of Dresbach fm., which coincides with "Eau Claire trilobite beds" of Wooster.

Eau Claire trilobite beds.

Upper Cambrian: Western Wisconsin.

L. C. Wooster, 1878 (Wis. Geol. Surv. Rept. 1877, pp. 36–41). *Eau Claire trilobite beds* mark lower limit of calc. matter in Potsdam ss. They hold at least 7 sp. of trilobites, of which 3 are new, and a few brachiopods. [Lie higher than Eau Claire grit and considerably lower than Hudson trilobite beds.]

L. C. Wooster, 1882 (Geol. Wis., vol. 4, pp. 101–140). *Eau Claire trilobite beds* lie 240 ft. above Eau Claire grit and 200 ft. below Hudson trilobite beds. They mark lower limit of calc. matter in Potsdam ss., and are characterized by several sp. of trilobites not found at any other horizon and also by being lower limit at which brachiopods were found in the Potsdam.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 149). Eau Claire is not type loc. of Wooster's "Eau Claire trilobite beds." He describes that (Geol. Wis., vol. 4, p. 117, 1882) as located 4 mi. above the Dalles which occur at Mount Simon, in the high bank nearly 200 ft. above the terrace, on left side of Chippewa River.

Included in Eau Claire ss. of Ulrich.

Eau Claire shale.

See under *Eau Claire ss.*

Eau Claire sandstone.

Upper Cambrian: Western Wisconsin.

C. D. Walcott, 1914 (Smithsonian Misc. Coll., vol. 57, p. 354). *Eau Claire. (Ulrich mss., 1914).*—Mostly thin-bedded, in part shaly ss., with many fossiliferous layers, including Owen's Menominee trilobite zone and Wooster's Eau Claire trilobite zone. Usually a coarse white friable ss. with *Dicellomus* and *Lingulella* at base. Numerous characteristic Upper Camb. trilobites, *Crepicephalus iowensis* being one of best guide fossils. Thickness about 100 ft. Underlies Dresbach ss. and overlies *Mount Simon ss.*

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). *Eau Claire sh.*, 200 to 350 ft. thick, underlies Dresbach ss. and overlies Mount Simon ss. in Wis.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 38–45, 79), treated these beds as a memb. of their Dresbach fm. [See 1934 and 1935 entries under *Dresbach ss.*]

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1690, 1694). *Eau Claire memb.*—Middle memb. of Dresbach fm. Underlies Galesville memb. [Dresbach ss. of many authors and repts] and overlies Mount Simon memb. Divided, on basis of fossils, into *Crepicephalus* zone (above), 75 ft. thick, and *Cedaria* zone (below), 50 ft. thick. Coincides with "Eau Claire trilobite beds" of Wooster.

The U. S. Geol. Survey at present treats the Eau Claire as a distinct fm., underlying Dresbach ss. [Galesville memb. of some authors] and overlying Mount Simon ss.

Named for exposures at mouth of Eau Claire River, Eau Claire Co.

†Ebensburg sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania (Cambria County).

C. Butts, 1905 (U. S. G. S. Ebensburg folio, No. 133). *Ebensburg ss.*—Generally rather coarse, thick-bedded, gray ss., locally containing layers of cgl. Is the ss. upon which town of Ebensburg is built, and according to well records it is there about 150 ft. thick. What is believed to be same ss. outcrops in river bluff to E. of Summerhill, and also on top of knoll just NW. of Summerhill. Here it is coarse, thick bedded, 50 ft. thick, and lies 100 ft. above Saltsburg ss. The Ebensburg rests on 40 ft. of red sh. and lies about 100 ft. below Summerhill ss. Is a memb. of Conemaugh fm. In valley of Roaring Run the Ebensburg is only 5 ft. thick.

W. C. Phalen, 1910 (U. S. G. S. Johnstown folio, No. 174, p. 6). *"Ebensburg"* ss. is same as Morgantown ss. memb. of Conemaugh fm. and is abandoned.

Echo granite.

Pre-Cambrian (?): Southern California (San Gabriel Mountains).

W. J. Miller, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 149–150). [Name used but not defined.]

W. J. Miller, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 161). Writer has mapped [does not say where published] *Echo granite (pre-Camb.?)*, in San Gabriel Mtns, Calif.

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. Math. and Phys. Sci., vol. 1, No. 1, map, pp. 12–15, 63–65). [*Echo granite (pre-Camb.?)* mapped.] Comprises several sq. mi., extending from Millard Canyon to Eaton Canyon, including part of Echo Mtn.

Echo Bay series.

Pre-Cambrian: Northwest Territory.

H. S. Robinson, 1933 (Canadian Min. and Met. Bull. 258, p. 613).

Echo Island formation.

Middle Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of dissert. 1924–26, vol. 1, p. 132).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, p. 487 and map). *Echo Island fm.*—Tuff, ss., etc., 2,700 ft. thick. Underlies Mysterious Creek fm. (basal Upper J.) and overlies Harrison Lake fm. (Middle J.). Assigned to Middle J.

Eckman sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 221). *Eckman ss.*—Massive to current-bedded, medium-grained, buff to bluish gray, 17 to 106 ft. thick. Lies 0 to 5 ft. below Pocahontas No. 6 coal and overlies Pocahontas No. 5 coal or Pocahontas No. 4 coal. Exposed at Eckman, McDowell Co.

Economy member. (In Latonia shale.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 9). *Economy.*—Blue shales and lss., 50 ft. thick, composing lower div. of Eden [Eden as here used excluded Fulton sh. at base]. Distinguished faunally by large number of Bryozoa. Overlain by Southgate memb. of Eden and underlain by Utica (Fulton) sh.

Is basal part of Latonia sh.

Economy was old name of village now known as West Covington, Ky.

†Ecphora bed.

†Ecphora beds.

Miocene: Western Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 124, 157, 158, 324). At Alum Bluff the Chesapeake group is represented by what I have termed *Ecphora bed*, of gray marl, with over 100 species of fossils, many of which are common to N. C., Va., and Md. It has a thickness here of 30 ft. or more.

A paleontologic term now abandoned for geographic name *Choctawhatchee fm.*

Ector tongue of Austin chalk.

Upper Cretaceous (Gulf series): Northeastern Texas.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, p. 149). *Ector tongue of Austin chalk.*—A thin tongue-like projection of chalk from basal beds of main body of the Austin, has been traced, by means of a few outcrops and the black soils to which the chalk weathers, from western Fannin Co. NE. to point about 1½ mi. SE. of Ravenna. Ector, for which the tongue is named, is a few hundred yds. W. of the belt of outcrop. Only 10 to 15 ft. of the chalk was seen in best exposures, and it probably does not exceed 50 ft. in thickness in vicinity of Ector [Fannin Co.]. The Ector tongue is underlain by shaly clay, with thin beds of sand and a basal cgl. ("fish-bed cgl."), which are regarded as distinct from underlying Eagle Ford fm. and are mapped with the Austin. [L. W. Stephenson now includes this shaly clay, sand, and "fish-bed cgl." in Ector tongue. See Am. Jour. Sci., 5th, vol. 16, p. 492, 1928; A. A. P. G. Bull., vol. 13, No. 10, 1929.]

Eddy sandstone.

Permian: Southern New Mexico.

C. R. Keyes, 1906 (Jour. Geol., vol. 14, pp. 147–154). *Eddy sss.*, 1,500 ft. thick, underlie Capitan lss. The name is substituted for Richardson's name *Delaware Mtn fm.*, which is preoccupied. [Derivation of name not given, but presumably Eddy, N. Mex.]

Delaware Mtn fm. of Richardson was not preoccupied, and there is therefore no occasion to rename it.

Eddy Hill grit.

Lower Cambrian: Eastern New York (Washington County) and southwestern Vermont (Rutland County).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 67–70). *Eddy Hill grit.*—The Black patch grit of [T. N.] Dale. Consists of 10 to 40 ft. of dark gray grit or ss. with black shaly patches, sometimes with calc. nodules. Underlies Schodack shales and lss. and overlies Mettawee slate; all Lower Camb. Named for exposures at Eddy Hill, near Fairhaven, Vt. [Eddy Hill is probably in Whitehall quad., but name does not appear on that map. It may be unnamed hill just SE. of Fairhaven.]

Eden group.

Upper Ordovician: Southwestern Ohio, southern Indiana and central northern Kentucky.

J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, table opp. p. 89), and E. Orton, 1873 (same vol., pp. 371–399). *Eden shales or Middle shales of Cincinnati beds proper.*—Slightly fossiliferous blue sh. with small amount of interbedded ls. Thickness 250 ft. Overlies River Quarry beds and underlies Hill Quarry beds; all included in Cincinnati beds proper, the middle fm. of Cincinnati group. [As thus defined the Eden includes at base the Fulton sh.]

Adopted as a group name, to include beds originally included, i. e., Latonia sh. at top and Fulton sh. at base, the top memb. of the Latonia being McMicken memb. of Bassler.

Named for Eden Park, Cincinnati, Ohio.

Eden beds.

Pliocene (lower): Southern California (San Jacinto quadrangle, Riverside County).

C. Frick, 1921 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 12, pp. 283–288). *Eden beds.*—Deposits containing considerable collection of vertebrate fossils (including species of *Pliohippus*), through which they are correlated with middle of Etchegoin fm. and the Rattlesnake, Thousand Creek, and Snake Creek fms. The beds occur in Eden region, San Jacinto quad. Assigned to upper part of lower Plio.

D. M. Fraser, 1931 (Min. in Calif., vol. 27, No. 4, pp. 511-514). Frick's name *Eden beds* being preoccupied, he suggests it be replaced by *Mount Eden fm.*, which is here used for the lower Plio. ss. and shales in region about Beaumont.

Edenian.

A term applied by R. Ruedemann (N. Y. State Mus. Bull. 258) to time covered by deposition of Eden group.

Edens sand.

A thin subsurface sand, of Upper Cret. age, in either Navarro fm. or Taylor marl of eastern Tex. Produced oil at Corsicana. Is a higher sand than Corsicana sand.

Edensburg oil sandstone.

J. F. Carll, 1883 (2d Pa. Geol. Surv. Rept. I_4, well sections). *Edensburg oil ss.* lies strat. lower than "Tanners Hill red" and higher than Clarendon sand [in Warren Co., Pa.]. Is probably of Chemung age.

Edgefield-Chesterfield zone.

Pre-Cambrian: Northern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 10, 12). *Edgefield-Chesterfield zone (Algonkian?)*.—Bounded on NW. by Abbeville-York zone; on N. by Hornsboro zone and State line; on SE. by a line proceeding from point where Whites Creek enters S. C. (Marlboro Co.) along said creek to the Pee Dee, thence by Catarrh, thence S. of Granny's Quarter, thence crossing Wateree River, near Camden, thence up Rice Creek and down Crane Creek. and thence crossing Brook River 3 mi. N. of Columbia, thence across Dutch Fork and by Half Way Swamp, to point near Edgefield, whence it proceeds southwesterly to Savannah River (near Scotts Ferry), the river completing the bdy on W. A division extends southwesterly by Edgefield by reason of granite anticline uplift, which diverts a subzone of these schists and a part of the slates toward Hamburg, with a SE. dip. Slates derived from alteration of basic igneous rocks constitute main mass; along both sides of the argillites the sericite schists interruptedly prevail. It appears that the sericite schists originated in the alteration of the tuffs and porphyries which interruptedly occur along southerly line of Abbeville-York zone, with a corresponding but more limited belt along opposite side of Edgefield-Chesterfield zone.

Probably named for exposures in Edgefield and Chesterfield Counties.

†Edgehill quartzite.

Lower Cambrian: Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6, map and btw. pp. 14 and 47). *Edgehill Rock (qtzite and cgl.)*, *Potsdam ss. (No. 1)* [on map].

F. Bascom, 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143), used *Edge Hill qtzite (Lower Camb.)* in tables.

Same as Chickies qtzite, the older name. Edge Hill is in Montgomery Co.

Edgewood limestone.

Silurian (early): Northeastern Missouri (Pike County) and southwestern Illinois.

T. E. Savage, 1909 (Am. Jour. Sci., 4th, vol. 28, pp. 517-518). *Edgewood ls.*—Ls., 0 to 12½ ft. thick, consisting of massive layer of hard gray coarsely crystalline ls. 4 ft. thick, oolitic in upper part, underlain by few ft. of fine-grained ls. and fossiliferous dark calc. sh., with, at base, cgl. of fragments of Girardeau ls. Uncon. overlies Girardeau ls. and uncon. underlies Sexton Creek ls., or is separated from the Sexton Creek by 2 inches of red residual clay. Assigned to Sil. [Later repts give thickness 0 to 75 ft.]

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 111-112, 351-376; Ill. Geol. Surv. Bull. 23). *Edgewood ls.* includes all strata in Ill. and Mo. btw. horizon of

Girardeau ls. up to top of the mag. ls. near Bowling Green, and top of the brown ls. overlying the oolite in Lincoln, Pike, and Ralls Counties, Mo., and on opposite side of river in Ill., and their equiv. elsewhere in Miss. Valley. It includes Bowling Green ls., Noix oolite, and Channahon ls. members, which represent local facies. The lower fossiliferous part of fm. and the overlying brown, unfossiliferous Bowling Green phase are well developed in vicinity of Edgewood, Pike Co., Mo., while the lowest beds of the Edgewood are not known N. of that locality. The fm. overlies Girardeau ls. with sedimentary break. In Kankakee Co., NE. Ill., it underlies, with possible break, Essex ls., which may prove to be a memb. of overlying Sexton Creek ls. [of SW. Ill. and Mo.]. Basal 8 to 15 ft. of the Edgewood is *Cyrene memb.*, which is conformably overlain by *Bowling Green memb.* (15 to 35 ft. thick). Upper half or two-thirds of Cyrene memb. is=Noix oolite of Keyes, which is a shallow-water phase of sedimentation near Miss. River, and is here called *Noix oolite memb.* The name *Channahon ls. memb.* is retained for easy reference to the strata seen only along Des Plaines River 1 mi. SE. of Channahon, Will Co., NE. Ill., which is=some part of Edgewood fm.

T. E. Savage, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 305–324). In NE. Ill. *Edgewood ls.* is 0 to 21 ft. thick and is not known N. of Oswego. It underlies Kankakee ls. with erosional uncon. It is here proposed to shift upper bdy of Edgewood fm. and basal part of overlying Sexton Creek ls. (of SW. Ill. and Mo.) 3 or 4 ft. higher than formerly, placing it at *top* of ls. containing *Platymerella manniensis* in Ill. and Mo., instead of at *base* of this zone, as formerly.

T. E. Savage, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 286–287; Geol. Soc. Am. Bull., vol. 37, pp. 517–526, 533). *Edgewood ls.* is exposed near Thebes, Oswego, Channahon, Essex, and Savanna, Ill., and extends as far N. as Belvidere, near N. border of State. *Platymerella manniensis* zone is included in Kankakee ls., instead of in Edgewood.

Named for exposures 3 mi. N. of Edgewood, Pike Co., Mo.

Ediger limestone. (Buried.)

Middle Devonian: Central Kansas (Harvey County).

L. A. Johnston, 1935 (Tulsa Geol. Soc. Digest, 1934, pp. 12–17, pl. 1). *Ediger ls.*—Varies from dense and micro-crystalline to coarsely crystalline, fossiliferous ls., sandy and glauconitic at base. In places lower part is white calc. sand of rounded and subrounded grains. Upper part may contain some chert, and usually has intercalated thin light-green sh. seams containing fossils. Rests uncon. on Hollow dol., or, where that is absent, on Maquoketa sh., and uncon. underlies Sylamore ss. in Hollow pool, Harvey Co. Name proposed by F. A. Bush, unpublished paper delivered before Tulsa Strat. Soc. in 1933. Assigned to Middle Dev. [Derivation of name not stated.]

†Edison gneiss.

Pre-Cambrian: Northern New Jersey.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 439). Belt of gneisses characterized by their richness in disseminated magnetite, which, from extensive mining operations at old Ogden mines, now called Edison, we have named *Edison gneiss.*

In U. S. G. S. Franklin Furnace folio, No. 161, 1908, this name was discarded, the rock being an inseparable part of Byram gneiss.

†Edisto marl.

Miocene (lower): Southern South Carolina (Colleton County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, 19). *Edisto phase* (also *Edisto marls and phosphates*).—Proceeding from Dorchester Strait SE. over Dorchester Ridge and the upper (Ecphora) marls, the Edisto phase is observed in compact yellow-white beds (very high in content of calcium carbonate); which rarely exceed thickness of 3 ft. This is phase of Mio. which has been phosphatized where favorably situated for accumulation of Salkehatchie oozes. This Edisto phase appears circumscribed in western Tertiary by a line extending from mouth of Wando River by Charleston, Church Flats, Port Royal, Parachucla, Givhams Ferry, Bacon's Bridge and thence back to head of Wando River. In eastern div. of Tert. the sea waves, along Myrtle Beach, cast upon the shores fragments of the equiv. marl, from bed of present ocean. Overlies Marks Head marl and is older than Goose Creek marl.

T. W. Vaughan, 1912 (U. S. G. S. P. P. 71). *Edisto marl.*—Indurated phosphatized marl in vicinity of Charleston, S. C. Thickness 2 to 3 ft. Overlies Cooper marl and underlies Goose Creek marl of Sloan, which is softer than Edisto marl.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). In this rept [on S. C. coastal plain] the lower Mio. deposits are called *Hawthorn fm.,* because the work of recent years has demonstrated that they are an eastern development of Hawthorn fm. of Fla. In previous S. C. repts all or parts of Hawthorn fm. have been called †Marks Head marl, †Edisto marl, †Parachucla sh., †Parachucla marl, and †Combahee sh., all of which are here abandoned. The Hawthorn includes †Marks Head marl and upper part of underlying Alum Bluff "fm." of Veatch and Stephenson's rept on coastal plain of Ga. (Ga. Geol. Surv. Bull. 26, 1911). It also includes part of †Ashley marl and part of †Salkehatchie phase of Sloan.

Named for exposures on Edisto River at "The Dividers," Colleton Co.

Edmonton formation.

Upper Cretaceous: Alberta, Saskatchewan, and Northwest Territory, Canada.

J. B. Tyrrell, 1887 (Canada Geol. Surv., n. s., vol. 2, pp. 74E–75E, 110E, 118E, 127E, 131E–135E, 137–138E), introduced *Edmonton series;* as he called it. Now considered=either Bearpaw sh. or Fox Hills ss. of Mont.

Edmunds formation.

Silurian: Southeastern Maine.

E. S. Bastin and H. S. Williams, 1913 (Maine Water Storage Comm. 3d Ann. Rept., p. 168; Geol. Soc. Am. Bull., vol. 24, pp. 378, 379). [Name mentioned but not defined. Refers to Eastport folio, in press.]

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, pp. 4, 10). *Edmunds fm.*—A series of alternating beds of sh. and deposits of volcanic rocks. Most abundant rock is rhyolite, both gray and red, which forms flows and associated tuffs. Next most abundant rock is purplish red andesite, which also occurs as flows and tuffs. Diabase flows and tuffs also occur. Estimated thickness 2,500 to 3,000 ft. Conformably underlies Pembroke fm. Overlies (possibly uncon.) Dennys fm. Fossils indicate Cobleskill and Niagara age. Named for exposures near Edmunds, Washington Co.

Edmunds Hill andesite.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1899 (Am. Jour. Sci., 4th, vol. 8, pp. 359–360). *Edmunds Hill andesites.*—Augite andesite forming entire top of Edmund's Hill, Chapman Twp, near middle of N. twp line, and being highest part of a ridge running N.-S. for several mi.

In a later rept (U. S. G. S. Bull. 165, pp. 112, 169–172, 1900) this rock was considered by Gregory to be Paleozoic. On 1933 geol. map of Maine, by A. Keith, the igneous rocks of this region, including andesite, are mapped as Dev.

Edray sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 413). *Edray ss.*—Gray or green flaggy or shaly ss. 0 to 75 ft. thick, in lower part of Lillydale sh., lying 0 to 50 ft. above its base. Type loc. in Pocahontas Co., W. Va., on mtn road 1.2 mi. N. of Edray. Also observed in Mercer Co., W. Va., and in Tazewell Co., Va.

P. H. Price, 1929 (W. Va. Geol. Surv. Rept. Pocahontas Co., pp. 163–164). *Edray ss.* is lenticular and does not appear in Edray section that was measured along new State road from Edray to head of Elk, but at other points it presents a prominent exposure. Occurs associated with Lillydale sh., at times coming well up in this memb., and at some points near base; and often rests directly on Alderson ls. of Greenbrier series. Best developed along waters of Elk, forming a massive cliff rock at junction of Big Spring Fork with Old Field Fork of Elk River, and is recorded in Slaty Fork and Props Run sections. In S. end of Co. it is noted in Stamping Creek and Briery Knob sections, as a brown to gray fine-grained micaceous ss., 10 to 25 ft. thick.

Edson beds. (In Ogallala formation.)

Pliocene (lower): Western Kansas (Sherman County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, pp. 161–162). [See under *Rhinoceros Hill beds.*]

Edwards limestone. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Southern Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. Nueces folio, No. 42, p. 2; U. S. G. S. 18th Ann. Rept., pt. 2, pp. 227–235). *Edwards ls.*—Generally whitish lss., but on weathering show buff, cream-yellow, and dull-gray layers; of variable hardness, frequently massive, and contain flint nodules. Usually harder than Comanche Peak ls. and weathers into cliffs. Thickness 600 ft. Top fm. of Fredericksburg div. Overlies Comanche Peak ls. and underlies Fort Worth ls. Replaces "Caprina" ls.; also replaces "Barton Creek" ls., as Barton Creek is not good type loc., name is binomial, and *Barton* was otherwise used many years before *Barton Creek.*

Edwards ls. underlies Georgetown ls. in some areas, Fort Worth ls. in other areas, and Kiamichi clay in NE. Tex. See also under *Fredericksburg group.*

Named for Edwards Plateau, Nueces and Uvalde quads., SW. Tex., of which it is chief component of scarps and mesas.

Edwardsville formation. (In Borden group.)

Mississippian: Southeastern Indiana.

P. B. Stockdale, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170). [See under *Borden group.*]

P. B. Stockdale, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, pp. 707–718). The *Edwardsville* is in many respects the most unique fm. in Borden group. Is top fm. of the Borden. Displays greatest range in thickness—from 40 to 200 ft. Predominantly sh., siltstone, and ss. A perplexing calc. lithology at extreme S. end of Ind. outcrop area and in adjacent Ky. renders it easily confused with basal memb. of overlying Harrodsburg ls. It overlies Floyds Knob fm.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 54, 76, 220, etc.). *Edwardsville fm.* in previous writings has been included in "Knob ss.," "Riverside ss.," "Knobstone ss.," and "Warsaw" of Butts (1915, 1918, 1922). Is named for village of Edwardsville, near center of NE¼ sec. 1, T. 3 S., R. 5 E., 4½ mi. W. of New Albany, Ind. It is completely exposed in clean-cut association with overlying Harrodsburg ls. and underlying Floyds Knob fm. along State Highway 62, a short distance NE. of Edwardsville, where it is 53 ft. thick. [Describes and names many local lithologic *facies* of the fm. On pp. 310–311 he suggests redefining top of fm., as explained under *Harrodsburg ls.*]

Edwin clay.

A white brittle clay, locally known as *Edwin clay*, forms lowest 8 ft. of clay at Jones Butte, Butte Co., Calif. (See V. T. Allen, Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 18, No. 14, pp. 381, 404, 1929.)

†Efaw rocks.

A name applied locally to Gilmore ss. memb. of Greene fm. in western Monongalia Co., W. Va., from locality near Wadestown, where it litters the ground with large boulders.

Effingham terrane.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 39, No. 4, 1923, p. 320) to 8 ft. of ls. in upper part of McLeansboro fm. (Penn.) of Ill. He placed it 200 ft. above Martinsville ls. Derivation of name not stated, but probably named for Effingham, Effingham Co., SE. Ill.

Egan limestone.

Lower Ordovician: Eastern Nevada (Ely region).

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 78). *Egan lss.* 1,100 ft. thick, underlie Cherry shales and overlie Schell shales in Nev. Named for Egan Range, of which they form E. base from Ely northward.

A part of Pogonip ls.

Eggleston limestone.

Middle Ordovician (Black River): Southwestern Virginia (Giles County).

A. A. L. Mathews, 1934 (Va. Geol. Surv. Bull. 40, pp. 7, 11, 30). *Eggleston ls.* includes the beds of upper Black River age that are younger than the upper red Moccasin memb. (Lowville) and older than Trenton ls. Although a good section of the fm. occurs 1.1 mi. S. of Eggleston, Va., the best section is along State Highway 8, 1 mi. N. of Narrows, Va. This will be considered type loc. In general consists of thin- to thick-bedded, fine-grained, argill., dark-buff to light-brown ls. which upon fracturing forms cuneiform blocks with the jointing perpendicular to bedding. Contains many thin beds and a few thicker beds of bentonite, and its peculiarities may be due to this material. Is widely distributed in Valley and Ridge province. In type loc. is more than 150 ft. thick. Contains upper Black River fossils.

Same as Chambersburg ls. restricted of C. Butts and G. W. Stose (1932), which is name at present in use by U. S. Geol. Survey. (See C. Butts, Va. Geol. Surv. Bull. 42, 1933.)

Egremont limestone.

Ordovician and Cambrian: Southwestern Massachusetts and northwestern Connecticut.

W. H. Hobbs, 1893 (Jour. Geol., vol. 1, pp. 717–736, 780–802). *Egremont ls.*—White to gray crystalline ls., often quite pure but for small scales of colorless mica and grains of pyrite. Locally contains thin qtzitic or schistose layers. Generally passes upward into Everett schist through a graphitic layer of variable thickness, and a similar graphitic rock is also found at its lower contact with Riga schist. Correlated with Bellowspipe ls. of NW. Mass. Included in Mount Washington series. Named for its wide extent in Egremont valley [Berkshire Co., Mass.].

Is a part of Stockbridge ls.

Egypt sand.

Upper Cretaceous: Missouri.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 252). *Egypt terrane.*—Sands, 150 ft. thick, of Ripley age, uncon. underlying Porter [Porters Creek] clays and uncon. overlying Dakotan series. [Derivation of name not stated.]

Eileen sandstone. (In Oronto group.)

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield County).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, pp. 50, 54). *Eileen ss.*—Red and white somewhat quartzose ss. Thickness 0 to 2,000 ft.; 1,800 ft. exposed. Included in Oronto group. Underlies Amnicon fm. and overlies Freda ss. Named for exposures in valley of South Fork of Fish Creek in town of Eileen, Bayfield Co.

Einstine sandstone. (Also spelled Einstein.)

Pennsylvanian: Eastern Kansas.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 7). *Einstine ss.*—Thin beds of soft brown micaceous and hard gray calc. ripple-marked sss. more or less intercalated with and passing into blue and brown sandy argill. shales. Upper part marly and fossiliferous at McFaddin's and at Ward's mill. Forms bed No. 10 (35 to 60 ft. thick) of geologic section of Miami Co. Overlain by Cave ls. and underlain by older Coal Measures strata.

In later repts called "Einstein ss." and included, together with †Cave ls., in †Cave Rock series. Probably represents whole or part of Chanute sh. memb. of Kansas City fm.

Derivation of name not stated.

Eiss limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 229, 233, 234, 235, 237). *Eiss ls.*, in Garrison shale, consists of (descending): (1) Dark-grey, siliceous, hard, massive, 1 ft. 3 in. to 2 ft.; (2) sh., bluish, argill., with fine calc. material, very fossiliferous, 7 ft.; (3) ls., dark gray, earthy, hard on exposure, 1 ft. 4 in. Total thickness 9 to 10 ft. Underlies Easly Creek sh. and overlies Stearns sh. Named for Eiss farm, S. of Humboldt.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 19). Type exposure of *Eiss ls.* is in SE¼ sec. 3, T. 1 N., R. 13 E., on Eiss farm, 8 mi. S. of Humboldt, Nebr.

G. E. Condra, 1935. (See under ***Bader ls.***)

Ekwan limestone.

Silurian: Canada (Hudson Bay region).

A. F. Foerste, 1927 (Denison Univ. Bull., vol. 27, No. 3, Sci. Lab. Jour., vol. 22, pp. 5, 7, 15).

Ekwan River limestone.

Silurian: Canada.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol Soc. Am. Bull., vol. 30, pp. 341, 357, 365, 368).

El Abra limestone.

Lower Cretaceous: Mexico.

V. R. Garfias, 1915 (Econ. Geol., vol. 10, pp. 199, 200).

Elbert formation.

Upper Devonian: Southwestern Colorado.

W. Cross, 1904 (Am. Jour. Sci., 4th. vol. 18, pp. 245–252). *Elbert fm.*—The strata overlying Ignacio fm. (chiefly qtzite and believed to be of Upper Camb. age), underlying Ouray ls., and carrying fish remains at base and near top, which seem unquestionably to form a lithologic strat. and faunal unit. At Devon Point the Elbert consists of (descending): (1) Red sh. or clay, 5 ft.; (2) ss. or qtzite containing fish scales in places, 1± ft.; (3) calc. shales and thin ls., buff or gray, breaking readily into slabs, salt casts common, 25 ft.; (4) thin layers of alternating qtzite, dull-gray aren. ls., and red calc. sh., 8 ft.; (5) hard fine-grained gray qtzite, 2 to ½ ft.; (6) red calc. sh., 4 in. to 1 ft.; (7) yellow earthy ls., 9 in.; (8) calc. and sandy shales, variegated, yellow, buff, lilac, 4 in. to 1 ft.; (9) fine-grained yellow-brown qtzite, 1 ft.; (10) sandy sh., red, greenish, or mottled, a harder layer in middle, 5 ft.; (11) sandy ls., shaly in part, rich in fish scales and plates, 1± ft.; (12) red sh., calc. and sandy, with specks of bone or shell, 2 ft. Total thickness at Devon Point 54 ft. Named for exposures on Elbert Creek, a western tributary of Animas River, entering it just above Rockwood. The Elbert has been observed below Ouray ls. in several quads. of San Juan region, and many exposures have been studied. Its most persistent feature is the crumbling calc. sh. div., with its casts of salt crystals. The most important variation in its lithology is appearance of dense earthy ls. of conchoidal fracture, in several beds in upper part. Only fossils found are fish remains. Appears to correlate with "Parting qtzite" of central Colo.

Elbrook limestone.

Middle and Upper Cambrian: Central southern Pennsylvania, western Maryland, and northwestern Virginia.

G. W. Stose, 1906 (Jour. Geol., vol. 14, p. 209). *Elbrook ls.*—Massive bluish gray mag. and cherty ls. with red and green shales in middle. About 2,000 ft. thick. Underlies Knox ls. and overlies Waynesboro fm. Quarried at Elbrook, Franklin Co., Pa.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170), divided the beds called *Knox ls.* in 1906 into Conococheague ls. below and Beekmantown ls. above, and stated thickness of Elbrook ls. to be 3,000 ft.

El Cano formation.

Cretaceous: Cuba.

J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 539).

El Capitan granite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, pp. 121–122, map). Light-colored biotite granite of moderately coarse and in part obscurely porphyritic texture, but along E. margin it passes from a porphyritic to a nonporphyritic rock. Is one of oldest intrusive rocks in Yosemite region.

Named for fact that it forms greater part of El Capitan, Yosemite Nat. Park.

†El Capitan limestone.

A term applied by some geologists to Capitan ls. of Tex.

Elco gravel.

Mississippian: Southwestern Illinois (Alexander County).

L. C. Glenn, 1906 (U. S. G. S. W. S. P. 164, pp. 22, 150–152). *Elco gravel.*—Name locally applied to 177 ft. of Miss. chert in deep wells at Cairo, Ill. Is quarried near Elco, Alexander Co., where it consists of very light-colored chert, 150 to 200 ft. thick, highly fractured; is not a gravel either in wells or in outcrop.

Elden limestones.

Mississippian: Northern Central Arizona (Flagstaff region).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 243, 251, 336). *Elden lss.*—Name derived from Elden Mtn, near Flagstaff. Includes the beds of Miss. series carrying Keokuk fauna. Thickness 250 ft. Top fm. of Miss. series in Ariz. Younger than Truxton lss.

Eldon limestone.

Middle Cambrian: British Columbia and Alberta.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 3). *Eldon fm.*—Massive aren., dolomitic lss., with a few bands of purer bluish-gray ls. Thickness 2,733 ft. in Mount Bosworth section and 2,195 ft. at Castle Mtn. Contains Middle Camb. fossils. Is top fm. of Middle Camb. Underlies Bosworth fm. and overlies Stephen fm. Comprises upper massive lss. of Castle Mtn, Alberta, 1 to 2 mi. N. of Eldon switch, on Canadian Pacific Ry.

Eldonian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289). *Eldonian series.*—Series of lss., aggregating 2,685 ft., uncon. underlying Bosworthian series and overlying Stephensian series. Uppermost div. of Mid Cambric in Alberta. [Apparently same as Eldon ls.]

Eldora sandstone.

Pennsylvanian: Central northern Iowa.

S. W. Beyer, 1900 (Iowa Geol. Surv., vol. 10, pp. 254, 259–278). *Eldora ss.*—Heavy-bedded ferruginous ss., 80 ft. thick, forming top fm. of Des Moines stage in Hardin Co. Overlain by Pleist. and underlain by sh. of Des Moines stage.

Named for Eldora, Hardin Co.

Eldoradan series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 51, 53, 78), to lower part of Eldorado ls. of Nev. and to supposedly contemp. deposits in other States.

Eldorado limestone.

Middle Cambrian: Eastern Nevada (Eureka district and neighboring regions).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1812, p. 184, footnote). As result of conference with Mr. Arnold Hague, *Eldorado ls.* is introduced to replace *Prospect Mtn ls.* [the name *Prospect Mtn* being retained for the older qtzite].

Named for Eldorado mine, Eureka dist.

Eldorado sand.

A subsurface sand in Annona chalk of NE. Tex.

Eldorado series.

Eldorado granodiorite.

Cretaceous: British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 79).

Eldoran epoch (and series).

Term proposed by G. F. Kay (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 449–452, 1931) to include Wisconsin (glacial), Peorian (interglacial), and Iowan (glacial) stages of Pleistocene epoch (and series), which Kay would elevate to Pleistocene *period* (and *system*). In vicinity of Eldora, Hardin Co., Iowa, the 3 stages have been mapped separately.

G. F. Kay and M. M. Leighton, 1933 (Geol. Soc. Am. Bull., vol. 44, pp. 669–673), redefined *Eldoran epoch* (*series*) by including in it "*Recent age* (*stage*)"; and they agreed to define "*Wisconsin age* (*stage*)" to include the following substages (descending): Mankato (late Wisconsin), Cary (middle Wisconsin), Tazewell (early Wisconsin), and Iowan. For their complete classification see under *Wisconsin stage*.

Eleanor slate.

Pre-Cambrian (Keewatin): Western Ontario.

A. P. Coleman and A. B. Willmott, 1902 (Toronto Univ. Studies, geol. ser. No. 2, p. 10; and Ont. Bur. Mines Rept. 1902, p. 158). *Eleanor slates*, Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 154). *Eleanor sl.* assigned to Keewatin.

†Electric intrusives.

Miocene: Yellowstone National Park.

A. Hague et al., 1899 (U. S. G. S. Mon. 32, pt. 2, pl. 10), mapped *Electric intrusives*. The U. S. Geol. Survey later adopted *Electric Peak intrusives* for these rocks.

Electric Peak intrusives.

Miocene: Yellowstone National Park.

A. Hague et al., 1904 (U. S. G. S. Mon. 32, Atlas, Gallatin sheet). *Electric Peak intrusives*.—Dikes of diorite porphyry and andesite of various kinds, breaking through sed. rocks of Electric Peak, in Gallatin quad., Yellowstone National Park.

Elenita syenite porphyry.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 324).

Elephant limestone.

Pennsylvanian: Southwestern Utah (southeast of Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Elephant ls.*—Heavy-bedded dolomitic and siliceous lss., 1,000± ft. thick, underlying (probably uncon.) Harrington fm. and overlying (conformably to N., but uncon. suggested to S.) Talisman qtzite. Named for Elephant Canyon, SE. of Frisco dist.

†Elevator B sandstone.

A term applied by C. W. Hall (Minn. Acad. Nat. Sci. Bull., vol. 3, pp. 125–136, 1889) to a ss., in lower part of Shakopee dol. as delimited by him, that was later named *New Richmond ss.* He described the beds as 20 ft. thick in well at Elevator B, St. Paul, Minn.

Elgin sandstone.

Pennsylvanian: Southern Kansas and central northern and central Oklahoma.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, p. 64). Name suggested by G. I. Adams. *Elgin ss.*—Sss. within Lecompton shales in S. part of State, which have great development around Elgin. [*Lecompton shales* of early Kans. repts has been replaced by *Kanwaka sh.*]

F. C. Schrader, 1908 (U. S. G. S. Independence folio, No. 159). *Elgin ss.*—Hard ferruginous ss. that weathers rough. Thickness 10 ft. in this quad. Rests conformably on Oread ls.

D. W. Ohern and R. E. Garrett, 1912 (Okla. Geol. Surv. Bull. 16, pp. 12–13). Elgin ss. is 50 to 40 ft. thick. It crops out in E. part of Osage Co., Okla., and extends across Osage and Pawnee Counties. Rests on Oread ls. and is overlain by 700 ft. of Penn. shales with thin lss.

L. C. Snider, 1913 (Petroleum and natural gas in Okla., pp. 44–49). *Elgin ss.* is 50 to 140 ft. thick. Is 140 ft. thick near Elgin, Kans., where it consists of an upper and lower ss. memb. separated by shaly ss. Rests on Oread ls.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3). In N. Kans. the Kanwaka sh. is calc. and locally includes thin beds of impure ls., but to S. it becomes very sandy and may well be called a ss. The name Elgin ss. has been suggested by Haworth (1898) for this phase, on account of exposures near Elgin, Chautauqua Co., where it is nearly 140 ft. thick, but to S. it becomes thinner.

A. E. Fath, 1925 (U. S. G. S. Bull. 759, p. 12). *Elgin ss.* has been traced across Pawhuska and Hominy, Okla., quads., by C. D. Smith and R. H. Wood, to whose unpublished maps writer has had access. In Bristow quad., Okla., it is a friable gray to yellowish brown ss. 50 to 80± ft. thick. Is exposed near W. margin of quad. and is highest ss. of considerable thickness in strat. section. In west-central part of quad. it is differentiated with difficulty from underlying Bristow fm. Its upper surface is distinct across the quad. and is a good strat. bdy. It is separated from overlying Perm. beds by several hundred ft. of Penn. sh., ss., and ls.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, pp. 75, 77). *Elgin ss.* is a massive ss., consisting usually of but a single memb., but it is more shaly to N. Thickness 50 to 210 ft. It rests on Nelagoney fm.

H. D. Miser, 1926 (Geol. map of Okla.). *Elgin ss.* underlies Pawhuska fm. and overlies Nelagoney fm. across central northern and part of central Okla.

†Elgin limestone. (In Maquoketa group.)

Upper Ordovician: Northeastern Iowa and western Wisconsin.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 98). *Elgin shaly ls.*—Ls., dolomites, and shaly lss., with beds of calc. sh. and thin partings of bluish, less calc. clays; generally of yellow color and 70 ft. thick. Forms basal fm. of Maquoketa stage. Includes *Isotelus* zone at base. Overlain by Clermont sh. (of Maquoketa stage) and underlain by Galena ls.

Preoccupied by Elgin ss. Is basal fm. of Maquoketa group.

Named for exposures near Elgin, Fayette Co., Iowa.

Eliot slate.

Carboniferous (Pennsylvanian?): Southwestern Maine and southeastern New Hampshire.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour. vol. 7, p. 198). *Eliot sl.*—Gray sericitic and siliceous slates, argillo-qtzitic schists, calc. beds, and carbonaceous phyllites. Present in Eliot, Maine, and Dover, N. H., extending thence SW. in two belts.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 169). *Eliot sl.*—An assemblage of gray sericitic and siliceous sericitic slates; beds of light-gray and drab argillo-qtzitic rocks, some of which are also calc.; thin laminae of light-bluish ls.; and thin layers of black carbonaceous sericite phyllite. Uniformly fine-grained and thin-bedded. Thickness not determinable. No fms. overlie it, and top may be absent. Rests on Kittery qtzite. Contemp. with lower part of Casco Bay group, especially Cape Elizabeth fm., but may also represent part of Scarboro phyllite. Assigned to Penn. (?).

Named for development at Eliot, York Co., Maine.

Eliot phyllite.

Same as Eliot sl.

Elisa quartz monzonite porphyry.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 329). [Age not stated. M. L. Lee, Econ. Geol., vol. 7, 1912, p. 330, assigned it to Tert.]

Elizabeth gabbros.

Pre-Cambrian: Eastern New York (Adirondack Mountains).

See under *Adirondack anorthosyte.*

Elizabeth sand.

Drillers' term, long in use, for a sand in western Pa. and W. Va. that probably lies in upper part of Chemung fm. Is younger than Warren First sand and Cherry Grove sand and older than Bayard sand.

Elizabeth Furnace conglomerate member (of Gettysburg shale).

Upper Triassic: Southeastern Pennsylvania (Lancaster County).

A. I. Jonas and G. W. Stose, 1930 (Pa. Geol. Surv., 4th ser., Topog. and Geol. Atlas of Pa., No. 168, Lancaster quad., p. 50). Heavy quartzose cgl., 2,500± ft. thick. Is closely associated with soft red ss. of type of Gettysburg sh. and is therefore treated as basal memb. of that fm. Rests on New Oxford fm. All included in Newark group. Forms prominent ridge (Elizabeth Furnace Hill) NE. of Mount Hope, Lancaster Co.

Elizabeth Islands moraine.

Pleistocene: Massachusetts. (See U. S. G. S. Bull. 597, 1917, p. 138.)

Elizabethtown gabbro.

Pre-Cambrian: Northeastern New York (Essex County).

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 82). *Elizabethtown gabbros* occur around Elizabethtown [Essex Co.], N. Y.

Elk conglomerates.

Cretaceous: Alberta.

W. W. Leach, 1913 (12th Int. Geol. Cong. Guidebook 9, p. 24).

Elk fire clay. (In Conemaugh formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., p. 179). *Elk fire clay.*—Reddish variegated fire clay, 5 to 7 ft. thick, underlying Brush Creek coal and overlying Mahoning ss. Named for Elk River, near Charleston.

Elk sand group.

A term applied to several subsurface brown sands, of Dev. age, aggregating 400 ft. in thickness, occurring at horizons varying from 100 to 500 ft. below Bradford sand group in Elk Co., western Pa. Immediately underlies McKean sand group. Includes Kane, Elk, and other sands. Named for Elk Co., Pa. The name *Elk* has also been applied to a sand at approx. this horizon in W. Va. (See also under *Kane sand.*)

Elk Basin sandstone member (of Telegraph Creek formation).

Upper Cretaceous: Central northern Wyoming and central southern Montana (Yellowstone and Bighorn Counties).

C. J. Hares, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 430). It has been fairly definitely established that type Eagle ss. includes in lower part the massive cliff-forming ss. at Park City and Billings, but about 100 ft. below the massive ss. is a thin sand, 10 to 40 ft. thick, which contains an Eagle fauna. This lower sand is rim-forming from Park City to Elk Basin and Shoshone River, but from there S. it is represented, as is remainder of Eagle fm., by thin-bedded sss. and aren. shales. This sand has been called *Elk Basin ss. memb. of the Eagle.* It is underlain by dark-colored sh. containing thin limy layers and concretions that weather reddish brown and rest on Carlile sh.

C. F. Bowen, 1918 (U. S. G. S. Bull. 691A, section A of pl. 25, also pl. 17), published the Elk Basin, Wyo., section from C. J. Hares' unpublished rept, in which he drew base of Montana group at base of *Elk Basin ss. memb.*, and drew base of Eagle ss. *doubtfully* 100± ft. above top of Elk Basin ss. and at base of a ss. that he correlated with Virgelle ss.

In 1922 (U. S. G. S. Bull. 736B, p. 38) the 350± ft. of transition beds underlying Virgelle ss. memb. of Eagle ss. in Yellowstone-Bighorn Counties region, southern Mont. (the fossils of which are "predominantly Montana types"), were named *Telegraph Creek fm.* by W. T. Thom, Jr. These transitional beds include the Elk Basin ss. of Hares about 100 ft. below their top. (See J. B. Reeside, Jr., U. S. G. S. P. P. 151, pp. 2, 3, 1927.)

Elk City sandstone member (of Quartermaster formation).

See under *Bessie memb.*

†Elk Creek beds. (In Cheyenne sandstone.)

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol 16, pp. 361, 366). *Elk Creek beds.*—Variable shaly and aren. strata composing that part of Cheyenne ss. that overlies Corral ss. Divided into Stokes ss. (a few ft. thick) above and Lanphier beds (10 to 15 ft. thick) below. Underlain by Corral ss. and overlain by Champion shell bed.

Named for Elk Creek, Kiowa Co.

This name was discarded by U. S. Geol. Survey in 1921, being a local name for major part of Cheyenne ss.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, pp. 13–14). *Elk Creek beds* of Cragin were named for exposures about head of Elk Creek, the lower part being differentiated by Cragin as *Lanphier beds*, from exposures on Lanphier ranch about 5 mi. SE. of Belvidere, where this memb. consists of 10 to 15 ft. of poorly cemented sands containing streaks and lenses of black to gray sh. Cross lamination is extremely common in the sss. Fragments of lignite, crystals of gyp. (selenite), and limonite concretions are commonly present. Many parts of the memb. are locally richly impregnated with gyp. Another characteristic is presence of logs composed of lignite and pyrite. All parts of Elk Creek beds contain dicotyledonous plants. Writer does not consider it possible definitely to recognize any memb. of Cheyenne ss. beyond limits of one locality. Cragin's divisions are considered to have no validity for more than local application, and as his 3 members were not differentiated in same section it is possible that 2 of them may be one.

Elk Falls limestone.

Pennsylvanian: Southern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 65–66, 105). *Elk Falls ls.* proposed by G. I. Adams in field notes for two well-defined lss. separated by a thin bed of aren. shales which here and there develop into well-formed ss. Overlies Lecompton shales and underlies Severy shales in Greenwood and Chautauqua Counties. Corresponds to Deer Creek ls., Tecumseh shales, and Lecompton ls., the two lss. being brought closer together to S.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 172, 182, 194). †*Elk Falls ls.* abandoned. Included Lecompton ls. to Topeka ls. inclusive.

Named for Elk Falls, Elk Co.

†Elkgarden formation.

Pennsylvanian: Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Elkgarden fm.*—Chiefly sh., gray and black, variably sandy and with interstratified thin flaglike bands of argill. ss. and variable bands of coal and carbonaceous sh. Base of Elkgarden coal is base of fm. Thickness nearly 280 ft. Overlies Fairfax fm. and is overlain by gravel of possible Mio. age. Most extensive exposure is on Elkgarden Plateau, Mineral Co., W. Va.

Same as Monongahela fm.

Elk Hill complex.

Pre-Cambrian (?): Southeastern Virginia (James River Basin).

S. Taber, 1913 (Va. Geol. Surv. Bull. 7, p. 57). *Elk Hill complex* is made up of 3 principal rock types—biotite granite, hornblende schist, and pegmatite—which occur interleaved in layers of varying thickness and in places are much contorted. The hornblende rock appears to have been formed first and the granite intruded into it later, while the pegmatite frequently cuts both of the other rocks. The complex is from 1 to 1½ mi. wide where it crosses James River at Elk Hill, and best exposures are found in bluffs ¾ mi. below Elk Hill.

Elkhorn shale.

Elkhorn hornstone.

Upper Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 437). *Elkhorn sh.* [on map], *Elkhorn hornstone* [text heading and table].—Series of thin-bedded strata varying from nearly pure, dense, fine-grained qtzites to calc. and argill. shales indurated and metamorphosed. Thickness 100 ft. Underlies Keene ls. [Dev. and Camb.] and overlies Cemetery ls. Seldom seen in good surface exposures, but is well exposed in a hanging-wall crosscut of Elkhorn mine, Elkhorn min. dist.

Elkhorn formation. (In Richmond group.)

Upper Ordovician: Southern and eastern Indiana and western Ohio.

E. R. Cumings, 1908 (Ind. Dept. Geol. and Nat. Res. 32d Ann. Rept., p. 678). *Elkhorn div.*—Shales and shaly lss., 46 ft. thick, overlying *Rhynchotrema dentata* zone and underlying the [so-called] Clinton [Brassfield ls.]. Characterized by

Platystrophia lynx var. *moritura*, and faunally to be known as *moritura* zone. Consists of 15 ft. of very soft blue sh., overlain by 25 ft. of blocky argill.-calc. sh., overlain by 6 ft. of hard brown ls., capped by 4 ft. of clay. Top div. of Richmond group.

E. R. Cumings, 1922 (Ind. Dept. Cons. Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 438+), gave further description of *Elkhorn fm.*, top fm. of Richmond group, and stated that type loc. is 3½ mi. SE. of Richmond, Ind.

Elkhorn moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for village of Elkhorn.

Elkhorn Ridge argillite.

Carboniferous (Pennsylvanian?): Northeastern Oregon (Baker and Sumpter quadrangles).

J. Gilluly, 1937 (U. S. G. S. Bull. 879). *Elkhorn Ridge argillite.*—Argillite, tuff, and chert, with subordinate ls. and greenstone masses. Thickness, 5,000+ ft. The interbedded lss. contain *Fusulina*, which definitely establishes Carbf. age, but possibly younger beds have been included in fm. as mapped in Baker and Sumpter quads. Relation to Clover Creek greenstone (Perm.) unknown. Named for exposures on Elkhorn Ridge, Sumpter quad.

Elkins sandstone.

Upper Devonian: Eastern West Virginia (Randolph County).

D. B. Reger, 1928 (Am. Jour. Sci., 5th, vol. 15, pp. 50–57). *Elkins ss.*—Greenish brown, generally composed of shaly, iron-stained flags or thicker beds, all separated by irregular deposits of green sh.; infrequent carbonaceous streaks. Thickness 450 to 500 ft. Marine fossils, also plants and tree trunks. Included in Chemung series. Separated from younger Valley Head ss. of the Chemung by 650 to 750 ft. of sh. and sss. Lies 1,025 to 1,250 ft. above base of Chemung. Well exposed on State road 3 mi. NW. of Elkins, Randolph Co.

Elkins Fork shale.

Pennsylvanian: Eastern Kentucky (Pike County).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 296, 297). The name *Elkins Fork shales* is proposed for the shales exposed opp. Elkins Fork school in northern Pike Co. Thickness 10 ft. The known fossiliferous portion of the shales is only 8½ ft. thick; is blue and argill., and lies only 3 ft. above creek level. Fauna (listed) chiefly species of *Productus*. By barometer the shales lie 50 ft. below Kendrick shales; and they lie 45 ft. above Dwale shales. Nothing further is known concerning the geographic distribution of these lower shales.

Elkland parvafacies.

See under *Potter parvafacies*.

Elk Lick limestone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. 60). *Elk Lick (Upper Berlin) ls.*, 6 to 12 ft. thick, underlies Elk Lick coal in Somerset Co., Pa., and lies 210 to 220 ft. below Pittsburgh coal. [On p. 223 is a section at Forwardstown, Somerset Co., Pa., in which Elk Lick ls. is placed 90 ft. above Berlin ls., and latter is shown as consisting of 2 lss. separated by 1′8″ of clay and coal. A section on p. 292 shows Elk Lick ls. lying 83 ft. above Berlin ls. and 65 to 70 ft. above Berlin coal. On p. 22 is statement that *highest ls. at Berlin* is Elk Lick ls.]

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 90). *Elk Lick ls.*—Light-gray ls., often tinged with buff. Thickness 0 to 12 ft. Lies a short distance below Elk Lick coal, from which fact it derives its name.

The Md. Geol. Surv. (vol. 11, 1922) applied *Barton* to the coal formerly called *Elk Lick* in that State, and also to the underlying ls.

Named for relations to Elk Lick coal, which was named for village of Elk Lick, Somerset Co., Pa.

Elk Lick clay.

A clay bed in Conemaugh fm., underlying Elk Lick coal of Appalachian region.

Elk Mountain transition group.

Upper Devonian or Mississippian: Northeastern Pennsylvania (Susquehanna and Wayne Counties region).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 235). ***Elk Mountain transition group*** [also ***Transition (Sub-Pocono) measures***].—Underlies Pocono gray ss. and overlies Catskill fm. Includes (descending): ***Elk Mountain Upper ss.***, 150 ft.; ***Elk Mountain shales***, reddish, 200 ft.; ***Mount Pleasant cgl.***, 20 to 25 ft. [On pp. 59 and 64 of this rept the name ***Elk Mountain shales and sss.*** was applied to 150 to 200 ft. of shales (largely gray, red, green, and spotted) with a few ss. layers, which crop out around slopes of North and South Knobs of Elk Mtns, are overlain by Mount Pleasant red sh. (top memb. of Catskill fm.), are underlain by Cherry Ridge group of Catskill fm., and occur much lower in section than Elk Mountain transition group. On p. 235, however, he called these shales and sss. of the Catskill the ***Elk Mountain lower sands***, having called a much higher ss. the ***Elk Mountain upper ss.*** The Elk Mtns are in SE. part of Susquehanna Co.]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 573–577, 606), restricted ***Elk Mountain*** to the flaggy sss. beneath his redefined ***Mount Pleasant red sh.*** and above Cherry Ridge group of I. C. White. These flaggy beds appear to be the *lower sands* of I. C. White. Willard stated his redefined ***Mount Pleasant red sh.*** included all beds above his Elk Mtn ss. and below Griswolds Gap cgl. (basal memb. of Pocono), or its equiv. This would include all of White's Elk Mtn subdivisions except his Elk Mtn lower sands, which becomes Elk Mtn ss. of Willard. He correlated his Elk Mtn ss. with Oswayo fm., which U. S. Geol. Survey classifies as Dev. or Carbf.

Elk Mountain shales.

Elk Mountain shales and sandstones.

Elk Mountain Upper sandstone.

Elk Mountain lower shales.

Elk Mountain lower sands.

See under *Elk Mountain transition group.*

Elk Mountain porphyry.

Eocene: Central Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48). ***Elk Mtn porphyry.***—Light gray, porphyritic. Named for Elk Mtn. [In inset headings he calls the mass of this rock on Copper Mtn the *Copper Mtn porphyry* and the mass on Gold Hill the *Gold Hill porphyry.*]

Elk Mountain sandstone.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 574–577). ***Elk Mtn ss.***—Green to grayish green, flaggy ss., very cross-bedded, with few sh. interbeds. The cross-bedding is most distinctive feature. The fm. extends around foot of Elk Mtns, Susquehanna Co., for which I. C. White named it. He appears to have included with the Elk Mtn some beds more truly assignable to adjacent red fms. As here used the name is applied to the nonred cross-bedded flags only, overlying Cherry Ridge red beds and underlying Mount Pleasant red sh. Latter includes all beds up to base of Griswolds Gap memb. of Pocono fm. One of best exposures of Elk Mtn ss. is in hills N. of U. S. Highway 6, near Prompton, Wayne Co., and there are many in SE. Susquehanna Co. This fm. is persistent from Wayne Co. S. into Monroe, but appears to die out there, so that it is not surely recognized W. of Pocono Plateau. Its absence prevents satisfactory separation of the Mount Pleasant and Cherry Ridge in Lehigh Valley and to W. To W. of Wayne Co., all through N. tier of counties to Potter, the fm. occurs, until it passes over into marine Oswayo sandy sh. in W. part of Potter and McKean Counties [which U. S. G. S. classifies as Dev. or Carbf.]. Probably present in Clinton Co. Thickness changes little from 150± ft. in Wayne Co. to slightly over 200 ft. in Bradford Co. In Potter Co. the cross-bedding is less pronounced, the color more olive to olive brown than green, indications of marine life appear, and at base there is a remnant of Salamanca cgl. with marine fossils. [As thus defined Elk Mtn ss. of Willard appears to replace *Elk Mtn lower sands* of I. C. White.]

Elko shale.

Elko group.

Eocene: Northeastern Nevada.

S. F. Emmons, 1877 (U. S. Geol. Expl. 40th Par. vol. 2, pp. 551–564, and other pages), stated in several sections that *Elko shales* are part of Green River fm.

C. King, 1878 (U. S. Geol. Expl. 40th Par. vol. 1, p. 458), applied *Elko group* to Eocene deposits in northern Nev., but on p. 393, where he described the deposits of Elko Range and Elko Station, he called the Eocene beds *Green River group*, and said they are same as Green River group of Hayden. This correlation with Green River fm. has not yet been established.

Elko formation.

Cambrian: British Columbia.

S. J. Schofield, 1914 (Canada Geol. Surv. Mus. Bull. 2, p. 83). [In 1915 and later repts assigned this fm. to Camb.]

Elkoan series.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, pp. 215, 217, 219). *Elkoan series.*—Includes (descending) Rooseville shales, Phillips shales, Gateway shales, Sheppard dolomites, and Purcell basalts. Uncon. overlies Helenan series [Helena ls.] and uncon. underlies Ross qtzites. Of latest Mid Proterozoic age.

Derivation of name not stated, but may be Elko, British Columbia.

Elko Prince rhyolite.

Tertiary: Central northern Nevada (western part of Elko County).

E. H. Rott, Jr., 1931 (Univ. Nev. Bull., vol. 25, No. 5). *Elko Prince rhyolite* (Tert.) occurs in both E. and W. walls of Elko Prince vein in Gold Circle or Midas mining dist. Is conformably overlain by andesite. Relations to June Bell rhyolite undet. If the June Bell is extrusive it is older than Elko Prince; if intrusive it is younger.

†Elk River series.

Pennsylvanian: West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 70–98). *Barren Measures or Elk River series.*—As defined [but not named *Elk River series*] by Rogers Bros. in Pa. and Va., this group extended from base of Pittsburgh coal to top of Mahoning ss., but subsequent investigations seem to render it more desirable to extend the group downward so as to include Mahoning ss.

Same as Conemaugh fm., the older name.

Elk River beds.

Pleistocene and Pliocene (?): Southwestern Oregon (Cape Blanco region).

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 30–31). At mouth of Elk River the Mio. sh. occurs at water's edge and is overlain (apparently conformably) by nearly 100 ft. of Pleist. gravel and sand (*Elk River beds*), near base of which, close to the Mio., is an unconsolidated shell bed rich in fossils. Toward Cape Blanco the shell bed rests uncon. on Mio. Dr. Dall says fossils are probably Pleist.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, No. 212, pp. 560, 595). *Elk River fm.* (*upper Plio.*).—Extending from the Goldwashers' cabin 1¾ mi. SE. of Cape Blanco S. to Garrison Lagoon, near Port Orford, is a gently southward-dipping cliff, essentially a raised beach composed of sands and littoral gravels, blue and more or less concretionized at base but rusty and hardly consolidated above, perhaps 250 ft. thick near their contact with underlying Empire ss., lying to N., but gradually dropping below sea level to S. This fm. has been named by Diller *Elk River beds*, from an important stream which cuts through the section. As a matter of fact Diller's name was given to only upper rusty portion of the section, while the blue beds conformable below were included with *Empire fm.* (*Cape Blanco beds*), a procedure not borne out by fauna. There is marked discrepancy btw. dip and strike of Empire beds and the overlying blue sands that was apparently overlooked by Diller. Fauna is chiefly recent species, but associated with them are others common to the Merced, thus establishing Plio. age of Elk River fm. [Fossils listed.]

B. Martin, 1916 (Univ. Calif. Bull., vol. 9, pp. 245–247). *Elk River beds* (*Pleist.*).—Consist of (descending): (1) Loose gray sand with fossils very similar to Upper San Pedro of Calif., conformable with (2), which consists of blue-gray argill. ss. or mudstone, probably late Plio.; (3) thick bed of cgl. at base. Uncon. overlies Cape Blanco beds (=Empire fm.).

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 264–270). Diller published nothing on fauna except that Dall had reported his collections to be Pleist. In 1913 Arnold and Hannibal published a partial list of fauna, but included that of underlying Plio. argill. sands without any information about zonal distribution of species. It is therefore impossible to say which sp. belong to Elk River beds and which to Plio. beds. [Discusses Martin's 1916 paper.]

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, p. 269), and H. V. Howe, 1926 (Pan-Am. Geol., vol. 45, p. 304), followed Arnold and Hannibal by assigning this fm. to upper Plio.

Elk Valley erosion cycle.

Name applied by G. R. Mansfield (Jour. Geol., vol. 32, 1924, p. 485) to a Pleist. erosion cycle in SE. Idaho.

Ellenburger limestone.

Late Cambrian and early Ordovician: Central Texas.

S. Paige, 1911 (U. S. G. S. Bull. 450, p. 24). *Ellenburger ls.*—Chert-bearing lss. and dolomites, with usually a conglomeratic ls. at top. Thickness probably 1,000 ft. Uncon. may exist near top. Overlies, possibly uncon. in places, Wilberns fm. and underlies Carbf.

Named for Ellenburger Hills, Burnet Co.

Ellensburg formation.

Miocene: Central Washington.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137, map). *Ellensburg ss.*—Sss., loose incoherent cgls., sheets of volcanic lapilli and white volcanic dust. Thickness 800 or 1,000 ft. Fresh-water. Fossil plants are upper Mio., according to F. H. Knowlton. Floors Kittitas Valley, in which Ellensburg is situated. Separated from underlying Roslyn ss. by several sheets of Columbia lava and associated tuffs.

In 1901 (U. S. G. S. W. S. P. 55) G. O. Smith applied name *Yakima basalt* to the basalt underlying Ellensburg fm., and gave thickness of Ellensburg as 1,600 ft.

G. O. Smith, 1903 (U. S. G. S. Ellensburg folio, No. 86, and U. S. G. S. P. P. 19). *Ellensburg fm.* consists of 1,570 ft. of largely volcanic sediments, the sss. and shales composed of finely comminuted andesitic material and the cgls. containing pebbles and bowlders of andesitic lavas. In Yakima region it is of fluviatile origin, while farther E. along the Columbia it is truly lacustrine. The lava flows interbedded in lower part are here named *Wenas basalt.* [The beds farther E. along the Columbia are now known to be younger than Ellensburg fm., and to be of Pleist. age. They have been named *Ringold fm.* by J. C. Merriam and J. P. Buwalda.]

In 1924 Knowlton was inclined to classify Ellensburg flora as middle Mio. In 1930 J. C. Merriam and J. P. Buwalda classified Ellensburg as late Mio. or lower Plio., which was age designation given to it in 1918 by H. F. Osborn. E. W. Berry (1932) considered this flora in need of careful study.

Ellerslie sandstone. (In Allegheny formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Ellerslie ss.*—Underlies Middle Kittanning (Luke) clay and overlies Lower Kittanning (Ellerslie) coal; all included in Allegheny fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 47). A ss. is found locally over Ellerslie coal, and to it the name *Ellerslie ss.* is here applied, because of its position. [The Ellerslie coal is mined at Ellerslie, Md.]

Ellerslie fire clay. (In Allegheny formation.)

Pennsylvanian: Western Maryland (Georges Creek Basin).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Ellerslie fire clay* (*Lower Kittanning fire clay*).—Underlies Lower Kittanning (Ellerslie) coal and overlies Mount Savage ss.; all included in Allegheny fm.

Ellettsville stone.

Trade name of a ls. quarried from Spergen ls. in southern Ind.

Ellicott shale member.

Upper Devonian: Northwestern Pennsylvania and southwestern New York (Chautauqua County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 66–70). *Ellicott sh. memb.*—Top memb. of Chadakoin stage. Overlies Dexterville sh. memb. and underlies, with hiatus, Panama cgl. memb. of Conewango series. Includes near top "Tanner's Hill red" band. Is well-marked lithic and faunal memb. and merits separation from Dexterville memb. In Warren folio upper part of Ellicott memb. was included in Conewango fm. because of failure to recognize Panama cgl. Fauna inadequately known, but there is abrupt faunal change at top of underlying Dexterville sh. [Thickness of Ellicott memb. not given and lithology not clearly defined, but on p. 64 author stated that 42 ft. of green platy sh. and ss., with fossiliferous lenses that weather chocolate, lie near base of Ellicott memb. at Dexterville brick sh. quarries, East Jamestown, N. Y., and that btw. this sh. and ss. and the Dexterville sh. is a concealed interval 140 ft. thick; the Dexterville sh. of this section consisting of chocolate and green shales and sss. aggregating 138 ft.] Type occurrence of Ellicott sh. memb. is along "Hunt Road," btw. Ashville and Jamestown, N. Y., where it is exposed in roadside cuts. This is in town of Ellicott, Chautauqua Co., N. Y.

Ellicott City granite.

Late Paleozoic (?): Northeastern Maryland (Baltimore County).

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 134–135). *Ellicott City granite.*—A narrow outcrop of massive biotite-quartz monzonite (very similar in appearance to Woodstock granite), which extends SW. from Ellicott City, on Patapsco River, to Orange Grove. Is quarried at Ellicott City. Intrudes Wissahickon fm. Age may be as late as close of Paleozoic.

Ellicottville conglomerate.

Name applied in some early N. Y. and Pa. repts to the cgl. at Ellicottville, Cattaraugus Co., N. Y., apparently supposed by J. P. Lesley in 1875 (see first entry under *Olean cgl.*) to be Olean cgl., but stated by J. F. Carll in 1880 (2d Pa. Geol. Survey Rept. I_3), also Lesley in 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, p. 1531), to be the much older Salamanca cgl.

Elliott Cove formation.

Upper Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Elliott Cove fm.*—Gray and black shales with cone-in-cone concretions and thin-bedded sss. Fossiliferous. Underlies Brown Mead fm. and overlies Manuels fm. Assigned to Upper Camb. [Derivation of name not stated.]

Elliott Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 376). *Elliott Creek bed.*—Chiefly bluish-gray clays, slightly shaly at places, but toward base and top interstratified with thin sss. Thickness 100 ft. Memb. of Strawn div. Overlies Burnt Branch bed and underlies Shadrick Mill ss.

Named for Elliott Creek, Lampasas Co.

Ellis formation.

Upper Jurassic: Montana (widespread) and northwestern Wyoming.

A. C. Peale, 1893 (U. S. G. S. Bull. 110, map). [This map (of "vicinity of Three Forks, Mont.") shows *Ellis fm.* as overlying Quadrant fm. and underlying Cret. (the basal fm. of which is designated *Dakota fm.*), but does not describe the deposits.]

J. P. Iddings and W. H. Weed, 1894 (U. S. G. S. Livingston folio, No. 1). *Ellis ls.*—Sandy ls. underlain by *Myacites* beds, the latter consisting of impure fossiliferous lss. or soft earthy calc. rocks of dark-gray color, with sss. at base. Thickness 400 ft. At Cinnabar Mtn the *Myacites* beds rest upon a massive cross-bedded, ripple-marked ss., underlain by a bright-red ss. which may be=the Red-bed sss. of more southern localities. Underlies Dakota fm. and overlies Quadrant qtzite.

A. C. Peale, 1896 (U. S. G. S. Threeforks folio, No. 24). *Ellis fm.* (*Juratrias.*)—As here mapped the basal part consists of 40 to 60 ft. of nonfossiliferous qtzitic ss., which probably belongs to the Juratrias but which may possibly be Carbf. Above this basal qtzite the fm. consists largely of argill. ls., many of the beds crowded with Jurassic fossils. The middle and upper parts of fm. are more aren. and devoid of fossils. Total thickness 300 to 500 ft. Overlies Quadrant fm. and underlies Dakota fm.

The commonly accepted definition of Ellis fm. applies to Upper Jurassic marine strata and excludes any older beds that may inadvertently have been included in the earlier mapping.

Named for Fort Ellis, an old military post in Livingston quad., to E. of Bozeman, Mont., near which the fm. is mapped in Livingston folio.

Ellis Bay formation.

Ordovician: Anticosti Island.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 695, 701).

Ellison formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, with maps). *Ellison fm.*—Massive, hard, medium-grained qtzites, usually in beds btw. 10 and 30 ft. thick, interbedded with gray quartz mica schist. Underlies West Ledge fm. and overlies Homestake fm. Thickness 300 ft. Believed to be of Keewatin age.

Named for exposures on road to Homestake mine office and Ellison shaft.

†Ellisville phase.

Miocene and Oligocene (?): Southern Louisiana and southern Mississippi.

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90–91). *Fort Adams or Ellisville phase* of Grand Gulf group Mio. has very irregular boundaries, its southern line drawn from Tunica, La., by Columbia, Miss., by mouth of Okatoma Creek, by the Falls on Leaf River near Estabuchie, passing to S. of Ellisville and crossing Chickasawhay River btw. Winchester and Waynesboro. For convenience this div. will be called *Fort Adams or Ellisville phase.* Extends into Ala.

Includes Catahoula ss., Hattiesburg clay, and lower part of Pascagoula clay. (See G. C. Matson, U. S. G. S. P. P. 98, 1916, pp. 224–225.)

Named for Ellisville, Jones Co., Miss., and Fort Adams, Wilkinson Co., Miss.

Ellsworth schist.

Cambrian or pre-Cambrian: Southeastern and central southern Maine.

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, pp. 1–2). *Ellsworth schist.*—Highly metamorphic argill. sed. rocks, of prevailingly greenish gray color and locally much injected by quartz. In contact with granite, diorite, serpentine, and Castine fm. (volcanic), all of which are distinctly younger. Believed to be oldest fm. in quad. Since Islesboro, Castine, and Penobscot fms. and North Haven greenstone are regarded as probably Camb. or Cambro-Ord. in age, the older Ellsworth schist is presumably early Camb. or pre-Camb. Named for exposures near Ellsworth, Hancock Co.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as pre-Camb.

Ellsworth shale.

Mississippian: Central western Michigan (Muskegon region).

R. B. Newcombe, 1932 (A. A. P. G. Bull., vol. 16, No. 2, p. 159). *Ellsworth fm.*—Blue sh. and limy ss., 509 ft. thick in H. Heinz No. 5 well at Muskegon, underlying Lower Marshall and Coldwater fms. and overlying Antrim fm. [Derivation of name not stated.]

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 22, 49). [On p. 22 the Bedford is shown as divided into (descending) (1) sh., gray, red, sandy, 0–160 ft.; (2) *Ellsworth,* sh., gray, greenish gray, sandy, 400 to 600 ft.; and as resting on Antrim sh.] The beds exposed S. of Ellsworth, Antrim Co., have not been correlated definitely with Bedford sh. of Ohio. Best exposure is about 1½ mi. S. of Ellsworth, in Petoskey Portland Cement Co. quarry, where a ledge of 30 to 40 ft. of greenish-gray sh. is being worked. Location of quarry is in NE¼ NE¼ sec. 26, T. 32 N., R. 8 W., Banks Twp, Antrim Co., Mich. Total thickness of strata btw. top of brown Antrim sh. and base of a red shaly ls., probably of Coldwater age, in W. part of State is btw. 500 and 600 ft. It is proposed that these beds be called *Ellsworth sh.*, and that type section be referred to above locality. A complete section of fm. is found in Chas. Reeths No. 1 well, NW¼ NW¼ sec. 9, T. 10 N., R. 16 W., Muskegon Twp, Muskegon Co., where the sh. series is 530 ft. thick. This section includes blue sh., light- and dark-gray sh., and greenish-gray sh. [Detailed section given.]

Elm Branch shale.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 90, 97). [See under *Swope fm.*] Named by N. D. Newell.

J. M. Jewett, 1932 (pp. 99, 101, 103 of book cited above). *Elm Branch sh.* will be proposed by Newell to include strata overlying Sniabar ls. and underlying Middle Creek ls. Where these limiting lss. are present in Kans. the thickness ranges from about 5 to 12 ft. and it contains local beds of ls. less than 1 ft. thick. [Derivation of name not stated.]

W. A. VerWiebe and W. R. Vickery also used *Elm Branch sh.* (on p. 117 of book cited above) for beds underlying Middle Creek ls. and overlying Sniabar ls.; as did R. C. Moore and G. E. Condra in their Oct. 1932 revised classification of Penn. of Kans. and Nebr., and J. M. Jewett (Kans. Acad. Sci. Trans., vol. 36, 1933, p. 132).

G. E. Condra and J. E. Upp, 1933 (Nebr. Geol. Surv. Paper No. 4, p. 7). In Madison Co., Iowa, *Elm Branch sh.* underlies Middle Creek ls., overlies Sniabar ("Hertha") ls., and consists of (descending): (1) gray calc. sh., fossiliferous at top, 1 ft. 10 in.; (2) ls.-mudstone, dark gray, probably not persistent, 1+ ft.; (3) gray argill. sh., 4 ft.; (4) ls.-mudstone, dark gray, uneven, 1 ft. 3 in.; (5) gray sh. with poorly defined reddish subzone near base, 6± ft. [Derivation of name not stated.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 19), called the sh. underlying Middle Creek ls. and overlying Hertha (Sniabar) ls. the *Ladore sh.*, and apparently discarded *Elm Branch sh.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 82), formally discarded †*Elm Branch sh.*

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Elm Creek limestone member (of Admiral formation).

Permian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 424). *Elm Creek bed.*—Mostly bluish-gray ls., with some yellowish, friable, dark shaly, and highly fossiliferous ls., and some marly clay. Thickness 25 to 150 ft. Memb. of Albany div. Overlies Coleman bed and underlies bed No. 8 (50 to 75 ft. of clay).

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192–198 and charts). *Elm Creek ls.*, 20 to 50 ft. thick, is top memb. of Admiral fm. (basal fm. of Wichita group). Overlies Coleman clay and underlies Belle Plains fm., the basal bed of which is bed No. 8 of Drake.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 170, 172, 173). *Elm Creek ls.*, 20 to 50 ft. thick, is top memb. of Admiral fm., and a prominent escarpment-forming ls.

Named for Elm Creek, Brown Co.

Elm Creek limestone. (In Canyon group.)

Pennsylvanian: Central northern Texas (Wise County).

E. Böse, 1918 (Univ. Tex. Bull. 1758, p. 18). *Elm Creek ls.*—Light-gray ls. in moderately thick beds, with an irregular surface. Thickness 8 ft. We find it in middle part of Elm Creek, Wise Co. Farther W. it is well exposed in lower part of Indian Creek and upper part of Big Creek, and to S. it forms an extensive plain slanting NW. to W. of Jack Co. line. Contains fossils. Is overlain by 20 ft. of gray shales with rare fossils and underlain by 40± ft. of gray shales with intercalated sss. Lies 140± ft. higher than Devils Den ls. Probably belongs to Canyon div.

Elm Creek limestone. (In Cherokee shale.)

Pennsylvanian: Northeastern Oklahoma (Ottawa County).

S. Weidman, 1932 (Okla. Geol. Surv. Bull. 56, pp. 25–26). *"Elm Creek" ls.*—A 6- to 10-inch band of ls., containing abundant fossils, is present in several places within Cherokee fm. in NW. part of Ottawa Co. and adjoining area in Kans. It occurs along Elm Creek, S. of the road, in NW¼ SE¼ sec. 10, T. 28 N., R. 22 E.; along Fourmile Creek in central part of sec. 30, T. 29 N., R. 22 E., and along E. bank of Neosho River in E. part of sec. 15, T. 29 N., R. 21 E. Also on S. slope of a hill in W. part sec. 15, T. 35 S., R. 3 E. (Kans.), a short distance N. of Kans. State line. Exact horizon of the ls. could not be definitely determined, but where developed it probably occurs 10 to 20 ft. below Bluejacket ss.; but it was not found in sections where the Bluejacket is known to occur. It is such a thin bed that it may not have been developed except in a few places, and it is possible the above occurrences do not represent same horizon.

Elmdale shale (Kansas). } (In Wabaunsee group.)
Elmdale formation (Oklahoma). }

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern and central Oklahoma.

J. W. Beede, 1902 (Kans. Univ. Sci. Bull., vol. 1, p. 178). *Elmdale fm.* proposed in unpublished mss. by C. S. Prosser and J. W. Beede. Consists of shales with occasional thin lss.; 111 to 118 ft. thick; containing many fossils in lower part. Underlies Neva ls. and overlies ls. which is probably = Americus ls.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 708). *Elmdale fm.*—Yellowish to bluish shales, with thin beds of alternating ls. including 2 or 3 thicker ones. Thickness 130 ft. Underlies Neva ls. and overlies Americus ls.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Elmdale beds*, 150 ft. thick, overlie Americus ls. and shales and underlie Crusher Hill alternating shales and lss. They include a friable Fusulina ls. 24 ft. above base; the Neva and Cottonwood lss. and intervening beds; and, at top, 12 ft. of sh.

A. J. Smith, 1905 (Kans. Acad. Sci. Trans., vol. 19, pp. 150–154). *Elmdale fm.* underlies Neva ls. and overlies Americus ls. [This definition of Elmdale was followed for many years.]

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, pp. 38, 52). As defined by Prosser and subsequently used in Kans., the *Elmdale sh.* included a series of beds of sh. and ls. above Americus ls. and below Neva ls., with a total thickness of 130 ft. The strata btw. same limiting beds are but little less than 130 ft. thick in Cowley Co., Kans., but lower third of this thickness combined with Americus (?) ls. is herein called *Foraker ls., thus restricting Elmdale sh.* to strata btw. Foraker and Neva lss., having a total thickness of about 80 ft. The lowermost third of Elmdale fm. as thus defined is mostly sh. and is succeeded by 20 ft. of thin-bedded gray ls., of which the uppermost 2 to 3 ft. is deep buff and soft, the whole 20 ft. constituting the Red Eagle ls. memb.

R. C. Moore, 1929 (Kans. Geol. Surv. Bull. 12, p. 50, footnote). The section E. of Elmdale exhibits clearly all subdivisions of Elmdale sh. differentiated and named by Condra in Nebr. (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 84, 1927), with Americus ls. at base and Neva ls. at top. The Foraker probably includes equivalents of Americus ls., Stine sh., Houchen Creek ls., Hughes Creek sh., and Long Creek ls. In view of known remarkable lateral persistence of minor strat. units from Nebr. to central Kans., it is likely detailed strat. work will afford basis for definite determination of relations of type Foraker to Americus and Elmdale.

See 1932 entry under *Admire sh.*, for later definitions of boundaries.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 50 and 251), dropped *Elmdale sh.* from his revised classification, treating its many subdivisions as fms. (See Kans. Nebr. chart compiled by M. G. Wilmarth, 1936.) The U. S. Geol. Survey has not yet had occasion to consider these innovations for its publications.

Named for exposures E. of Elmdale, Chase Co., Kans.

Elm Grove limestone member (of Washington formation).

Permian: Northern West Virginia (Panhandle) and southeastern Ohio.

G. P. Grimsley, 1907 (W. Va. Geol. Surv. Rept. Ohio, Brooke, and Hancock Counties, p. 68). *Elm Grove ls.*—Deep-blue or black ls., 2½ to 10 ft. thick. Underlies Waynesburg ss. and overlies Cassville plant sh. Exposed near Elm Grove and E. from that town, in Ohio Co., W. Va.

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21). *Elm Grove ls.* is of fresh-water origin.

Elmo limestone member. (In Sumner group.)

Permian: Central Kansas (Dickinson County).

C. O. Dunbar, 1924 (Am. Jour. Sci., 5th, vol. 7, pp. 176, 178–208). *Elmo ls. memb.*—Chalky, light-gray, argill., thin-bedded ls., in layers ½ inch to 4 inches thick, containing fossil insects and land plants. It is the conspicuous calc. zone in a section dominantly made up of shales. Thickness 5½ ft. Overlain, on Insect Hill, by 9 ft. of light-gray sh. and harsh shaly ls., and underlain with sharp and irregular contact, by "stump bed," consisting of black sh. containing land plants and, at base, bone cgl. Occurs in midst of Wellington sh., probably 250 to 300 ft. above base. Named for occurrence about 3 mi. S. and ½ mi. E. of village of Elmo, Dickinson County, where it caps Insect Hill.

Elmont limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 30). *Elmont ls.*—Very fossiliferous, white or gray argill. ls., 1 to 2 ft. thick, found on top of hills near Elmont [Shawnee Co.] and to N. Included in Upper Coal Measures of Shawnee Co. [From statement on p. 28 appears to underlie Willard sh. and overlie Auburn sh.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 66, 68, 71). Elmont ls. of Beede is one bed of the unit which Kirk may have meant to call Emporia ls. It is "Preston" ls. of Condra and Bengston. If Emporia is to be retained it should apply to ls. btw. Willard sh. and Auburn sh., and that definition is adopted in this rept. Emporia has priority over Beede's Elmont ls. [This discards *Elmont ls.*]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). Preston ("Emporia") ls. fm. underlies Willard sh. fm., overlies Auburn sh. fm., and is divided into (descending): *Elmont ls.*, 2 to 5 ft. thick; Harveyville sh., 3 to 7 ft. thick; and Reading ls., 3± ft. thick.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 226). According to Beede's section *Elmont ls.* occurs btw. Auburn sh. below and Willard sh. above. It appears from study of type sections that the Elmont is="upper Emporia" of authors. In southern Kans. the Elmont is dense, hard, dark-blue ls. very like Reading ls., but it commonly bears much more closely spaced vertical joints and is typically a single massive bed that weathers light bluish. Is traced from Nebr. across Kans. to northern Okla. where it has been included in upper part of Stonebreaker ls. Thickness 1 to 15 ft.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Elm Point limestone.

Devonian: Manitoba.

E. M. Kindle, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 251).

Elmtree slates.

Silurian: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 43).

Elmwood beds.

Silurian: Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 26, 27–31). *Elmwood beds.*—Underlies, with sharp contact, Clark Reservation ls. and grades into underlying

Olney ls., all included in Manlius group. Is divided into (descending): (1) *Elmwood C*, upper water lime, consisting of 4± ft. of drab water lime usually very soft, barren in Onondaga Co.; (2) *Elmwood B*, bluish black ls., which disappears to W.; (3) *Elmwood C*, lower water lime, consisting of 6± ft. of drab water lime nearly or quite barren, sometimes hard in lower part, but chiefly fairly soft. Type section at Sweet's quarry, about ½ mi. NE. of Onondaga Hill and in belt btw. St. Agnes Cemetery and Elmwood Park.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 18). [See 1935 entry under *Manlius ls.*]

El Pasan series.

A term employed by C. R. Keyes to cover the Ord. lss. of western Tex. and southern N. Mex., which were formerly all included in El Paso ls., but which are now divided into Montoya ls. (above) and El Paso ls. restricted (below). He also applies the name to supposedly contemp. deposits in other States.

El Paso limestone.

Lower Ordovician: Western Texas and southern New Mexico.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 29). *El Paso ls.*—Mainly massive gray fossiliferous ls., locally aren. at base and containing throughout bands of chert irregularly distributed. Of variable hardness. Ranges in color from drab and buff, with locally reddish and bluish streaks, to prevailing gray. Thickness 1,200 ft. Comprises all of Ord. in Franklin Mtns. Underlies Sil. ls. In places overlies Camb. Bliss ss. and in other places rests on pre-Camb. rocks.

G. B. Richardson, 1908 (Am. Jour. Sci., 4th, vol. 25, pp. 476, 477–479), restricted *El Paso ls.* to lss. of Lower Ord. age, and named the lss. of Upper and Middle Ord. age the *Montoya ls.* He described El Paso ls. as thus restricted as gray, chiefly mag. ls., usually massive but locally thin-bedded; lower 100 ft. characteristically aren. and weathers brownish. Thickness 750 ft. in Van Horn quad. and 1,000 ft. in El Paso quad. Not sharply separated from Montoya ls. In El Paso quad. overlies Bliss ss. with apparent conformity, where that fm. is present; where it is absent the El Paso rests on pre-Camb. In Van Horn quad. it overlies Van Horn ss. (Camb.).

Of Beekmantown and Chazy age. May possibly include beds of Upper Camb. age.

Named for exposures in Franklin and Hueco Mtns, El Paso quad., Tex.

El Portal stage.

Pleistocene: Eastern California (Yosemite region).

F. E. Matthes, 1929 (Sci., n. s., vol. 70, pp. 75–76). Three stages of glaciation are recognized in Sierra Nevada; the youngest is properly correlated with Wisconsin stage; to the next older, which probably corresponds to Illinoian stage, the name *El Portal stage* is here applied; and to the oldest the name *Glacier Point stage* is here applied. The ice of El Portal stage was much more extensive than the ice of Wisconsin stage, reaching 10 mi. farther down Merced Canyon and terminating a short distance below El Portal, the entrance to Yosemite Park. Frontal moraines are lacking there, but the lateral moraines can readily be traced to vicinity of El Portal, and beyond that place begin the remnants of a long valley train of outwash material that must have extended from the front of the glacier. [See also F. E. Matthes, U. S. G. S. P. P. 160, 1930.]

El Reno formation.

Permian: Western Oklahoma.

C. M. Becker, 1929 (A. A. P. G. Bull., vol. 13, p. 955). *El Reno fm.* proposed for beds of Chickasha-Duncan time, to include all beds from top of Hennessey sh. to base of lower memb. of Whitehorse ss.

C. M. Becker, 1930 (A. A. P. G. Bull., vol. 14, pp. 37–56). At a conference of 10 geologists, who had detailed the areas in Wichita Mtns region here described, it was decided to suggest the name *El Reno fm.* to include the 575 to 650 ft. section (of Chickasha-Duncan ss.) from top of Hennessey sh. to base of Whitehorse ss. That the Chickasha-Duncan grades laterally into Dog Creek, Blaine, and Flower-Pot and has same time equiv. is now recognized by every field geologist who has detailed the entire region.

Probably named for El Reno, Canadian Co.

Elsinore metamorphic series.

Triassic: Southern California (Riverside County).

P. H. Dudley, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 223). *Elsinore series*, large thickness of metamorphics in area btw. towns of Riverside and San Jacinto and Corona and Elsinore. Oldest rock in area.

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, pp. 493-496). The name *Elsinore metamorphic series* has been chosen to include all metamorphic rocks in Perris-Elsinore area. Includes meta-sediments and meta-volcanics, ranging from coarsely crystalline gneisses and schists to slates, granulites, lss., banded cherts and altered andesitic volcanics. Thoroughly recrystallized. Color varies from dark brown to almost bluish black. Intruded by various plutonic bodies and by Temescal dacite porphyry. Are oldest rocks in Perris-Elsinore region. Uncon. overlain by Alberhill clays (Tert.). No fossils. Correlated, on lithology, with metamorphics of Santa Ana Range and Cuyamaca region. [On map assigned to Triassic.]

Elsinore sand.

A subsurface oil sand, of middle Mio. age, in North Dome of Kettleman Hills, southern Calif., where it is said to lie above Temblor fm. and in Monterey sh. (See H. V. Dodd and E. J. Kaplow, 1933, Calif. Div. Oil and Gas, Calif. Oil Fields, vol. 18, No. 4, pl. 1, where it is shown as lying at 1,875± ft. depth.)

†Elstone formation.

Eocene: Southern Texas (Medina County).

R. A. Liddle, 1921 (Univ. Tex. Bull. 1860, p. 75, map, and columnar section). *Elstone fm.*—Impure gray and yellow-gray, medium coarse-grained ls., moderately soft glauconitic ls.; argill. and aren.; fossiliferous. Thickness 30 to 40 ft. Lower fm. of Midway group in Medina Co. Underlies Squirrel Creek fm. and uncon. overlies Escondido fm. (Upper Cret.). Occurs in bed of Hondo River ¼ mi. above the bridge at Elstone.

G. H. Chadwick, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 117). [See 1929 entry under *Squirrel Creek fm.*]

Julia Gardner (personal communication, July 1930). The so-called "Elstone fm." and "Squirrel Creek fm." are lithologic facies and do not maintain a uniform strat. position in the Midway.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 539, 550, 556). *Elstone ls. lentil* was named by Liddle. It is a white, hard, massive, fossiliferous ls. at top of Pisgah memb. of Kincaid fm. in southern Tex. Typically exposed near Elstone, Medina Co.

El Torre syenite.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 324).

Elvins group.

Upper Cambrian: Southeastern Missouri.

E. O. Ulrich and H. F. Bain, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, pp. 12, 17, 23-26). *Elvins fm.*—Shales, shaly lss., and more or less earthy dolomites, 0 to 120 ft. thick, intervening btw. shaly top of underlying Bonneterre ls. and cherty lss. of Potosi group above. In vicinity of Elvins and Flat Rock base of Elvins is marked by zone, 6 to 10 ft. thick, consisting mainly of indurated platy sh., at bottom and top of which is a layer, a few inches thick, largely made up of lenticular pebbles, usually arranged edgewise, in subcrystalline limy matrix, and btw. the layers one or more smaller lenses of cgl. This "cgl. zone" was included in the Potosi by Nason, which writers believe to have been a mistake, and prefer to make it the lower and greater part of a distinct fm. for which the name *Elvins fm.* is proposed. The Elvins is=basal part of Potosi ls. and=Potosi slates and cgls. of Nason. It rests uncon. on Bonneterre ls., the most appropriate and probably the only strictly available designation for the ls. beneath the cgl. of Elvins fm. Contact with overlying Potosi [restricted] is at least locally uncon. In N. part of St. Francois Co. drill holes frequently pass through 160 to 250 ft. of shales and chertless ls., thus indicating a greater thickness for the fm. than is found in section measured at Elvins. However, it is at present not possible to say how much of these shaly beds underlies the cgl. layers and thus belong to Bonneterre fm.

E. R. Buckley, 1907 (Mo. Bur. Geol. and Mines vol. 10, 2d ser., *separate*), in a table, divided Elvins fm. into (descending) Doe Run, Derby, and Davis, but did not define the subdivisions.

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1), divided *Elvins fm. of Ulrich* into (descending) Doe Run, Derby, and Davis fms., and restricted Potosi fm. to overlying 300 ft. of siliceous cherty and drusy dol.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 623, 629). Bonneterre dol. is followed, *apparently without break*, by *Elvins fm.*, which begins with a sh. and ends with an earthy mag. ls. There is an important uncon. btw. Elvins fm. and overlying Potosi dol.

See also under *Bonneterre dol.* and *Davis fm.* This name is now used as a group name, to include Doe Run dol., Derby dol., and Davis fm.

Named for exposures at Elvins, St. Francois Co.

Elwren sandstone. (In Chester group.)

Mississippian: Southwestern Indiana and northern Kentucky.

C. A. Malott, 1919 (Ind. Univ. Studies, vol. 6, No. 40, pp. 7–20). *Elwren ss.*—One or more members of ss. and frequently considerable thicknesses of sh. In region of "American Bottoms" it consists below of a ss. from a few ft. up to 30 ft. thick, and above of a gray-blue sh. with a maroon streak extending up to overlying Beech Creek ls. Rests on Reelsville ls. Named for exposures in vicinity of Elwren, Monroe Co., Ind., in cuts of Illinois Central Ry. To N. and E. of area mapped the Elwren ss. has unusual thickness and occupies position of several of the lower units which had been eroded away previous to its deposition.

Ely greenstone.

Pre-Cambrian (Keewatin): Northeastern Minnesota (Vermilion district).

C. R. Van Hise and J. M. Clements, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Ely greenstone.*—An ellipsoidally parted basic igneous and largely volcanic rock. Basal fm. of Vermilion series. Overlain by Soudan fm. Typical exposures are under and adjacent to town of Ely.

Ely limestone.

Pennsylvanian: Eastern Nevada (Ely region).

A. C. Lawson, 1906 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 4, No. 14, p. 295). *Ely ls.*—Regularly stratified, thick-bedded, more or less cherty ls., 1,500 ft. thick, underlying Arcturus shaly ls. Basal Carbf. fm. in Robinson mining dist. [Ely quad.]. Fossils. Overlies White Pine sh., of supposed Dev. age.

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 26, 27, map). *Ely ls.* is herein given a considerably greater thickness than that assigned to it by Lawson. This arises from discovery that "Ruth" ls. as mapped by him lies much lower in section than he supposed, and in fact is same as Ely ls. The discovery of abundant fossils in overlying Arcturus ls. has made it possible to outline distribution of the fm., and here again the geol. map is different from Lawson's. The Ely is fully 2,000 ft. thick and perhaps 2,500 ft. It consists of gray or bluish dense ls. in well-defined massive beds from a few ft. to nearly 50 ft. thick. The massive beds are separated by partings of shaly ls. or by mere seams. Chert nodules are prominent feature of certain of the lss. Locally there is, S. of Lane, a 30-foot bed of gray clay sh. 200± ft. above base. Fossils (Penn.) listed. The fm. covers a greater area in Ely quad. than any other fm.

†Elysian moraine.

Pleistocene (Wisconsin stage): Southeastern Minnesota.

Name applied in early Minn. repts to morainal deposits which F. Leverett (U. S. G. S. P. P. 161, 1932) considers to be "only a spur formed in a recess in the ice harbor of the Gary moraine." Named for occurrence at Elysian, LeSueur Co.

Ely Springs dolomite.

Upper Ordovician: Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171). *Ely Springs dol.*—Dol. or dolomitic ls., usually dark-gray dol. weathering smoky brown, in beds of variable thickness up to 5 ft. Some beds are laminated. Is cherty at a number of levels. In upper part are some thick beds of gray dol. Total thickness 675 ft. Fossils (listed) are Upper Ord., approx. of Richmond age, according to E. Kirk. Overlies, apparently conformably, Eureka qtzite, and is conformably overlain by dol. carrying Sil. (Niagaran) fossils, according to E. Kirk. Named for exposures in Ely Springs Range.

†Embar formation.

†Embar group.

Permian and Lower Triassic: Western and central Wyoming.

N. H. Darton, June, 1906 (Geol. Owl Creek Mtns, Wyo.: 59th Cong., 1st sess., S. Doc. 219, p. 17). *Embar fm.*—A prominent series of ls. and chert beds lying btw. Tensleep ss. (below) and Chugwater red beds (above). Thickness 200 to 250 ft. Consists of (descending): (1) Yellowish sss. and cherty beds [in 1 place mentions a ls.], 100 to 200 ft.; (2) ls., 30 to 50 ft., "constitutes greater part of upper memb. of fm. throughout its course," [but further along is statement this ls. is overlain by 100 to 200 ft. of sss., etc.]; (3) cherty sh., 100 ft. or more; (4) ls. and sh. alternating, 25 ft. or more.

N. H. Darton, Nov. 17, 1906 (U. S. G. S. P. P. 51, p. 35), stated that *Embar fm.* was named for Embar post office on Owl Creek, a short distance S. of which the fm. is extensively developed.

D. D. Condit, Dec. 4, 1916 (U. S. G. S. P. P. 98, pp. 263–270), divided Embar fm. of Darton in Dinwoody Canyon, Wind River Mtns, into 2 fms., the names for which were selected by E. Blackwelder, namely, Dinwoody fm. (Triassic), new name, and Park City fm. (Perm. and Penn.), the latter beds being identified by Blackwelder (U. S. G. S. Bull. 470, 1911, pp. 452–481) with typical Park City fm. of Utah. He reported the type Dinwoody (200 ft. of pale-green to white clay and shaly ls., weathering brown and containing pelecypod shells) as overlain by 150± ft. of typical Chugwater redbeds, and both the Dinwoody and Park City as grading eastward into the much thicker deposit of Chugwater redbeds of Bighorn Mtns. In some subsequent repts *Embar group* was used to include Dinwoody and Park City fms., the term *Embar* being in common use among oil geologists and drillers. Later work proved that the beds that had been called Park City fm. in western Wyo., are, in fact, the same as Phosphoria fm. and equiv. to only upper part of Park City fm. of Utah, and for several years the equiv. of Embar fm. of Darton was divided into Dinwoody fm. and Phosphoria fm.

In 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1670–1671) H. D. Thomas abandoned Embar fm., as it "has been superseded by Phosphoria and Dinwoody;" and the U. S. Geol. Survey now considers *Embar* discarded as the name of a geologic unit.

Embarrass granite.

Pre-Cambrian (post-Keweenawan): Northeastern Minnesota (Mesabi district).

C. K. Leith, 1903 (U. S. G. S. Mon. 43, p. 186). *Embarrass granite.*—Pink hornblende granite, usually of coarse grain. Intrusive into Upper Huronian in E. part of Giants Range. Named for its lithologic similarity to granite exposed at Embarrass Station on Duluth & Iron Range R. R. just N. of Mesabi Range.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52). The intrusive *Embarrass granite,* of Keweenawan age, forms core of extreme E. end of Giants Range. The rest of Giants Range is formed by Giants Range granite, of lower or middle Huronian age. Is younger than Duluth gabbro and the diabase.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Embarrass granite* to *Killarney revolution* (*post-Keweenawan pre-Cambrian*).

†Emerald series.

Upper or Middle Cambrian: Southeastern Arizona (Tombstone district).

W. P. Blake, 1902 (Tombstone and its mines). *Emerald series* includes the heavy qtzites of Ajax Mtn. [Appears to underlie his Luck-Sure series.]

†Emerald limestone.

Upper or Middle Cambrian: Southeastern Arizona (Tombstone district).

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Emerald ls.*—Thin lss. interleaved with finer shales. At some localities it is made up of thicker and purer lss. with thicker beds of qtzite. Thickness 420 ft. Underlies Lucky Cuss ls. and overlies Ajax qtzite.

Emerald dolomite member (of Ajax limestone).

Lower Ordovician: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Emerald dol. memb.*—Cream-white, almost pure dol., for most part fine-grained but containing small patches and veinlets of coarser grain. Thickness 30 to 40 ft. Lies 90± ft. above base of Ajax ls. Named for Emerald mine. Continuously exposed from Mammoth to Eureka.

Emery sandstone member (of Mancos shale).

Upper Cretaceous: Central eastern Utah (Wasatch Plateau and Book Cliffs).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, p. 439). *Emery ss. memb.*—Brown ss., 0 to 800 ft. thick, lying 600 ft. below top of Mancos sh. at S. end of Wasatch Plateau and 1,100 ft. below top to N. of Emery. Named for exposures SW. of town of Emery.

Emigrant formation.

Upper and Middle (?) Cambrian: Southwestern Nevada.

H. W. Turner, 1902 (Am. Geol., vol. 29, pp. 261–272). *Emigrant fm.*—Thin-bedded lss. and reddish slates with some layers of black chert. Thickness not stated. Conformably underlies Palmetto fm. and uncon. overlies Silver Peak fm. Finely developed to S. of Emigrant Pass, in N. part of Silver Peak Range, Esmeralda Co.

Emigration formation.

Lower Triassic: Central northern Utah (central Wasatch Mountains).

A. A. L. Mathews, 1931 (Oberlin Coll. Lab. Bull., n. s., No. 1). *Emigration fm.*—Chiefly light-colored thin-bedded platy friable calc. sss. with some beds of light-blue to olive-drab sandy lss.; at or near base is a dark-blue thick-bedded hard, very resistant ls. that weathers very light gray or dirty white, which forms cliffs as high as 100 ft. Thickness 1,000+ ft. Is upper part of Thaynes ls. Underlies (conformably) Ankareh fm. and conformably overlies Pinecrest fm. (lower part of Thaynes ls.). Named for Emigration Creek, E. of Salt Lake City, which it cuts across N. and NE. of Pinecrest Hotel.

Emily member (of Crow Wing formation).

Huronian (upper): Central Minnesota (Crow Wing, Aitkin, and Cass Counties).

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 101–106). *Emily memb.*—Lower memb. of Crow Wing fm. Underlies Cuyuna memb. of the Crow Wing and conformably overlies Aitkin fm. Consists of some green but largely dark-colored slaty rocks, probably few if any volcanics, and many scattering lenses of iron-bearing rocks, which are only slightly magnetic or nonmagnetic. Black graphitic slates are abundant in lower part. Green slates and green schistose rocks are more and more abundant as one approaches the upper horizons of Emily memb. It is convenient to consider lower part of the Crow Wing as a separate memb. and it is called *Emily*. Is distributed along W. and S. borders of Aitkin fm. and can be traced through middle-west part of Aitkin Co., then NW. through NE. part of Crow Wing Co., and into Cass Co. Named for occurrence at village of Emily, Crow Wing Co.

See also under *Cuyuna memb.*

Eminence dolomite.

Upper Cambrian: Southeastern and central (?) Missouri.

E. R. Buckley, 1908 (Am. Min. Cong. Rept., Proc. 10th Ann. sess., p. 286), gave, in table of Mo. fms., the following downward succession: Roubidoux; Gasconade; uncon.; Proctor; *Eminence;* Potosi; uncon.; Elvins (with Doe Run at top).

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1, p. 58). In SE. part of State Dr. E. O. Ulrich has recognized above Potosi fm. a cherty memb. which he has named [unpublished] *Eminence fm.* Writer is unfamiliar with this fm. It does not occur in southern, western, and eastern parts of Ozark region, which have been the special fields of study of writer.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27, pp. 629–633). *Eminence chert.*—Very cherty dol. that rests, apparently uncon., on the Potosi or overlaps that fm. and then usually comes in contact with pre-Cámb. porphyry. Above it is limited by base of Proctor dol. Thickness in Shannon Co. not less than 200 ft. Widely distributed in Mo. Well displayed in valleys of Carter and Reynolds Counties. Also comes to surface in some of deep valleys near the Osage, in N. part of Camden and S. part of Morgan Counties.

Wallace Lee, 1914, suggested *Eminence fm.* may include Proctor fm. (See 1914 entry under *Proctor dol.*)

H. A. Buehler, 1917 (Am. Inst. Min. Engrs. Bull. 130, pp. 1699–1718). *Eminence,* 150 ft. thick, underlies Proctor and overlies Potosi. [Same definition given by C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser.).]

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Eminence fm.,* 0 to 300 ft. thick, consists mainly of compact medium- to coarse-grained, sometimes oolitic cherty dol.; chert mostly light and porous, but some layers are white and dense. Occurs in SE. part of State, on E. flank of Ozarks. Uncon. underlies Gasconade fm. and overlies Potosi fm. Further investigation may show that Eminence is same as Proctor fm., 0 to 60 ft. thick, of W. flank of Ozarks.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.). *Eminence fm.*—Very cherty dol., few ft. to 200± ft. Uncon. underlies Proctor fm. and uncon. overlies Potosi dol. Typically exposed in Shannon, Carter, Reynolds, and parts of Jefferson, Franklin, Washington, and Ste. Genevieve Counties, and doubtfully present in Camden and Morgan Counties, but thus far not identified in other parts of State.

Named for exposures at Eminence, Shannon Co.

Emmet moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (fig. 7) in U. S. G. S. Detroit folio (No. 205), p. 9, also on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Emmet, St. Clair Co.

Emmett formation.

Pleistocene: Southwestern Idaho (Gem County).

V. R. D. Kirkham, 1928 (Idaho Bur. Mines and Geol. Pam. 29, p. 1). Several hundred ft. of almost unconsolidated but distinctly stratified sands and clays which are tentatively called *Emmett fm.,* and which have their origin in deltas, fans, and alluvial flood plains of Pleist. age. [Derivation of name not stated. May be from town of Emmett, Gem Co.]

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, p. 198). *Emmett* was first proposed as a term to include part of what was originally called *Idaho fm.*

Emmitsburg facies.

Upper Triassic: Western Maryland.

G. E. Dorsey, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 155–156). *Emmitsburg facies.*—Westernmost facies of Newark system in Md. Predominantly soft red to purple sh. weathering into cubes. In places micaceous.

Probably named for occurrence at or near Emmitsburg or Emmitsburg Junction, Frederick Co.

Emmons Peak quartzite.

Pre-Cambrian: Northeastern Utah and northwestern Colorado.

H. E. Wood, 2d, 1934 (Bull. Am. Mus. Nat. Hist., vol. 67, p. 244). *Emmons Peak qtzite* proposed to replace preoccupied name "Uinta qtzite" of Powell, from peak of that name, which is an appropriate term geographically and geologically, since it is a high peak carved in that fm., as well as sentimentally, since it bears the name of an original student of the fm. [Emmons Peak is shown on King's 40th Par. Surv. map, at 40°42′ N. lat. and 110°18′ W. long., and with 13,694 ft. elev., within Uinta Mtns.]

†*Emory sandstone.*

Pennsylvanian: Southeastern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., p. 153). *Emory ss.*—Great ss., forming top stratum of Tracy City Measures in water gaps of Big Emory River at Harriman, Roane Co.

Same as Rockcastle ss., older name.

Emperador limestone.

Miocene: Panama Canal Zone.

D. F. MacDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 709).

Empire formation.

Miocene: Southwestern Oregon (Port Orford and Coos Bay quadrangles and neighboring regions).

J. S. Diller, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 475). The Mio. rocks of Coos Bay are well exposed on beach 3 mi. SW. of Empire City, btw. Pigeon Point and Fossil Point. They are so well characterized at this locality by their fossil contents and position with reference to adjoining rocks that we designate them *Empire beds*. [Fossils listed.] Assigned to Mio. on Dall's identification of fossils. Uncon. overlain by Plio. marine beds at "Fossil Rock." Uncon. underlain by Arago beds.

J. S. Diller, 1901 (U. S. G. S. Coos Bay folio, No. 73). *Empire fm.* consists of massive sss., white sh. of Mio. age similar to Monterey sh. of Calif., and, below the white sh., darker sh. Contains marine Mio. fossils. Uncon. underlies Coos cgl. and uncon. overlies Arago fm.

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 30–31). At Cape Blanco [Port Orford quad.] *Empire beds* (*Cape Blanco beds*) are 600 ft. thick, and consist of (descending): Argill. sands with some calc. nodules, 75 ft.; cgl., 25 ft.; light-gray sand beds, 50 ft.; yellowish ss., 30 ft.; tuff, 20 ft.; yellowish ss., 400 ft. Uncon. underlie Elk River beds (Pleist.) and uncon. overlie Cret. (?) crushed gray ss.

H. V. Howe, 1922 (Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 14, No. 3, pp. 86–91), gave thickness of Empire fm. at South Slough, Coos Bay, as 1,100± ft. and assigned the fm. to lower Plio.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 264–270), assigned Empire fm. to middle Mio., after reviewing fossils and Howe's evidence.

H. G. Schenck, 1928 (Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 18, No. 1, opp. p. 4). Empire fm. is Plio. according to B. L. Clark and H. V. Howe, and Mio. according to Dall and others.

Empire shale.

Pre-Cambrian (Belt series): Western central Montana.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Empire shales.*—Greenish-gray, massively bedded banded siliceous shales, 600 ft. thick. Underlie Helena ls. and overlie Spokane shales. Type localities are on ridge N. of Empire [2 mi. W. of Marysville] and in canyon walls just below Marysville.

Empire limestone.

Oligocene: Panama.

E. Howe, 1908 (Am. Jour. Sci., 4th, vol. 26, p. 224).

Empire Gulch rhyolite.

Tertiary: Leadville region, Colorado.

W. Cross, 1886 (U. S. G. S. Mon. 12, p. 351). White, very fine-grained, but with many clear and sharp quartz crystals. Named for occurrence on S. side of Empire Gulch, S. of Leadville.

Emporia limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

M. Z. Kirk, 1896 (Kans. Univ. Geol. Surv. vol. 1, pp. 72–85). *Emporia ls.*—Ls., quarried at Emporia and to NE. and disappearing under river near Emporia water works. Separated from overlying Americus ls. by an extensive bed of sh. and from underlying Wyckoff ls. by a bed of sh. 40 to 50 ft. thick.

The definition of Emporia ls. as overlain by Admire sh. and underlain by Willard sh. was followed by Kans. Geol. Survey and U. S. Geol. Survey for many years.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 61–91). Kans. Geol. Surv. applies *Emporia ls.* to beds underlying Admire sh. and overlying Willard sh. The Willard sh. and so-called Emporia ls. have been difficult to work out. The beds called by these names in Kans. need redefining in order to establish a basis for correlation in Nebr. I have studied the exposures in vicinity of Wyckoff, Chicago Mound, and Emporia. *Emporia,* if it is retained, should apply to No. 3 of the Nemaha beds of SE. Nebr., because Kirk seems to have meant to apply it to this unit, and because Haworth and Moore have, in effect, defined it as such. This name has priority over Beede's Elmont ls: This unit (No. 3) underlies Willard sh. and overlies Auburn sh., top bed of Humphrey sh. memb. of Wabaunsee fm. [This definition of Emporia ls. was adopted by R. C. Moore in 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3) and by Moore and Condra in their Oct. 1932 revised chart of Penn. rocks of Kans. In these 1932 repts Admire sh. was restricted to uppermost part of Admire sh. of previous repts.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), discarded *Emporia* for *Preston.* He stated: *Preston ("Emporia") ls. fm.*, 9 to 11 ft. thick, underlies Willard sh. fm., overlies Auburn sh. fm., and includes (descending): Elmont ls., 2 to 5 ft. thick; Harveyville sh., 3 to 7 ft. thick; and Reading ls., 3± ft. thick.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 223). It is impossible to determine to which of 3 or more lss. exposed near Emporia Kirk intended to apply this name. Judging from localities cited by him it appears that he considered as identical beds that are actually 75 ft. or more apart. [On p. 226:] It appears from study of type sections that the Elmont is="upper Emporia" of authors. [Moore discarded *Emporia ls.* from his revised classification as published in this bull. See p. 49, where he shows it as replaced by (descending) Elmont ls., Harveyville sh., and Reading ls., which he treated as fms.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Emporia blue limestone.

Pennsylvanian: Northeastern Kansas.

A. J. Smith, 1903 (Kans. Acad. Sci. Trans., vol. 18, p. 100). *Emporia blue ls.*—Hard blue ls., 3 ft. thick, with 6-inch layer at top that makes a good flagstone extensively used in Emporia. In Lyon Co. separated from underlying Burlingame ls. by 44½ ft. of shales with two thin lss. [Humphrey sh. of A. J. Smith 1905 rept] and separated from overlying Emporia ls. by about 64 ft. of shales with some thin lss. and one coal bed [Olpe sh. restricted of A. J. Smith 1905 rept].

Preoccupied. Discarded by A. J. Smith in 1905 (Kans. Acad. Sci. Trans., vol. 19, pp. 150–154) and replaced by *Reading blue ls.*

Named for Emporia, Lyon Co.

†Emporia reservoir shales.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Emporia reservoir shales.*—Aren. shales, 77 ft. thick, carrying 6-inch coal bed at top. Overlie Emporia buff lss. and underlie Admire shales and lss. [In same publication Wooster used *Emporia beds* to cover all rocks btw. top of Burlingame ls. and top of his Emporia reservoir shales, making three different uses of *Emporia.*]

Preoccupied. Lower part of Admire sh., as *Admire* was used for many years.

Probably named for Emporia.

Emrick sand.

A subsurface sand forming basal part of Ellis fm. (Upper Jurassic) in central northern Mont. (Great Falls-Conrad region). Named for man who drilled the well in Bannatyne oil field. Sometimes called "Ellis sand."

Encinas quartz porphyry.

Age (?): Mexico (Sonora).

N. L. Taliaferro, 1933 (Jour. Geol., vol. 41, No. 1, p. 33).

†Encrinal limestone.

A descriptive term—derived from presence of encrinites (fossil crinoids)—applied in early N. Y. repts to a ls. later named *Tichenor ls.;* also, according to Hartnagel (1912), to lss. at other horizons within Hamilton fm., and to Becraft ls.; also to Menteth ls. (See G. A. Cooper, 1930 entry under *Moscow sh. memb.*)

†Encrinital limestone.

A descriptive term applied in early repts on Mississippi Valley to *Burlington ls.* Derived from predominance of fossil crinoids. In some early repts the Keokuk ls. was included, and in others the name was restricted to lower memb. of the Burlington.

Endeavor granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated).

Endee shale.

Triassic (?): Northeastern New Mexico.

C. R. Keyes, 1905 (Am. Jour. Sci., 4th, vol. 20, p. 424). *Endee shales*, 300 ft. thick, underlie Amarillo sss., uncon. overlie Cimarron shales (=Moencopie shales), and are correlated with Shinarump shales of western N. Mex. [Derivation of name not given.]

Endicott sand series.

Series of subsurface Penn. sss. and interbedded strata in central northern Okla. corresponding to upper part of Nelagoney fm. Thickness 30 to 200± ft.

Endicott diorite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series*. Exposed on Endicott Hill.

Enfield shale member (of Portage formation).

Upper Devonian: Southern central New York (Ithaca region).

H. S. Williams, 1906 (Sci. n. s., vol. 24, pp. 365–372). Nunda fm. [Portage fm. of U. S. Geol. Survey and N. Y. State Survey] of Ithaca region divided into (descending): *Enfield sh. memb.*, 550 to 800 ft.; Ithaca sh. memb., 80 to 300 ft.; Sherburne flagstone memb., 188 to 260 ft. The Enfield is overlain by Cayuta sh. memb. of Chemung fm. Typically exposed at town of Enfield [W. of Ithaca, Tompkins Co.].

The above definition was followed by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369) and by G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352).

Enfield facies subgroup.

Upper Devonian: Southern central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 201). *Enfield facies subgroup* (of Ithaca-Enfield facies group), divided into (descending) Van Etten memb., Grimes (?) ss. memb., and Hatch ss. memb. Overlies Ithaca facies sub-group and underlies Chautauquan series.

Engadine dolomite.

Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).

R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21, p. 151). *Engadine dol.*—Very massive, hard, very crystalline dol., distinctly bluish or mottled and streaked with blue. Also characterized by numerous drusy cavities more or less completely filled with crystals of dol. or pearl spar. Thickness 54 to 95 ft. Top memb. of "Niagara" in Mich. Overlies Manistique series. Named for exposures at and around Engadine, Mackinac Co.

G. M. Ehlers, 1920 (Mich. Acad. Sci. 21st Rept., pp. 87–90), stated that *Engadine fm.* contains strata of Guelph and of pre-Guelph age, and suggests that *Racine*, the older name, be used to replace *Engadine*.

A. F. Foerste, 1924 (Univ. Mich. Contr. Mus. Geol., vol. 2), applied *Racine fm.* to fm. overlying Manistique fm.

W. A. VerWiebe, 1928 (Mich. Acad. Sci., Arts, and Lett. Papers, vol. 8, p. 330), applied *Engadine fm.*, to beds overlying Manistique fm.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, geol. ser. 32, pp. 34, 35, 37). *Engadine dol.*—Top div. of Niagaran in Mich. Underlies Salina fm. (but contact has not been seen in Mich.) and overlies Manistique fm. Is probably = lower part of Guelph of Ont. and N. Y., and is about = Lockport of N. Y. and Ont. and the Racine of Wis.

Engle coal group. (In Vermejo formation.)

Upper Cretaceous: Eastern Colorado (Elmoro region).

R. C. Hills, 1899 (U. S. G. S. Elmoro folio, No. 58), applied *Engle group* to 100 ft. of sh., shaly ss., and coal beds immediately overlying Trinidad ss. These beds are basal part of Vermejo fm. of present terminology. They were described as separated from overlying Sopris group by 35 to 40 ft. of sh.

Engle shale.

Ordovician (?): North-central Kansas.

J. S. Barwick, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 184). *Engle sh.*—Unit No. 4 encountered in wells in Salina Basin. Not exposed. Light-colored fine-grained sh., generally of bluish-gray or greenish-gray cast; in places a small amount of dolomitic lime or fine-grained quartz sand silt. Thickness 60 to 100 ft. where overlain by Younkin fm. (unit No. 3). Overlies Urschel lime (unit No. 5). Lithology and position indicate it correlates approx. with Sylvan sh. of Okla. and Maquoketa sh. of Iowa and Mo. Named for Marland Oil Co.'s Engle No. 1 well, sec. 12, T. 14 S., R. 1 E., Dickinson Co., where it lies at 2,876 to 2,962 ft. depth.

Englevale channel sandstone.

Pennsylvanian: Southeastern Kansas (Crawford County).

W. G. Pierce and W. H. Courtier, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 1061–1064). *Englevale channel ss.*—Usually light-brown with reddish-brown specks, micaceous, somewhat massive and cross-bedded. Locally middle part may be darker and lower part slightly shaly. Thickness 0 to 50 ft. Areal distribution is linear, trending N.-NW. from Arma for 9 mi., to Crawford Co. line, the limit of field work. Is younger than Fort Scott ls., which it cuts, and may possibly be younger than lower part of Labette sh. So far as seen its upper limit is gradational into lower part of Labette sh., and its base cuts into Fort Scott ls. and in places rests on upper part of Cherokee sh. Best exposed in vicinity of Englevale, along N.-S. road on E. side of town and along E.-W. road ½ mi. N. of town.

Englewood limestone.

Mississippian (Kinderhook): Western South Dakota (Black Hills) and northeastern Wyoming.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 509). *Englewood ls.*—Pink slabby ls., 20 to 30 [25 to 60] ft. thick, underlying Pahasapa ls. and overlying Deadwood fm. (Camb.). Merges rapidly into Pahasapa ls., with occasionally a few ft. of impure buff ls. intervening. Name suggested by T. A. Jaggar, from Englewood, in northern Black Hills, where it is extensively exposed. In northern Black Hills a mass of buff ls. of Sil. age [Upper Ord. Whitewood ls.] intervenes btw. Englewood ls. and Deadwood fm.

English Head formation.

Ordovician: Anticosti Island.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 695).

English River sandstone member (of Hannibal shale).

Mississippian: Southeastern Iowa and (?) central western Illinois (Pike County.)

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 322). *English River grits.*—Fine-grained buff to white ss. or gritstone, 0 to 20 ft. thick, underlying Wassonville ls. and overlying Maple Mill sh.; all included in Kinderhook.

W. H. Schoewe, 1924 (Iowa Geol. Surv. vol. 29), defined *English River gritstone memb. of Kinderhook series* as separated from overlying Wassonville ls. memb. by an oolitic ls. ledge memb. 2 to 3 ft. thick.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 21, 22, 23, 49, 56–59). *English River ss. memb. of Hannibal fm.*—Massive fine-grained soft drab ss., weathering buff, with occasional thin intercalated layers of sh. Upper 2 ft. filled with casts of fossils, most abundant being *Chonopectus fischeri*. Has commonly been called *Chonopectus* ss. Thickness at Prospect Hill, Burlington, Des Moines Co., Iowa, 22½ ft. Older than McKerney ls. memb. of Hannibal fm. and younger than Maple Mill sh. memb. of Hannibal.

L. R. Laudon, 1931 (Iowa Geol. Surv., vol. 35, pp. 341–387+). *English River fm.* underlies (uncon.) Hampton fm. and overlies (conformably) Maple Mill fm. in SE. Iowa, all of which are in Kinderhook series.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245), assigned this ss. to Kinderhook.

Named for exposures along English River in Washington Co., Iowa.

Englishtown sand. (In Matawan group.)

Upper Cretaceous: New Jersey Coastal Plain.

H. B. Kümmel, 1907 (N. J. Geol. Surv. Pal., vol. 4, p. 17, footnote). The term *Columbus* as here used has been found to conflict with its prior use in Ohio for a Dev. fm., and in this rept the term *Englishtown sand* will be used instead, as the fm. is well developed near that place in Monmouth Co. [See under †*Columbus sand.*]

Enid formation.

Permian: Western Oklahoma and Kansas (?), and Panhandle of Texas.

C. N. Gould, 1905 (U. S. G. S. W. S. P. 148, pp. 39–44, map). *Enid fm.* includes all red beds from base of Perm. to lowermost gyp. ledge on E. slope of Gypsum Hills. Top of fm. is not a plane, since the gyp. beds which mark its uppermost limits are more or less lenticular when traced long distances. Is chiefly brick-red clay shales, with some interbedded ledges of red and whitish ss. Thickness 1,200 to 1,500 ft. Includes Harper, Salt Plain, Cedar Hills, and greater part of Flowerpot memb. of Cragin's first paper and Kingfisher and Glass Mtn fms. of his second paper. Underlies Blaine fm. and overlies Wellington fm.

F. Aurin, 1917 (Okla. Geol. Surv. Bull. 30, p. 24). It can readily be seen that *Enid fm.* is a color distinction and not a constant strat. unit. In some places it includes more than in others. It is a name applied to part of lower Perm. Red Beds, and does not include the nonred Perm. even though it is of same age as lower part of Enid.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 88). *Enid fm.* is exposed in all or parts of Murray, Garvin, Stephens, McClain, Cleveland, Oklahoma, Pottawatomie, Canadian, Logan, Lincoln, Kingfisher, Blaine, Major, Garfield, Noble, Payne, Kay, Grant, Woodward, Alfalfa, Harper, and Woods Counties. Recent work in SW. Okla. has led to subdivision of upper part of rocks of that area heretofore mapped as Enid into Chickasha and Duncan fms.; also to conclusion that lower part of typical Enid (Enid, Garfield Co.) is there represented by upper part of rocks mapped as Clear Fork and Wichita fms. on 1926 Okla. geol. map. Base of Enid is believed by Aurin and Clark to be top of Wellington fm. of Kans. There are several unsolved problems connected with relations of Enid. In SW. Okla. it includes equivalents of Chickasha, Duncan, Clear Fork, and possibly part of Wichita. In Kans. the equiv. fms. are Harper, Salt Plains, Cedar Hills, and a part at least of Flowerpot sh.

C. N. Gould, 1926 (Jour. Geol., vol. 34, No. 5, pp. 416–421). *Enid group.*—The Enid fm. as originally described included all Oklahoma Perm. red beds below base of Blaine gyp. It has been divided into following fms. (descending): Chickasha fm., Duncan ss., Hennessey sh., Garber ss., Wellington fm., and Stillwater fm.

The Enid and Double Mountain overlap each other, the Duncan and Chickasha being represented in both. *Enid* appears to have had little usage in recent years.

Named for Enid, Garfield Co., Okla.

†Enochkin formation.

Middle and Upper Jurassic: Alaska (Iniskin Bay).

T. W. Stanton and G. C. Martin, 1905 (Geol. Soc. Am. Bull., vol. 16, p. 397). *Enochkin fm.*—Shales and sss., with some cgl. beds, typically exposed on E. shore of Enochkin [Iniskin] Bay. Thickness 1,500 to 2,500 ft. Is Middle Jurassic. Overlies Lower Jurassic tuffs and sss. and underlies Naknek fm. (Upper Jurassic).

Later work resulted in dividing these rocks into 2 fms., Chinitna sh. (Upper Jurassic) and Tuxedni ss. (Middle Jurassic).

Ensenada shale.

Cretaceous: Puerto Rico.

G. J. Mitchell, 1922 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 3, p. 252).

†Enterprise green marl. (In Claiborne group.)

Eocene (middle): Southeastern Mississippi.

O. Meyer, 1885 (Am. Jour. Sci., 3d, vol. 30, p. 435). [*Enterprise* (?) used in Miss. column of table opp. *Claibornian*. No definition.]

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, pp. 76–77). *Enterprise green marl.*—Light-gray to dark-green marl, the color determined by relative proportions of glauconite or greensand. Highly fossiliferous. Thickness 12 ft. Basal memb. of Lisbon fm.

Conflicts with Enterprise sh. (Perm., Kans.), the older name. The marl is now included in Winona sand, basal memb. of Lisbon fm. in Miss.

Named for exposures at town of Enterprise, Clarke Co.

Enterprise shale. (In Sumner group.)

Permian: Central Kansas, northern Oklahoma, and southeastern Nebraska.

J. W. Beede, 1909 (Kans. Acad. Sci. Trans., vol. 21, pt. 2, p. 253). *Enterprise shales.*—Shales, with some thin lss. near top; 44 ft. thick; overlying Luta ls. and underlying Herington ls. All included in Marion stage.

In 1927 †Marion fm. was abandoned by both Kans. Geol. Survey and U. S. Geol. Survey, and *Enterprise sh.* was elevated to rank of a fm. within Sumner group.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 13), divided Enterprise sh. into 3 members (descending): Paddock sh., Krider ls., and Odell sh.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), discarded *Enterprise*, raised Odell sh. to rank of a fm., and combined Condra's Krider ls. and Paddock sh. with overlying Herington ls. into a newly named fm. (Nolans ls.). These changes have not yet been considered by U. S. Geol. Survey for its publications.

Named for Enterprise, Dickinson Co., Kans.

†Enterprise sandstone. (In Boggy shale.)

Pennsylvanian: Central eastern Oklahoma (Muskogee County).

S. W. Lowman, 1932 (Summaries and abstracts of technical papers presented before Tulsa Geological Society 1932, unpaged; paper dated Dec. 19, 1932). The Salt sand of Okmulgee underground is to be correlated with the massive ss. 300 ft. above base of the Boggy in Rattlesnake Mtn, just NW. of Warner [Muskogee Co.]. This has been called *Enterprise ss.* (a manuscript name), from a locality on N. side of McAlester basin. [The town of Enterprise is in Haskell Co.]

This name being preoccupied in several senses, and the ss. having been found, by tracing, to be same as Bluejacket ss., it was called *Bluejacket* by C. W. Wilson, Jr., in 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 504–520). Wilson treated the Bluejacket as top memb. of Savanna ss., but it is now treated by U. S. Geol. Survey as basal memb. of Boggy sh., and *Enterprise ss.* has been discarded. (See C. H. Dane and T. A. Hendricks, A. A. P. G. Bull., vol. 20, No. 3, 1936, pp. 312–314.)

Entiat physiographic stage.

Pleistocene: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. P. 19). *Entiat physiographic stage.*—Earlier Glacial epoch. Type loc., basin of the Entiat and foot spurs of Chelan Range.

Entrada sandstone. (In San Rafael group.)

Upper Jurassic: Southeastern, southern and northeastern Utah, northwestern New Mexico, and western and central Colorado to east side of Front Range.

J. Gilluly and J. B. Reeside, Jr., 1926 (U. S. G. S. Press Bull. 6064, March 30, 1926; name adopted at joint conference of J. Gilluly, J. B. Reeside, Jr., R. C. Moore, and

H. E. Gregory, from area specially studied by Messrs. Gilluly and Reeside). *Entrada ss.*—Thin-bedded red sh. and ss. at base; heavy, massive, red-brown, earthy ss. above, which weathers into rounded forms and steep cliffs. Thickness 265 to 844 ft. Conformably overlies Carmel fm. and uncon. underlies Curtis fm. Belongs to San Rafael group.

Named for strong development of fm. on Entrada Point, in N. part of San Rafael Swell.

For further details see U. S. G. S. P. P. 150, 1928 (by J. Gilluly and J. B. Reeside, Jr.), and U. S. G. S. P. P. 183, 1936 (by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.).

Enumclaw volcanic series.

Miocene (upper): Western Washington (Puget Sound region).

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13, p. 84). Along W. slopes of Cascade Mtns there are extensive deposits of andesitic lavas and interbedded tuffs and clays. The older Eocene deposits pass beneath these lavas along W. margin of foothills of the Cascades. Well exposed from Enumclaw to Cedar Lake, in [SW. part of] King Co., and name *Enumclaw volcanic series* is provisionally applied to them. They may be W. extension of Keechelus volcanic series. Rest uncon. on older qtzites, schists, and granodiorites (Snoqualmie granodiorite), also on Eocene and Olig. sediments in E. part of Puget Sound Basin. Assigned to upper Mio. Probably in part= Keechelus fm.

†Eobiotic era.

A part of Proterozoic era of U. S. Geol. Survey. For definition see U. S. G. S. Bull. 769, p. 27.

Eocene epoch (or series).

Oldest epoch (and the rocks) of the Tertiary period. For definition see U. S. G. S. Bull. 769, p. 54.

Eogene.

A term employed by European geologists to include the Oligocene and Eocene series of American geologists.

†Eolian limestone.

Ordovician and Cambrian: Southwestern Vermont (Bennington and Rutland Counties).

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1, pp. 396–419). *Eolian ls.*—White and gray ls., both nonmagnesian and dolomites. Thickness 2,000+ ft. Includes some sparry ls., clay sl., talcose schist, talcose ls., etc. Same as Berkshire ls. and Stockbridge ls. of Mass. and Dorset ls. of Vt. (Elem. geol. of E. and C. H. Hitchcock, 1860). The name *Eolian ls.* is more appropriate for this fm. than *Stockbridge ls.*, because only a part of fm. is developed in that town, and that is in an inferior condition to this. Named for Mount Eolus (Dorset Mtn) [in Pawlet quad.], of which it composes greater part. [Gave a detailed section of beds on Dorset Mtn, in Dorset Twp, Bennington Co., SW. Vt.] May be Sil. or may be Dev.

E. Hitchcock, 1862 (Geol. Me., Prel. Rept., vol. 2, pp. 245–259), used Eolian ls. in Maine, and in same year (Maine Bd. Agric. 7th Ann. Rept.) he called the ls. in Maine *Taconic (Eolian) ls.* and *Stockbridge ls.*

C. H. Hitchcock, 1866, also 1867. [See 1866 entry under *Dorset ls.*]

J. E. Wolff, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 331–338). Eolian ls. of Vt. geol. repts includes Centre Rutland ls. and West Rutland ls. (which are of "Trenton-Chazy-Calciferous" age) and Rutland ls. (which is of Lower Camb. age).

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pl. 97). In SW. Vt. at least 470 ft. of lower part of Stockbridge ls. is Camb.

T. N. Dale, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pl. 67, pp. 533–543). Stockbridge ls. (=Eolian ls. of Hitchcock) is 1,000–1,400 ft. thick in Rutland-Danby Ridge-Clarendon, Vt., and includes Lower Sil. [Ord.], upper and middle Camb.(?), and 470 ft. of lower Camb. Overlies Vermont fm.

T. N. Dale, 1904 (Am. Jour. Sci., 4th, vol. 17, pp. 185–190). Stockbridge ls. is present in valleys in Rutland Co., Vt. Upper part is of Chazy and Trenton age; lower part is Camb.

H. M. Seely, 1910 (7th Rept. Vt. State Geol., pp. 257–313). "Eolian ls." of Hitchcock (type loc. of which was Dorset Mtn, at that time renamed *Mount Eolus*) includes beds of Trenton, Black River, Chazy, and Beekmantown age.

F. A. Burt, 1929 (16th Rept. Vt. State Geol., pp. 68–84). Stockbridge ls. of Bennington area, Vt., is 1,200± ft. thick, and consists of bluish crystalline lss. and dolomites; near bottom ls., schist, and qtzite layers are interbedded. Underlies Berkshire schist and overlies Vermont fm.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), showed Stockbridge ls. of southern Vt. as containing beds of Chazy, Beekmantown, Tribes Hill, Little Falls, and Upper Camb. age.

Replaced by Stockbridge ls., which has many years priority and is the name now applied to this ls. in southern Vt.

Eolian limestone member (of Pueblo formation).

Pennsylvanian: Central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 24, 31, 171–173, pl. 2, and table 2). *Eolian ls. memb.*—Blue or bluish-gray hard crystalline ls., weathering in large rectangular yellowish-brown blocks. Average thickness is but 1 ft., and it does not form a prominent or persistent escarpment. It may be= Stockwether ls. of Drake. Is separated from underlying Saddle Creek ls. by 50 to 60 ft. of sh. and from overlying Camp Colorado ls. by 75 to 125 ft. of sh.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103). *Eolian ls.*, in Pueblo fm., named for exposures near Eolian, Stephens Co.

†Eo-lignitic.

A term applied by A. Heilprin, 1882 (Phila. Acad. Nat. Sci. Proc. 1881, pp. 158–159), to the pre-Claiborne Eocene (Wilcox and Midway) deposits of the eastern and southern coastal States.

Eolus granite.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Eolus granite.*—Coarse pink hornblende-biotite granite. Occupies about one-third of quad., and composes Mount Eolus. Intrudes Archean schists and Uncompahgre fm. (Algonkian), and is uncon. overlain by Ignacio qtzite [Upper Camb.].

The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

†Eomorphic era.

A part of Proterozoic era of U. S. Geol. Survey. For definition see U. S. G. S. Bull. 769, p. 27.

†Eozoic era.

As originally defined applied to all pre-Paleozoic time. In later usages it has been applied: (1) To all Camb. and pre-Paleozoic time; (2) to pre-Paleozoic time only; (3) to only the period formerly called "Algonkian period;" (4) to Huronian, Laurentian, and Keewatin time; (5) to a part only of the so-called "Algonkian period;" and (6) to a hypothetical pre-Keewatin interval. For definition see U. S. G. S. Bull. 769, pp. 27–30.

†Eparchean.

A term applied in some early repts to part of the pre-Camb. rocks, including Keweenawan, Huronian, and others. (See U. S. G. S. Bull. 360, 1909, pp. 87, 745.)

Eparchean interval.

A term applied by A. C. Lawson to the period of granitic intrusion believed to have immediately preceded the upper Huronian. (See U. S. G. S. Bull. 360, 1909, pp. 38, 322–323, 371, 382.)

Ephraim conglomerate. (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 82). *Ephraim cgl.*—Red cgl. with minor amounts of ss. and some thin bands of gray to purplish ls. Thickness varies, but is 1,000± ft. at type loc. Forms most of mass known as Red Mtn in NE. part of Montpelier quad. Named for Ephraim Valley, sec. 36, T. 10 S., R. 45 E. Boise meridian, which lies in the fm. Is basal fm. of Gannett group. Underlies Peterson ls. and overlies Stump ss. May be Jurassic.

Epicene series.

A term proposed by C. R. Keyes for "early or preglacial Quat. deposits" of N. Mex. (See Iowa Acad. Sci. Proc., vol. 22, p. 262, 1915.)

Epperson sand.

A subsurface sand in Lee fm. (of Pottsville group) of Knox Co., SE. Ky.

Epworth dolomite.

Pre-Cambrian: Arctic Canada.

J. J. O'Neill, 1924 (Canadian Arctic Expedition, 1913–18, vol. 11, pt. A, p. 21).

Equity quartz latite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Equity quartz latite.*—Entirely massive rock, and in large part at least a single great flow, forming top fm. of Alboroto group (of Potosi volcanic series). Thickness 0 to 1,000 ft. Overlies, rather regularly, the Campbell Mtn rhyolite, and therefore occupies about same position in section as Phoenix Park quartz latite, from which it differs chiefly in its more massive character and, slightly, in its composition, which is somewhat nearer that of a rhyolite. The two latites have not been found in contact, but are believed to be very closely related and to represent different phases of same period of eruptive activity. Named for development near Equity mine.

†Equus beds.

A paleontologic name applied to Pleist. deposits containing *Equus* remains. Replaced by different geographic names in different areas: In Kans. by *McPherson fm.;* in western Tex. by *Tule fm.* (also called "Rock Creek beds," but that name is preoccupied); in Nebr. and adjacent States the name "Sheridan fm." has been used, but that name also is preoccupied. The U. S. Geol. Survey in general calls the beds containing *Equus* remains the *Equus zone*, but *McPherson fm.* and *Tule fm.* are also in good standing in their respective regions.

Eramosa member.

Term applied by M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser.), to what he called top memb. of Lockport dol. in Ontario Peninsula. Overlain conformably by Guelph dol. (which he treated as distinct fm.) and underlain by unnamed dol., which separated his Eramosa memb. from underlying Gasport dol. memb.

Erian period or group.

See under *Erie group.*

Ericson sandstone. (In Mesaverde group.)

Upper Cretaceous: Southwestern Wyoming (Baxter Basin, Sweetwater County).

J. D. Sears, 1926 (U. S. G. S. Bull. 781, p. 20, pl. 5). [See under *Almond fm.*]

Erie group.

Erie series.

Upper and Middle Devonian: New York.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. 2d dist., pp. 100, 429). *Erie group.*—Named for Lake Erie, the valley of which is excavated out of Ludlowville shales, shaly sss., etc., which compose it. Includes Chemung and Ithaca shales and grits, Genesee sl., Tully ls., and Hamilton and Marcellus shales. Is top group of New York system. Overlies Helderberg series, which includes at top Schoharie grit and overlying Helderberg [Onondaga] ls. Underlies Old Red ss.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3). *Erie div.*—Includes Chemung group at top and Marcellus shales at base. [Used in this sense by James Hall (1843), W. W. Mather (1843), and other geologists.]

J. S. Newberry, 1874 (Am. Ass. Adv. Sci. Proc., vol. 22, pp. 185–196). The Portage and Chemung form an indivisible mass of mechanical sediments, of which both fossils and lithological characters contrast strongly with underlying Hamilton and is evidently the record of a new era in geol. history of continent. This new *group* I have called the *Erie*, and I think it will be found to belong, both by its fossils and its physical relations, rather with the Carbf. than the Dev. system.

In 1879 T. Sterry Hunt included in his *Erian or Devonian* all beds btw. top of Catskill and base of Oriskany.

J. M. Clarke and C. Schuchert, 1899 (Sci., pp. 874–878). *Erian period or group.*—The "Erie div." comprised the fms. from top of Onondaga ls. to top of the Chemung. We propose to save the term to N. Y. nomenclature by reviving it with a restricted meaning—to include the rocks btw. Tully ls. and Onondaga ls. [This definition has been generally followed, except that in 1910 Schuchert (Geol. Soc. Am. Bull., vol. 20, p. 541) included the Onondaga, as did G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), who proposed that it be called *Erie series*.]

The U. S. Geol. Survey does not use *Erian* or *Erie* in its classification. The present N. Y. State Survey includes in its Erian the beds below Tully ls. and above Onondaga ls. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 370.)

†Erie clay.

Pleistocene: Ontario, Ohio, New York.

W. E. Logan, 1863 (Canada Geol. Surv. Repts. 1843–63, pp. 887, 896–907). *Erie clay.*—The lower of the two divisions of stratified clays which overlie the boulder fm. or glacial drift of western Canada [Ontario]. Is sometimes associated with beds of gravel and sand. When moist is of blue color, with thin grey bands. Is commonly more or less calc. and always holds boulders and pebbles (of Paleozoic, Laurentian, and Huronian rocks) in greater or less abundance. Thickness more than 200 ft. No fossils yet found. With few interruptions runs along N. shore of Lake Erie from Long Point westward to Detroit River, and appears to underlie whole country btw. this part of the lake and the main body of Lake Huron. Also occurs at Owen Sound and along Nottawasaga River, also along shores of Lake Ontario, and as far E. as Brockville. Is uncon. overlain by Saugeen clay. The Erie and Saugeen clays and sands of western Canada apparently belong to a distinct basin, and are in part at least of fresh-water origin, so that their relations to lower and upper divisions of the stratified drift of eastern Canada and Vt. cannot yet be determined.

J. W. Spencer, 1888 (Am. Geol., vol. 2, pp. 294–297). *Erie clay* is best represented in the Lake region. It is a well-stratified, generally stoneless blue clay derived from the older drift. It also includes some stony stratified clays. Rests on Upper Drift or Till and is overlain by Saugen [Saugeen].

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 222). In Ontario the boulder clays are superimposed by the Erie clay, which in turn is overlain by the Saugeen clay and sands.

The name "Erie clay" was introduced into northern Ohio by J. S. Newberry, in 1870, and for many years was applied to the blue clays, 0 to 280 ft. thick, "overlying the glacial drift and underlying sands of variable thickness." The upper part was described by Newberry (Ohio Geol. Surv. vol. 2, pt. 1, 1874) as consisting of fine laminated clay without pebbles and corresponding closely to Saugeen clay, and the lower part as consisting of tough blue unstratified clay. According to Frank Leverett (unpublished letter dated Jan. 10, 1928) "the ordinary glacial till of Wisconsin age seems to be the main deposit that has been called Erie clay in Ohio."

†Erie shale.

Upper Devonian: Northern Ohio.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 20). *Erie sh.*—Bluish or greenish shales, 400 ft. thick in northern Ohio; absent in central Ohio. Topmost fm. of Dev. in northern Ohio. Overlain by black bituminous Cleveland sh. and underlain by Huron sh.

Preoccupied. Replaced by *Chagrin sh.*

Named for exposures on shores of Lake Erie from mouth of the Vermillion to Dunkirk.

†Erie limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 108, 118). *Erie ls.*—System of lss., few ft. to 60 ft. thick, overlying Laneville shales and underlying Chanute shales. [Some later repts have called the beds *Erie or Triple ls. system.*]

According to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), †Erie ls. of Haworth extended from top of Dennis ls. down to base of Hertha ls.

Named for Erie, Neosho Co.

Erin shale.

Carboniferous (probably early Pennsylvanian): Eastern Alabama (Clay County).

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, p. 217). *Erin sh.*—Black carbonaceous sh. or sl. exposed in vicinity of Erin, Clay Co. Weathers gray or dirty white. Thickness tentatively estimated as 2,000 ft. Contains fossil plants of Carbf. (probably Penn.) age. Heretofore included in Talladega sl.

C. F. Park, Jr., 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 6, pp. 278–279). It has been stated by C. Butts that C. W. Hayes considered Erin sh. to be an infolded bed in Talladega sh. Butts' notes, however, indicate a fault along SE. contact of Erin sh. and Talladega sl., but he stated that Hayes's interpretation seems equally probable. (Personal communication Jan. 1935.) C. W. Hayes and D. White concluded, after field study, that Erin sh. is uncon. with Talladega sl. (U. S. G. S. Bull. 340, 1908, p. 38.) Miss Jonas has recently described and mapped (Am. Jour. Sci., 5th, vol. 24, 1932, p. 243) Erin sh. as a fenster in Talladega sl. but does not discuss it in detail. There is sufficient evidence to indicate a fault btw. Talladega fm. and Erin sh. and to justify suggestion that Talladega fm. has been thrust over Erin sh., which is thought to have been exposed by erosion of the thin overthrust plate, thus forming a window. The assignment of part of Talladega sl. and other crystalline rocks in eastern Ala. to Carbf., on supposition that Erin sh. is a lenticular mass originally deposited in the Talladega, is believed to be unwarranted.

Erindale member.

Ordovician (Richmond): Ontario.

W. S. Dyer, 1925 (Ont. Dept. Mines 32d Ann. Rept., pt. 7, p. 121).

Ermont formation.

Devonian: Southwestern Montana (Argenta, Beaverhead County).

P. J. Shenon, 1931 (Mont. Bur. Mines and Geol. Bull. 6). *Ermont fm.*—In vicinity of Ermont mine, Argenta dist., it rests conformably on Tilden fm. (Camb.) and consists of (descending): (1) Poor exposures, but probably bluish gray ls., 230 ft., Dev. fossils in dense bluish-gray ls. bed at base; (2) poor outcrop, but probably gray sh., 100 ft.; (3) dense light-gray massive ls., 30 ft.; (4) sill of dark-green andesite porphyry, 80 ft.; (5) dark-colored mag. ls. with buff-colored patches which may be due to alteration, 248 ft.; (6) black shaly ls. similar to basal beds, 80 ft.; (7) sill of dark-green andesite porphyry, 228 ft.; (8) black shaly mag. ls., with sugary appearance, in beds mostly less than 6 inches thick, a bed 2 ft. thick with twiglike bodies lying 10 ft. above base. Color contrast clearly marks division line btw. Ermont and underlying Tilden fm. Top of Ermont is not definite but was fixed at a cherty horizon in rocks that resemble the overlying Madison ls., Madison fossils being found a short distance above this cherty horizon. Correlates fairly well with Jefferson fm. of Threeforks region, although no sh. beds corresponding in position with Threeforks sh. are present in Argenta dist.

Erskine moraine.

Pleistocene (Wisconsin stage): Northwestern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 115–117). Well developed in vicinity of Erskine, Polk Co.

Ervay tongue (of Phosphoria formation).

Permian: Northwestern Wyoming (Owl Creek and Wind River Mountains).

H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1664, 1666). *Ervay tongue of Phosphoria fm.*—The uppermost lss. of Phosphoria fm., which extend E. and S. from Wind River and Owl Creek Mtns as a fairly widespread tongue. Crops out a few hundred ft. W. of Ervay, a post-office in Natrona Co., near N. end of Rattlesnake Hills, Natrona Co., and also at such scattered localities as Ferris Mtns, Green Mtns, and Alcova. Thickness 9 to 16 ft. The tongue is not as well exposed near Ervay as on the head of Casper Creek near Garfield Peak, about 15 mi. S. of Ervay, where it forms the dip-slope of a prominent hogback. Type section is on Casper Creek. [Fossils of the tongue are listed.] Underlies Dinwoody fm. and grades laterally into Freezeout tongue of Chugwater fm.

Ervine Creek limestone. (In Deer Creek limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northwestern Missouri, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 49, 50). *Ervine Creek ls.* is top unit in Deer Creek ls. It is 24 to 28 ft. thick in SE. Nebr., 22½ ft. thick in SW. Iowa, 16 ft. thick at Forbes, Mo., and 12 ft. thick in Kansas Valley E. of Topeka, Kans. Its thickest and best-known development is near Louisville, Nebr. Overlies Mission Creek sh. and underlies Jones Point sh., the basal bed of Calhoun sh. Named for Ervine Creek, NE. of Union, Nebr.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), excluded from Calhoun sh. the Jones Point sh. and the overlying ls. and included them in Deer Creek ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11), transferred Jones Point sh. and overlying ls. to Calhoun sh., leaving his Ervine Creek ls. the top bed of Deer Creek ls. This classification was adopted by R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 48), but on pp. 187–194 he proposed to redefine Ervine Creek ls., Jones Point sh., and Sheldon ls. on a cyclothem basis. (See 1936 entry under *Sheldon ls.*)

For Condra's latest interpretation of strat. position of this ls. see 1937 entry under *Topeka ls.*

Erving hornblende schist.

Carboniferous: Western central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60, 72–74, and map). *Erving hornblende schist.*—A thick mass of fissile, rather fine-grained hornblende schist, which is in middle of Quabin qtzite in Northfield, but sinks lower farther S., and in middle of State it forms the basal memb. In many places it passes into a gray tremolite-actinolite schist. It appears to represent a calc. band in the original Paxton schist. Named for occurrence at Erving.

Erwin quartzite.

Lower Cambrian: Southwestern Virginia, western North Carolina, and eastern Tennessee.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 5 and columnar section). *Erwin qtzite.*—White ss. and qtzite, 500 to 700 ft. thick, of very uniform appearance. The strata are composed of fine white sand, more or less cemented by secondary silica. Layers very massive and show scarcely any sh. partings. Between the qtzite and overlying Shady ls. are a few ft. of sandy sh. and thin ss., in which are found a few Lower Camb. fossils of the *Olenellus* fauna. Scolithus borings are common in the qtzites. Overlies Hampton sh.

Named for exposures near Erwin, Unicoi Co., Tenn.

Escabrosa limestone.

Mississippian (lower): Southeastern Arizona (Bisbee region).

F. L. Ransome, 1904 (U. S. G. S. P. P. 21). *Escabrosa ls.*—Characteristic rocks are rather thick-bedded, nearly white to dark-gray, granular lss. made up largely of fragments of crinoid stems. Lower 100 ft. is usually in beds 10 to 15 ft. thick; above that in beds 1 to 5 ft. with occasional occurrences of more massive strata. As a whole it is a pure nonmagnesian ls. containing practically no aren. sediments anl only occasional irregular bunches and nodules of chert, usually in upper part. General appearance of fm. is white or light gray, but some dark-gray beds occur, particularly near top. Thickness 800± ft. Rests, apparently conformably, on Martin ls. and is conformably overlain by Naco ls. Named for conspicuous exposures on Escabrosa Ridge, Bisbee quad.

Escamela limestone.

Cretaceous: Mexico (Guerrero).

C. E. Hall, 1903 (Soc. cient. Ant. Alzate Mem. y rev., t. 13, p. 328). *Escamela ls.*, in Washita div. of Comanche series, at and in vicinity of town of Iguala.

Escanaba limestone.

Middle Ordovician: Michigan (Upper Peninsula).

A. C. Lane, 1909 (Mich. Geol. Surv. Rept. 1908, p. 47). *Escanaba ls.*—Local name suggested by A. W. Grabau for Trenton ls. of Mich., because neither at top nor bottom do the dividing lines exactly agree in time with the Trenton of N. Y. But it is entirely unlikely that the dividing lines are exactly the same at the two ends of the State, that is, on the Escanaba and St. Mary's Rivers, where alone it has been or can be studied.

A. C. Lane, 1910 (Jour. Geol., vol. 18, btw. pp. 393 and 430). Trenton ls. of Mich. includes equivalents of Chazy, Birdseye, Black River, and Trenton of N. Y. So Grabau would suggest a local name like *Escanaba*. While *Escanaba ls.* is a more euphonious term, my impression is it would be better to use Trenton in a broad sense and introduce *Escanaba* as applicable to some accurately defined subdivision.

Escondido formation. (Of Navarro group.)

Upper Cretaceous (Gulf series): Southern Texas.

E. T. Dumble 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 227–229, 230). *Escondido beds.*—Lower part ss. with indurated glauconitic layer containing small oysters and other fossil forms; upper part friable and hard sss. alternating with blue, buff, brown, and green clays and sandy clays, the sss. in places highly calc. and containing beds of oyster shells. Thickness 3,300 ft. Top fm. of Eagle Pass div. Overlies Coal series [Olmos fm.] of Eagle Pass div. and underlies Webb Bluff Tertiary.

According to L. W. Stephenson, 1928 (Am. Jour. Sci., 5th, vol. 16, p. 492), the Escondido fm. of Rio Grande region overlies Olmos fm.; the Escondido of Anacacho Mtn region rests uncon. on Anacacho ls. The Escondido of Medina River region is separated from underlying Taylor marl by Corsicana marl. The Escondido is top fm. of Upper Cret. in southern Tex., and is uncon. overlain by Midway fm.

Named for exposures on Escondido River below Eagle Pass, Maverick Co.

†Escondido series.

Miocene (?): Southern California (Los Angeles County).

O. H. Hershey, April 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [*Escondido series* and *Escondido lava* are titles of two blocks on the map, lying btw. Rosamond series below and Tejon (?) ss. above.]

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349–372). *Escondido series.*—Marine sediments and contemp. interbedded lava flows of Eocene (?) age occurring near head of Escondido Canyon [Los Angeles Co.]. Type section is in Tick Canyon. Slightly younger than Rosamond series.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753, pp. 38, 52). Hershey's "Escondido series" is tentatively correlated with Sespe fm., and mapped as *Sespe (?) fm.* No fossils found. Is overlain uncon. by Mint Canyon fm. Name is preoccupied.

E. C. Simpson, 1934 (Calif. Dept. Nat. Res. Div. Mines, Calif. Jour. Mines and Geol., vol. 30, No. 4, pp. 391–395, and 401, in rept. on Elizabeth Lake quad., which includes part of Escondido Canyon). *Escondido fm.* is probably middle Mio. and = Topanga fm., instead of same as Sespe (?) fm. of Kew. The Escondido accumulated subaerially; the Topanga contains abundant middle Mio. marine fossils. The two fms. closely resemble each other lithologically. So it is thought best to retain "Escondido fm." In quads to S. and W. the Escondido is overlain uncon. by Mint Canyon fm. (late Mio.).

R. P. Sharp, 1935 (Pan-Am. Geol., vol. 63, No. 4, p. 314). *Vasquez series* is here suggested to replace "Escondido series," preoccupied.

Escuminac beds.

Upper Devonian: Quebec (Escuminac Bay).

E. M. Kindle, 1930 (Canada Geol. Surv. Dept. Mines Summ. Rept. 1928, pt. C, pp. 82C–84C, pl. opp. p. 82C). Gray ss. and sh., carrying Upper Dev. fishes and ferns, discon. underlying Bonaventure cgl. (Carbf.) and overlying Fleurant cgl. in Escuminac Bay section, Gaspe Peninsula, on N. shore of Chaleur Bay, opp. Dalhousie, N. B. Highest Upper Dev. in section.

Eshamy granite.

Mesozoic (?): Southeastern Alaska (Prince William Sound region).

U. S. Grant and D. F. Higgins, 1910 (U. S. G. S. Bull. 443, pp. 34–35, 46). *Eshamy granite.*—Pinkish gray, medium-grained; granitoid texture. Practically surrounds Granite Bay and occupies nearly all of neck of land btw. Granite and Eshamy Bays. Cuts Valdez group.

Eska conglomerate.

Miocene (?): Central southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 500, pp. 15, 52–54). *Eska cgl.*—Predominantly coarse cgl. in massive plates interbedded with some coarse ss. Thickness, 3,000± ft. Overlies, without observed uncon., Chickaloon fm. and uncon. underlies basaltic lavas, breccias, and tuffs of Plio. (?) age. Extends W. from valley of Eska Creek, for which it is named. No determinable fossils, but regarded as certainly Tert. and probably Mio.

Eskota beds.

Permian: Central northern Texas.

J. W. Beede and W. P. Bentley, 1921 (Univ. Tex. Bull. 1850, pp. 16, 22, 29, 51, 53). *Eskota or Greer beds.*—A series (65 ft. thick in Coke Co.) of soft, evenly bedded clayey fine-grained sss. and fine sandy shales provisionally referred to Greer stage. As a rule the sss. and shales are dark red. Locally they are leached to a buffish or greenish shade, and occasionlly there are persistent light-colored beds. In this fm. are many heavy gyp. beds. Throughout its extent in Coke Co. only 1 thin sheet of ls. has been seen, and that is of a very peculiar crystalline texture, locally found to be very sandy. It is correlated by Wrather with the dol. in Eskota gyp. It is reasonably certain that the gypsums of Double Mtn fm. correspond in general way to those of Greer fm., and the succession is similar in Okla. and central Tex., as Wrather pointed out. Wrather tentatively refers the ls. or dol. in these gypsums to Eskota dol. Overlies, probably conformably but with sharp division line, San Angelo fm., and underlies Quartermaster (?) fm.

Probably named for Eskota, Fisher Co.

Eskota dolomite.

Eskota gypsum.

Permian: Central northern Texas.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 10, p. 953). *Eskota dol. gyp.*—Massive gyp. beds, 10 to 20 ft. thick, underlain by thin dol. Has not been followed farther than central Fisher Co. Lies 120 ft. above Childress dol. and gyp., and is older than Croton gyp.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 180). *Eskota gyp.* is a memb. in Whitehorse-Cloud Chief interval.

Probably named for Eskota, Fisher Co.

Eskridge shale.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

J. W. Beede, 1902 (Kans. Univ. Sci. Bull., vol. 1, p. 181). *Eskridge sh.*—Name suggested by C. S. Prosser, in unpublished ms., for 30± ft. of shales overlying Neva ls. and underlying Cottonwood ls.

Top fm. of Wabaunsee group as used in Kans. for many years, but Kans. and Nebr. Surveys have recently greatly restricted Wabaunsee group. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.) Some geologists, including R. C. Moore, 1936, assign this fm. to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Named for exposures near Eskridge, Wabaunsee Co., Kans.

Esmeralda formation.

Miocene (upper): Southwestern and central Nevada and Inyo County, California.

H. W. Turner, 1900 (Am. Geol., vol. 25, pp. 168–170; U. S. G. S. 21st Ann. Rept., pt. 2, pp. 197–208). *Esmeralda fm.*—Fresh-water lake deposit, consisting of sss., shales, and lacustral marls, with local development of breccia and cgl. on large scale; rhyolitic and basaltic lavas and tuffs at top in some places; also layers of rhyolitic and andesitic tuff lower down in fm. Thickness 14,800 ft. Overlain by rhyolitic and andesitic eruptive rocks. Named for development in Esmeralda Co., Nev. [before the county was subdivided].

S. H. Ball, 1907 (U. S. G. S. Bull. 308), mapped *Siebert lake beds* (now abandoned for Esmeralda fm., the older name) in Inyo Co., eastern Calif.

†Esopus millstones.

Silurian: Eastern New York (Ulster County).

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 246–250). Shawangunk grit extends N. from Shawangunk Mtn nearly to Kingston, N. Y., where the firm coarse grits have long been quarried for millstones, known on the market as *Esopus millstones*, from name of township and village of Kingston during War of Revolution. [According to N. H. Darton (personal communication) the †Esopus millstones are older than Esopus grit, and were quarried from Shawangunk cgl. The present village of Esopus is about 10 mi. S. of Kingston, Ulster Co.]

Esopus slate.

See under *Esopus grit.*

Esopus grit.
Esopus shale. } (In Oriskany group.)

Lower Devonian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 127–130). *Cauda-galli grit.*—Fine-grained, calc. and argill ss., usually drab and brownish. Underlies Schoharie grit and overlies Oriskany ss.

From 1842 until 1894 this fm. was called "Cauda-galli grit" and "Cocktail grit."

J. Hall, 1867 (N. Y. Nat. Hist. Geol. Survey N. Y., vol. 4, pp. 1–3). *Cauda-galli grit.*—Usually occurs as aren. sh. or sh. The rock itself is usually dark or nearly black slaty grit, weathering grayish or brownish gray, with strong lines of jointing. *Fucoides cauda-galli* in upper beds.

N. H. Darton, 1894 (N. Y. State Geol. 13th Ann. Rept., pp. 209–210, 244–245, 302). *Esopus shales* (*Cauda-galli grit*).—The shales and slates which have been known as "Cauda-galli grit" attain max. development in N. Y. about Catskill and Kingston; thinning gradually to 70 ft. at Schoharie; 40 ft. near Jordansville, N. of Richfield Springs; 3 ft. at Columbia, NW. of Richfield Springs; and are entirely absent at Litchfield, 8 mi. farther W. This rock expands greatly in N. J. Thickness at Clarksville [Albany Co., N. Y.], 110 ft.; in Ulster Co., 200 to 300 ft. In order to have a locality designation for Cauda-galli grit, *the State Geologist* [*James Hall*] *has suggested Esopus sl.*, from Esopus settlement, of which the portion now known as Kingston is largely on this fm.; and Esopus Creek, along which, for some mi. above Saugerties [Ulster Co.], the slates are particularly well exposed. Is in greater part a fine-grained aren. deposit of dark-gray color, with more or less completely developed slaty cleavage. About Schoharie and westward to its termination it is moderately hard, sandy sh., dark gray or buff to light olive, but E. and S., with increasing thickness, the color becomes darker, the texture harder, and slaty cleavage is general. In Helderburg Mtns and westward the shales constitute a slope btw. shelves of Onondaga ls. above and Oriskany ss. below, but from S. part of Albany Co. southward it constitutes high rough ridges.

H. Ries, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1), gave thickness of 750± ft. for *Esopus sl.* in Orange Co., N. Y.

F. J. H. Merrill, 1898 (N. Y. State Mus. Bull. 4, pp. 137–180). Only fossil known in Cauda Galli grit is *Spirophyton caudæ galli*, which occurs also in underlying Oriskany ss. [He treated *Cauda Galli grit* as top fm. of his Oriskany group, and Oriskany ss. as basal fm. of that group. For views of other geologists regarding the group classification of Esopus grit see under *Oriskany group.*]

C. S. Prosser, 1899 (N. Y. State Geol. 18th Ann. Rept., pp. 63–67), gave thickness of *Esopus sh.* at Schoharie and vicinity as 121 ft. (instead of 70 ft., as reported by Darton). G. Van Ingen and P. E. Clark, 1903 (N. Y. State Mus. Bull. 69, pp. 1176–1227), reported 300 to 325 ft. of *Esopus grit* in vicinity of Rondout, N. Y.

The U. S. Geol. Survey includes Esopus grit (and Esopus sh.) in Oriskany group. (See under *Oriskany group.*) The present N. Y. State Survey includes Esopus grit in its *Oriskanian*, but calls the underlying fm. *Oriskany ss.* (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 370.)

Espanola granite.

Pre-Cambrian: Western Ontario.

T. T. Quirke, 1917 (Canada Geol. Surv. Mem. 102, p. 33).

Espanola graywacke.

Pre-Cambrian (Huronian): Western Ontario.

See under *Bruce series.*

Espanola limestone.

Pre-Cambrian (Huronian): Western Ontario.

See under *Bruce series.*

Esperanza trachyte.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). *Esperanza trachyte.*—Dense lilac-gray to brown volcanic flows of latitic trachyte, with some breccia. Thickness 0 to 1,000± ft. Younger than Alcyone trachyte. Overlain by Oatman andesite. Named for Esperanza Canyon.

Espina breccia.

Tertiary (upper? Miocene): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 69, etc.). *Espina breccia.*—Breccia and tuff, 200± ft. thick, which show rough, nearly horizontal bedding. Mostly greatly altered, so that original character is in part doubtful. May be a part of Siebert [Esmeralda] fm., but definite correlation is not at present possible. [Forms Espina Hill; see map.]

Esplanade sandstone member (of Supai formation).

Permian: Northern Arizona (Grand Canyon).

D. White, 1929 (Carnegie Inst. Wash. Pub. 405, p. 11). *Esplanade ss. memb.*—A group of hard sss. at top of Supai fm., which form shelf known as the "Esplanade." Underlies Hermit sh.

Esquias formation.

Upper Cretaceous: Honduras.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 354).

Essex limestone.

Silurian (pre-Niagaran): Northeastern Illinois (Will and Kankakee Counties).

T. E. Savage, 1912 (Ill. Acad. Sci. Trans., vol. 4, p. 100). *Essex ls.*—Small remnants of fossiliferous lss. of early Sil. (pre-Clinton) age, 0 to 10 ft. thick, uncon. overlying Maquoketa sh. in Will and Kankakee Counties. Believed to be younger than Edgewood fm. and to belong near top of Alexandrian series. Upper 1½ ft.

yellowish-brown mag. ls. with small nodules and masses of chert; lower 8½ ft. yellowish-brown thin-bedded mag. ls.

T. E. Savage, 1913 (Ill. Geol. Surv. Bull. 23). *Essex ls.* underlies Sexton Creek ls. with possible break in deposition. Is thought to be a distinct fm., but later studies may show it should be treated as a memb. of the Sexton Creek or as a memb. of underlying Edgewood ls.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 111–112), divided his Alexandrian series into (descending) Sexton Creek (Brassfield) ls., *Essex ls.*, Edgewood ls., and Girardeau ls., and stated "the several fms. are uncon. among themselves."

T. E. Savage, 1914 (Am. Jour. Sci., 4th, vol. 38, pp. 28–37). *Essex ls.* of Will Co., NE. Ill., represents a horizon of the Edgewood a little higher than Channahon ls., and is overlain by brown, almost barren mag. ls. corresponding to Bowling Green memb. of the Edgewood.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 270–274). *Essex ls. memb.* is probably at or near top of Edgewood ls.

Named for Essex, Kankakee Co.

Estancia basalt.

Quaternary: Mexico.

R. H. Palmer, 1926 (Pan-Am. Geol., vol. 45, p. 128).

Estelle quartz diorite.

Late Jurassic (?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 502). Late Jurassic (?) intrusive occurring in first valley E. of Estelle Mtn, Riverside Co.

Estes system.

Pre-Cambrian: Western South Dakota (Black Hills).

J. J. Runner, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 354–372). The pre-Camb. rocks of Black Hills, S. Dak., are here divided into (descending): Lead system, Estes system, and Nemo system. The Estes consists of (1) very thick qtzite, sl. iron fm., and arkosic grits, underlain by (2) cgl., qtzite, ls., and sl. Underlies Lead system with possible uncon. and rests uncon. on Nemo system. Well exposed along Estes Creek.

Estevan formation.

Eocene (?): Saskatchewan and Alberta.

N. B. Davis, 1918 (Canada Dept. Mines, Mines Branch, Rept. clay resources southern Saskatchewan, p. 9). Included in Fort Union beds (Eocene).

All subsequent repts assign this fm. to Cret.

Esther granite.

Paleozoic (?): Southeastern Alaska (Prince William Sound region).

U. S. Grant and D. F. Higgins, 1910 (U. S. G. S. Bull. 443, pp. 39–41, 46). *Esther granite.*—Gneissic granite. Occupies greater part of Esther Island, at S. end of Port Wells. Probably oldest granite of Prince William Sound. Cuts Valdez group.

Estill clay.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 59). *Estill clay.*—Clay, 65 to 120 ft. thick, overlying Waco ls. and forming top memb. of Alger fm. (of Niagaran age). Overlain uncon. by Dev. ls.

In 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173) Foerste assigned this clay to Clinton epoch.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 132). Type exposure of *Estill clay* is NE. of Estill Springs, Estill Co., N. of Irvine, where it is 56 ft. thick.

Etchegoin formation (narrow sense).

Pliocene: Southern California.

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 178–192). [Name applied to lower two-thirds of Etchegoin fm. See description under *Etchegoin fm.*]

W. P. Woodring, 1934 (U. S. G. S. geol. map and structure sections of Kettleman Hills), restricted *Etchegoin*, under the name *Etchegoin ss.*, to lower two-thirds of Etchegoin fm. as originally defined and used in previous publications, and adopted *San Joaquin fm.* for upper part, previously called *San Joaquin clays*.

This restricted unit is now known as *Etchegoin fm.*

†Etchegoin formation (broad sense).

Pliocene: Southern California (Sunset, Midway, Coalinga, Mount Diablo, and Salinas Valley districts).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 178–192). *Etchegoin beds*.—Divided into Etchegoin sands, which compose lower two-thirds of fm., and San Joaquin clays, which compose upper one-third. The *Etchegoin sands* consist of unconsolidated sands and gravels in many places characterized by blue or bluish gray color. They vary in thickness from 1,200 to 2,500 ft. Are commonly coarse in texture and often pebbly, forming beds of cgl. One fossil horizon occurs near bottom and another some distance above. [Fossils listed.] The *San Joaquin clays* are about 1,500 ft. thick. At a distance they present a banded appearance, from the zones of color seen in the different strata, some of which have a width of 200 or 300 ft. The clays are conformably overlain by fresh-water Tulare fm. The Etchegoin beds overlie in turn all older fms. of region, resting upon each respectively with a distinct noncon. The next older rocks are the Coalinga beds.

R. Arnold and R. Anderson, 1908 (U. S. G. S. Bull. 357, pp. 46–55). In accordance with Mr. [F. M.] Anderson's statements and on basis of reasons stated below the Etchegoin fm. is mapped and described in present paper as the succession of slightly consolidated beds of sand, gravel, and clay, interbedded with occasional indurated beds, occurring on summit and flanks of Anticline Ridge and on SE. end of Joaquin Ridge N. of Coalinga, above base of the hill-forming ss. beds (referred to for convenience as *Glycymeris* zone), and below the beds described as Paso Robles fm. Strata in other parts of Coalinga dist. are referred to Etchegoin fm. on basis of paleontologic correlation with the beds on Anticline Ridge. The *Glycymeris* zone is underlain by clay that is classed in Jacalitos fm., and is overlain by a thick succession of bluish gray sand beds interbedded with dark-gray sand. An uncon. occurs below the *Glycymeris* zone in the synclinal basin N. of White Creek. Although in most places the Etchegoin appears to rest conformably on Jacalitos fm., in other places it overlaps the Jacalitos. It is overlain by Tulare fm., with possible uncon. Thickness over 3,600 ft. in S. part of dist., 1,700 ft. in oil field N. of Coalinga, 1,100 ft. in White Creek basin. [Fossils listed. The fm. includes marine, brackish, and fresh-water deposits.]

The broad usage of *Etchegoin* has been discontinued by U. S. Geol. Survey, and *Etchegoin fm.* has been adopted for the beds called *Etchegoin sands*, and *San Joaquin fm.* has been adopted for the beds called *San Joaquin clays* in original definition of Etchegoin fm.

Named for exposures in vicinity of Etchegoin ranch, 20 mi. NE. of Coalinga, in NW¼ sec. 1, T. 19 S., R. 15 E., Fresno Co.

Etchegoin sands.

Pliocene: Southern California.

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 178–192), applied this name to lower two-thirds of Etchegoin fm. (See under *Etchegoin fm.*)

Etcheminian series.

Etcheminian group.

Lower Cambrian: Newfoundland, Nova Scotia, and New Brunswick.

G. F. Matthew, 1888 (Am. Geol., vol. 2, p. 1). *Etcheminian series*, Camb., Canada.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4), applied *Etcheminian series* to lower part of Lower Camb. of Newfoundland, the upper part of Lower Camb. being named *Hanfordian series*. He divided his Etcheminian series into (descending) Smith Point, Brigus, and Bonavista fms., and listed fossils from each fm.

Etheline volcanics.

Tertiary: British Columbia.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 47).

Etholen conglomerate.

Lower Cretaceous (Comanche series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 723, 736). *Etholen bed.*—Consists of (descending): Lenticular bed of gyp., 0 to 90 ft.; massive bowlder breccia and cgl. made of Carbf. ls. and chert, 240 ft. Overlies Malone bed and underlies Yucca bed; all included in Washita div.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745, pp. 7–40). *Etholen cgl.*—Consists of 250 ft. of cgl. alone on N. flank of Quitman Mtns. Includes beds of ls., ss., sh., and marl. Is lowest group of Trinity found uncon. overlying Perm. and older rocks, although it possibly may not be oldest Trinity in Malone Mtns. Is probably = Campagrande fm. of Richardson. Occurs in Etholen Knobs, just NW. of Etholen section house, and in nearby small hills S. of the railway. Grades into overlying Cox ss.

Etna sandstone.

Pennsylvanian: Central Tennessee (Grundy County).

J. J. Stevenson, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 125, 201+). *Etna ss.*—Underlies Cashie coal bed and overlies Etna coal bed. On W. side of basin extends N. to middle Tenn.; on E. side to probably 50 mi. N. from New River in W. Va. Is same as Cliff ss. and Lower Etna cgl. of Safford in Tenn. [Safford used *Cliff Rock (Lower Cgl. of Etna Mines).*]

J. J. Stevenson, 1912 (Am. Phil. Soc. Proc., vol. 51, p. 460). *Etna ss.*—Varies in texture, as does the younger Bonair ss. Is often fine-grained and without pebbles when the Bonair is very coarse, and very coarse when the Bonair is not coarse. Can be recognized over nearly as great an area as Bonair ss., which can be traced from northern W. Va. and northern Tenn. almost continuously into Ala. Included in New River fm.

Etna quartz monzonite porphyry.

Post-Carboniferous: Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 80). Characterized by numerous large orthoclase phenocrysts.

Eubanks sand.

A subsurface sand occupying interval btw. 2,927 and 2,936 ft. depth in Richland gas field, NE. La. According to D. Gordon (A. A. P. G. Bull., vol. 15, No. 8, 1931) it lies at horizon of upper part of lower part of Glen Rose, of Trinity group.

†Euchee phase.

Miocene (probably upper): Northwestern Florida.

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90–91). *Euchee phase of the younger Miocene.*—Near Euchee Ana it consists of a sandy ferruginous clay, calc. in spots, having innumerable shells and casts of the small *Mactra congesta*. This is a counterpart of topmost layers at Alum Bluff. Estuary deposit. Underlies Alaqua phase.

According to studies of Julia Gardner these beds are probably Choctawhatchee fm. (upper and middle Miocene) and younger than "Alaqua phase."

Named for development at Eucheeanna, Walton Co.

Euclid sandstone lentil (in Bedford shale).

Devonian or Mississippian: Northern Ohio.

W. F. Morse and A. F. Foerste, 1909 (Jour. Geol., vol. 17, p. 166). Sss., in regular layers, at about same horizon in Bedford fm., along Euclid Creek. Known to trade as Euclid stone, and the division has been appropriately named *Euclid lentil* by C. S. Prosser in ms. [Defined by C. S. Prosser (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 24, 26, 51, 1912) as *Euclid ss. lentil of Bedford sh.*, consisting of 19 to 20 ft. of sss. in lower part of Bedford; separated from underlying Cleveland sh. by 5 to 14 ft. of argill. bluish-gray sh. forming basal part of Bedford.]

Named for Euclid Creek, E. of Cleveland.

Euclid moraine.

Pleistocene (late Wisconsin): Northern Ohio and northwestern Pennsylvania. Oldest moraine of Lake Escarpment morainic system. Named for Euclid, Ohio. (See U. S. G. S. Mon. 41.)

Eudora limestone.

Pennsylvanian: Eastern Kansas.

J. Bennett, 1896 (Univ. Geol. Surv. Kans., vol. 1, p. 113), casually used, in one place, *upper Eudora ls.*, but did not define it nor locate it in his section. On p. 136 of same vol. E. Haworth stated: We must conclude that *Eudora ls.*, as shown by Bennett in chap. VI and pl. VI, is nearly 100 ft. below the thin ls. at the dam, and therefore that Garnett ls. is also; for we have satisfactory evidence the two are the same. [Pl. VI does not show Eudora ls. but does show *Garnett ls.*]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 131). †*Eudora ls.* of Bennett (Kans. Univ. Geol. Surv., vol. 1, p. 113, 1896) is Stanton ls. of modern usage at Eudora, and is abandoned.

Eudora shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 12, 26, 27, 31, 34). *Eudora sh.*, in lower part of Stanton ls. memb., consists of alternating thin beds of bluish to black sh. and bluish lss. Total thickness 9± ft. Underlies Stoner ls. and overlies Meadow ls. as here redefined. Named for good exposures E. of Eudora, Kans.

Foregoing definition was used by R. C. Moore, C. O. Dunbar, G. E. Condra, and others.

In Kans. Geol. Surv. Bull. 21, pt. 1, May 15, 1935, pp. 76–79, N. D. Newell defined *Eudora sh. memb. of Stanton ls.* of Johnson and Miami Counties, NE. Kans., as consisting of 4 to 11 ft. of black carbonaceous sh., overlain by Olathe ls. memb. and underlain by Captain Creek ls. memb. (See also Newell, Jour. Geol., vol. 44, No. 1, 1936, pp. 23–31, and Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

†Eufaula sands.

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88 geographic map of Ala.). [*Eufaula* (*Ripley*) is applied to uppermost Cret. fm. of Ala. on this map, the name †*Demopolis* (*Rotten ls.*) being applied to underlying fm. There is no description or definition.]

W. H. Dall and G. D. Harris, 1891 (U. S. G. S. Bull. 84, p. 166), used "Eufaula sands" for the Cret. beds overlying †Tombigbee chalk and underlying †Lignitic in Miss.

Replaced by Ripley fm., older name.

Presumably named for exposures at Eufaula, Barbour Co., Ala., where Ripley fm. is well developed.

Eugene formation.

Oligocene: Northwestern Oregon (Eugene region).

W. D. Smith, 1924 (Econ. Geol., vol. 19, No. 5, p. 462). At Eugene the principal fm. is *Eugene fm.*, which consists largely of tuffaceous shales and sss. of Olig. age, in a monoclinal attitude, intruded by basalt dikes and sills. [In table on p. 458 he stated that *Eugene fm.* is = Astoria and Yaquina fms.]

W. D. Smith, 1925 (Oreg. Univ. Commonwealth Rev., vol. 7, No. 4, pp. 149–156). A considerable thickness of sh. of Olig. age in upper end of Willamette Valley we have called *Eugene fm.* It is in part marine, but with it are associated more or less volcanic ash or tuff. As the tuffaceous material is not especially coarse, it may have come from a considerable distance (Cascades), being blown by winds and later water-sorted along the shore. There are some terrestrial deposits associated with this, indicating a change from marine to land conditions, perhaps several fluctuations from one to the other.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, p. 269), assigned Eugene fm. to middle Olig.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 453, 459). *Eugene fm.*—Marine ss., sandy sh., cgl., and tuff, cut by basaltic dikes and sills. Typically exposed in city of Eugene. Fossils listed. Assigned to middle Olig. Younger than Fisher fm. [Thickness not stated.]

H. G. Schenck, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12). *Eugene fm.* has total thickness of perhaps 5,000 ft.

R. W. Chaney and E. I. Sanborn, 1933 (Carnegie Inst. Wash. Pub. 439), assigned Eugene fm. to middle part of lower Olig.

Euphemia dolomite.

Silurian (Niagaran): Southwestern Ohio.

A. F. Foerste, 1917 (Ohio Jour. Sci., vol. 17, pp. 187, 201, 202). *Euphemia dol.*—The very porous Mottled Zone of Prosser (Jour. Geol., 1916, pp. 334–365). Was identified by Orton with his West Union fm. of more southern counties in Ohio. Cannot be identified W. of New Paris nor S. of Cedarville. Overlies Laurel ls. and is regarded as inaugurating the dolomitic series herein named *Durbin fm.*, which includes (descending) Cedarville dol., Springfield dol., and Euphemia dol. Type loc. of Euphemia dol. is at quarry described by Prosser as Lewisburg stone quarry, 1 mi. NW. of Lewisburg; Euphemia is ½ mi. NW. of Lewisburg and a little nearer the quarry.

A. F. Foerste, 1923 (Denison Univ. Bull., Sci. Lab. Jour., vol. 20, pp. 43–49). *Euphemia dol.* is West Union bed of Orton in Clinton Co. and northward. Underlies Springfield dol.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 136–137). *Euphemia dol.* is of Lockport age. [On p. 154 he stated that at Springfield, Ohio, *Euphemia dol.* is 8 ft. thick and is overlain by typical Springfield dol. and underlain by Massie clay. Thicknesses given at other places range from 2.6 ft. (at New Paris) to 7.2 ft. at Cedarville and S. of Covington. Not identified S. of Cedarville. Foerste's *Springfield dol.* appears to be only a part of *Springfield ls.* of Orton.]

Eureka quartzite.

Ordovician (Middle): Northern Nevada, western Utah, and Inyo County, California.

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 262). *Eureka qtzite.*—Compact vitreous qtzite; white and blue, passing into reddish tints at base; indistinctly bedded. Thickness 500 ft. Uncon. overlain by Lone Mountain ls. and underlain by Pogonip ls. Named for development at Eureka, Nev. [See E. Kirk, 1932, below.]

This fm. was mapped by S. H. Ball (U. S. G. S. Bull. 308, 1907) in Inyo Co., Calif.

E. Kirk, 1932 (Am. Jour. Sci., 5th, vol. 26, pp. 27–43). Recent observations show that Eureka qtzite may have been essentially a continental deposit. The widespread occurrence of cross-bedding, ripple marks, and sun cracks clearly indicates shallow water and emergent conditions over large areas. It may well be that except for marginal zone along W. border of its area the Eureka was subject to only partial and intermittent marine transgression. The Pinyon Range, Nev., is its northern known limit. There it is 400± ft. thick. Southern known limit is in S. part of Las Vegas quad., Nev., where it is 20 ft. thick. To W., in Amargosa Range, it is 800 ft. thick, in Kawich Range, 1,200 to 1,500 ft., in Monitor Range, 400± ft., while in Toquima Range it is absent. Eastern known limit is in Dugway Mtns, Utah (300 ft.), and Fish Springs Mtns and Confusion Ranges, Utah. It appears to be absent in Stansbury Mtns, Utah, but is represented in Frisco dist., SW. Utah, by Morehouse qtzite, 2,000 ft. thick. The Eureka qtzite as heretofore understood included 3 divisions: (1) At top 0 to 3± ft. of saccharoidal ss., which is now known to be of Upper Ord. (probably Maysville) age, and to be uncon. on (2), the main mass of the Eureka, which consists of dense, white, vitreous qtzite; the basal beds (3) vary from sandy calc. argillites, cross bedded, to massive, brownish, cross bedded sss., some lss., dol., etc., in places containing Black River (Middle Ord.) fossils. *It is here proposed, with the approval of*

U. S. Geol. Survey, to transfer to overlying Lone Mtn ls., the few ft. of Upper Ord. saccharoidal ss. at top, and to designate the exposures on SW. slope of Lone Mtn as the type section of the fm., because here it is completely exposed, together with overlying Lone Mtn ls. and underlying Pogonip ls., while it is not exposed at Eureka, although it is poorly exposed in Eureka region. The Lone Mtn section is 18± mi. NW. of Eureka, and was known to Hague, who named the fm. Recent work has shown that basal part of Eureka qtzite about 30 mi. SW. of Eureka grades laterally into sss., calc. beds, and lss.

†Eureka shale.

Devonian (?): Northern Arkansas.

J. C. Branner and F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. xiii, 26–27). [According to p. xiii the fm. was named by Branner; the description is by Simonds.] *Eureka sh.*—Very black argill. sh., with marked tendency to break into prismatic blocks. Lithologically resembles Fayetteville sh. but is older. Same as "Black sh." of Dr. Safford in Tenn. Thickness in Washington Co., Ark., 10 to 12 ft. Oldest outcropping fm. in Washington Co. Underlies Boone chert and cherty ls.

E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, correlation chart). ***Typical Eureka sh.*** underlies St. Joe ls., overlies Sylamore fm., and is=Noel sh.

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202, correlation chart). Chattanooga sh. underlies St. Joe ls. memb. of Boone ls., overlies Clifty ls., and is divided into black clay sh. (which is=typical Eureka sh.) underlain by Sylamore ss. memb.

Named for Eureka Springs, Carroll Co.

†Eureka limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 67, 73). *Eureka ls.* proposed by G. I. Adams for ls. which serves as a protector and assists in production of permanent escarpment extending from Madison [in directions described in detail] to S. line of State. Overlies what seems to be equiv. of Osage shales [really a higher sh., the Scranton]. Same as Burlingame ls. [older name].

Preoccupied. Same as Burlingame ls., according to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 215).

Named for Eureka, Greenwood Co.

†Eureka limestone.

Lower Ordovician and Upper, Middle, and Lower Cambrian: Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 622). *Eureka ls.*—Dolomitic, cherty, and shaly ls., with several beds of clay sl. near base. Thickness 4,000 ft. Underlies Godiva ls. and overlies Robinson qtzite. [A footnote on p. 620 says that in Tintic folio the Eureka ls. will be named *Mammoth fm.*, in order to avoid duplication of names, and it was so named. Later, however, (U. S. G. S. P. P. 107, 1919), it was divided into 9 fms. (of Lower Ord. and Upper, Middle and Lower Camb. age) and *Mammoth ls.* was abandoned.]

†Eureka beds.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Eureka beds* introduced [reason not stated] to include Topeka ls., Severy shales, Howard ls., Burlingame shales, and Burlingame ls.

Preoccupied and conflicts with established classification.

Probably named for Eureka, Greenwood Co.

Eureka rhyolite. (In Silverton volcanic series.)

Tertiary (Miocene): Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Eureka rhyolite.*—Massive flows, dikes, and well-bedded tuffs, former greatly predominating. Much of rock can be called a flow breccia. Thickness thin to 2,000 ft. Uncon. underlies Burns latite complex and uncon. overlies Picayune andesite. [Mapped around town of Eureka, Silverton quad.]

Eureka fire clay.

A fire clay, 10 ft. thick, lying 100 ft. above Eureka coal in NE. Mo. Named for Eureka shaft.

Eureka Divide type.

Name applied by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 326–327, 546–547, 1900) to a series of dikes of analcite basalt on Eureka Divide, btw. Bandbox Mtn and Steamboat Mtn, Little Belt Mtns, Mont.

Eurepticau.

A term used by H. M. Seely (7th Rept. Vt. State Geol., 1910) "to indicate the great interval existing in the rocks of western Vt.—the geological gap reaching up from top of the Utica to bottom of Pleistocene."

†Eurypterus beds.

A paleontologic name applied in some repts to Rondout ls. of N. Y.

Eutaw formation.

Upper Cretaceous: Western Georgia, Alabama, eastern and northern Mississippi, and western Tennessee.

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 3, 61–68). *Eutaw group.*—Bluish, black, or reddish laminated clays, often lignitic, alternating with and usually overlain by noneffervescent sands, mostly, though not always, poor in mica and of gray or yellow tint. Contains beds of lignite, and very rarely other fossils. Lowest Cret. fm. in Miss. Underlies Tombigbee sand group. Overlies Carbf.

Later studies revealed that Coffee sand of J. M. Safford is lithologically like but younger than Eutaw group of E. W. Hilgard, and that in northern Miss. it is underlain by a sand lithologically like Tombigbee sand of Ala. and forming the upward extension of that sand. The Coffee sand and Tombigbee sand were therefore for many years treated by U. S. Geol. Survey and Miss. Geol. Survey as members of *Eutaw fm.* (See L. W. Stephenson, Ga. Geol. Surv. Bull. 26, pl. 5, 1911; Wash. Acad. Sci. Jour., vol. 7, No. 9, 1917; U. S. G. S. W. S. P. 576, 1928.) Further studies, however, led Stephenson to opinion that Coffee sand should be treated as a distinct fm., and in March, 1936, it was decided to remove it from Eutaw fm. It grades laterally into basal part of Selma chalk, but is lithologically distinct.

In central and western Ala. the Eutaw fm. as now defined is overlain by Selma chalk, with which it intertongues. In eastern Ala. and western Ga. it is overlain by Ripley fm. In NE. Miss. it is overlain in places by Selma chalk, and in other places by Coffee sand. In western Tenn. it is everywhere separated from Selma chalk by Coffee sand. In western Tenn. it is in places underlain by Tuscaloosa fm. and in other places it rests on Paleozoic rocks; in Miss. and Ala. it is underlain by Tuscaloosa fm.

Named for Eutaw, Greene Co., Ala.

Evacuation Creek member *(of Green River formation).*

Eocene: Northeastern Utah (Uinta Basin) and northwestern Colorado (Garfield and Rio Blanco Counties).

W. H. Bradley, 1931 (U. S. G. S. P. P. 168). *Evacuation Creek memb.*—Barren sh. and marlstone that weathers brown or brownish gray. Locally the sh. is sandy and locally thin beds of soft claystone occur. Thickness 530 to 840 ft.; latter figure in vicinity of Piceance Creek, Rio Blanco Co., Colo. Top memb. of Green River fm. in S. part of Uinta Basin. Overlies Parachute Creek memb. Named for excellent exposures on Evacuation Creek, Utah.

Evans granite.

Pre-Cambrian (?): Central northern Colorado (Georgetown region).

J. Underhill, 1906 (Univ. Colo. Studies, vol. 3, No. 4, p. 272; also Colo. Sci. Soc. Proc., vol. 8, pp. 103–122). *Evans granite.*—Occupies a small area in W. part of Evergreen [Denver Mtn Parks] quad. Strongly resembles Central City granite and very likely is same petrographic unit.

Probably named for Mount Evans, Clear Creek Co.

Evans Creek coal series.

Eocene: Western central Washington (Puget Sound region).

B. Willis, 1886 (U. S. 10th Census, vol. 15, pls. 81, 84). Puget Sound coal measures divided into (descending): (1) *Evans Creek coal series,* 10,260 ft., including coals 24 to 127; (2) sh. and sss., 400 to 500 ft.; (3) *Wilkeson [coal] series,* 1,260 ft., including coals 11 to 20; (4) sh. and sss. and coals 10 and 11, 300–900 ft.; (5) lower series, including coals 1 to 9, 980 ft. The *Carbon River [coal] series,* 1,180 ft. thick, probably lies btw. coals 10 and 11.

Evans Gulch porphyry.

Eocene: Northern central Colorado (Leadville district).

S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927 (U. S. G. S. P. P. 148). *Evans Gulch porphyry.*—A gray porphyry, of fine, almost even-grained texture, containing less quartz and more biotite than Mount Zion porphyry. Belongs to Gray porphyry group. Named for exposures in Evans Gulch, E. of Leadville.

Evans Landing facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 167, etc., 1931) to a lithologic development of his Carwood fm. in a part of southern Ind.

Evanston formation.

Eocene or Upper Cretaceous: Southwestern Wyoming.

L. Lesquereux, 1876 (U. S. Geol. and Geog. Surv. Terr. Bull. 5, 2d ser., pp. 244–248). *Evanston group* (upper Eo. or lower Mio.), may represent merely an upper memb. of Lower Lignitic (Eo.), which it overlies. Separated from Green River group (upper Mio.) by *Carbon group* (*middle Mio.*). [Latter name doubtless applies to Wasatch group, Eo.]

C. A. White, 1879 (U. S. Geol. and Geog. Surv. Terr. 11th Ann. Rept., pp. 240–241). *Evanston coal series* underlies Wasatch and overlies Bear River.

A. C. Veatch, 1906 (U. S. G. S. Bull. 285, p. 332). *Evanston fm.*—Gray and yellow clays, with irregular ss. beds containing Almy coal and several minor coal beds. Characterized by plants which are distinctive of upper Laramie beds, and by invertebrates which are common to the Laramie and Fort Union. Thickness 1,500 ft. Of Eo. or Upper Cret. age. Underlies Wasatch and rests on Bear River and Jurassic beds. Exposed from Evanston for 10 mi. N. The coal mined at Evanston is in this fm. Is same as "Evanston coal series" of C. A. White, 1879.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56), gave thickness of *Evanston fm.* (*"Upper Laramie"*) as 1,600± ft. and stated that it rests on Bear River and Beckwith fms.

†Evanston coal series.

See 1879 entry under *Evanston fm.*

†Evanstonian series.

A term applied by C. [R.] Keyes (Pan-Am. Geol., vol. 41, 1924, pp. 36, 65–66) to Evanston fm.

Evansville sandstone bed. (In Wellington formation.)

Permian: Central northern Oklahoma (Logan and Lincoln Counties).

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 243, 251, etc.). The name *Evansville ss. bed* is proposed for a ss. bed in Iconium memb. of Wellington fm. that has heretofore been called by some geologists the *Bu-Vi-Bar bed,* because it is well developed near a dry hole drilled by Bu-Vi-Bar Oil Co. close to town of Evansville. Lies lower in section than Lowrie ss. bed. Bed has been traced from S. line of Logan Co. to N. line of T. 16 N., R. 1 W. It is massive ss., cross-bedded, friable, reddish brown, and averages about 25 ft. in thickness. Top of bed is exposed ¾ mi. E. of Evansville, with approx. elev. of 1,120 ft., but is better exposed as conspicuous ledges S. of there, at locality 500 ft. N. of SW. cor. of sec. 25, T. 15 N., R. 1 W., Logan Co., at elev. 1,062± ft. Latter exposure shows top of the ss. and base of overlying sh.

†Everett schist.

Ordovician: Southwestern Massachusetts and northwestern Connecticut.

W. H. Hobbs, 1893 (Jour. Geol., vol. 1, pp. 717–736, 780–802). *Everett schist.*—The upper schist horizon of Mount Washington. Overlies Egremont ls. Is top fm. of Mount Washington series. Named for fact it has its max. thickness within area of Mount Everett, Mass. Is a porphyritic rock not easily distinguished from Riga schist, from which it differs chiefly in absence of macroscopic garnets and staurolites. Correlated with Greylock schist of NW. Mass.

Is same as Berkshire schist. See B. K. Emerson, 1917 (U. S. G. S. Bull. 597 and map).

†Everglades limestone.

Pleistocene: Southeastern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 101, 154, 157, 325). The deposit upon which the Everglades immediately rest, in this part at all events, is a recent organic ls. probably based on the Tert. rocks, which farther N. are elevated above the sea. For it we may provisionally adopt the name *Everglades ls.* It is the rock forming about the margin and underlying the basin of the Everglades of Fla.; the deposits lately formed and apparently now forming in region of Everglades. They are partly organic and partly chemical in origin. To latter fact may perhaps be ascribed the exceptionally crystalline character which some of Everglades ls. exhibits and which, so far, has not been duplicated elsewhere in State. [According to table on p. 157 it underlies white sand and overlies †Vermetus rock.]

Replaced by Miami oolite and Anastasia fm. (both Pleist.) and Caloosahatchee marl (Plio.).

Evergreen amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. The fm. belongs in Central Mine group, since it lies above cgl. No. 8, in Evergreen mine, N. of Evergreen Bluff, Ontonagon Co. The mineralized part is the Evergreen lode.

Evergreen flow.

Includes Evergreen amygdaloid and underlying trap.

Everona limestone.

Lower Ordovician: Northeastern Virginia.

A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 842). *Everona ls.*—A narrow belt of blue slaty ls. exposed from Mitchells Ford, on Rapidan River, to SW. of Rivanna River near Charlottesville. Named for small village in Orange Co., where the ls. is exposed in a small quarry N. of Mountain Run. The ls. is blue, crystalline, with slaty partings, closely crumpled, with breaks cemented by secondary white calcite, and is interbedded with thin, blue, only slightly calc. slates, which form a considerable part of fm. Probably of same age as Frederick ls. of Md., which Bassler concludes is probably Chazy. Is believed to be in fault contact with Wissahickon schist.

Eversole chert.

Middle Devonian: Central Ohio.

C. R. Stauffer, 1909 (Ohio Geol. Surv. Bull. 10, pp. 72–74). *Eversole chert.*—Layers of gray chert alternating with layers of subcrystalline gray or brown ls.; 8 ft. thick. Forms zone D of Columbus ls.

Named for Eversole Run, Delaware Co.

Everton limestone.

Lower Ordovician: Southern Missouri and northern Arkansas.

A. H. Purdue, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 251–256). *Everton ls.*—Named by E. O. Ulrich, from Everton, Boone Co., Ark. Absent over W. and extreme N. parts of Ark. Uncon. underlies Upper St. Peter of Ulrich [St. Peter ss. of present usage] (which in places was deposited in hollows in Everton ls.) and uncon. overlies Lower St. Peter of Ulrich [later named Kings River ss. memb.].

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). *Everton ls.* uncon. underlies St. Peter ss. and uncon. overlies Yellville fm. [The Yellville of this 1911 rept applied to Powell ls. only, according to A. H. Purdue and H. D. Miser, 1916 publication cited below.]

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Everton ls.* consists of 3 subdivisions: (1) Sneeds Creek ls. lentil at base; (2) Kings River ss. memb.; and (3) a fine-grained nonmag. ls. interbedded with ss., which forms bulk of fm. in Harrison quad. and a small part of it in Eureka Springs quad.

C. L. Dake, 1921 (Univ. Mo. School Mines and Met. vol. 6, No. 1). In Mo. *Everton ls.* consists of 2 members: (1) a basal group of dominantly sandy beds with some interbedded lss., and (2) an upper ls. The lower memb. is 20 to 55 ft. thick; the upper memb. 0 to 55 ft. thick. Rests uncon. on Powell ls. or older beds. (See also under *†St. Peter group.*)

E. T. McKnight, 1935 (U. S. G. S. Bull. 853). *Everton fm.* of Yellville quad., northern Ark., is 0 to 400 ft. thick. It underlies the unfossiliferous Jasper ls. (0 to 50 ft. thick) and farther E. in Ark. uncon. overlies Black Rock fm., of Beekmantown age. It is possible later work may show that Jasper ls. really belongs to Everton fm. The Jasper is uncon. overlain by true St. Peter ss. The Everton as here interpreted includes the so-called Joachim ls., the so-called St. Peter ss. (here named *Newton ss. memb. of Everton fm.*), and the so-called Everton ls. (0 to 190 ft. thick) of Eureka Springs-Harrison folio. [See under *Black Rock fm.*]

J. Bridge, March 1937 (personal communication). *Everton* belongs with the Chazy. In fact some consider it post-Chazy.

Ewing limestone member (of Conemaugh formation).

Pennsylvanian: Southeastern Ohio and northern West Virginia.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 889, 890, 897, and pls. opp. pp. 889, 900, 912). *Ewing ls.*—Ferruginous ls., 5 ft. thick, in Coal Measures, about 80 ft. above Cambridge ls. and 40 ft. below Ames ls. Extends from Sunday Creek Valley southward to Ohio River.

Named for Ewing Site, in Sunday Creek Valley, in Hocking or Perry Co.

Excelsior formation.

Middle Triassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Muller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Excelsior fm.*—Dominantly effusive and pyroclastic rocks, with subordinate sediments. The lavas range from andesite through quartz latite to rhyolite. Is cut by intrusives that are probably of same age as the lavas. Thickness 12,000 ft. In Pilot and Excelsior Ranges 8,000 ft. of fm. consists of massively bedded cherts, which microscope shows to be extremely fine-grained water-laid tuff cemented and largely replaced by silica. Interbedded with the cherts are dark tuffaceous slates, a little impure ss., and some lava and breccia. The cherts are present in other ranges but are subordinate. In places lenticular lss. occur; these have yielded some Middle Triassic fossils. Overlies Candelaria fm. (Lower Triassic), probably with uncon., but contact not seen. Underlies Luning fm. (Upper Triassic) with marked erosion uncon. Named for Excelsior Mtns, where fm. is well exposed in Gold Range min. dist., about 6 mi. SW. of Mina.

Exeter diorite.

Post-Carboniferous: Southeastern New Hampshire (Rockingham County).

C. H. Hitchcock, 1870 (2d Ann. Rept. Geol. N. H., map and p. 32). *Exeter syenites.*—Syenitic rocks, of probable Laurentian age, exposed along Boston & Maine R. R. btw. Mass. and Maine, especially in towns of Exeter and Dover (SE. N. H.). They form, apparently, an anticlinal mass overlaid by Merrimack slates.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, btw. pp. 658 and 675), used *Exeter sienite and diorite.*

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 176). *Exeter diorite.*—Generally even, medium-grained light- to medium-gray hornblende-biotite diorite or quartz diorite. Intrudes Kittery qtzite and Eliot sl. Occurs in Exeter, Newmarket, Durham, Madbury, Dover, and Rollinsford Twps, in Rockingham and Strafford Counties. Is post-Carbf. Named for occurrence in Exeter Twp, Rockingham Co.

Exeter syenite.

See *Exeter diorite.*

Exeter sandstone.

Jurassic (?): Northeastern New Mexico and Panhandle of Oklahoma (Cimarron County).

W. T. Lee, 1902 (Jour. Geol., vol. 10, pp. 45–46). *Exeter ss.*—Firm, hard, and rather coarse but even-laminated sss., pink to white. Consists of (descending): (1) Massive white ss., 35 ft.; (2) loose-textured and readily weathered ss.; (3) massive chalky white ss., cross bedded and cavernous weathering, 15 ft.; (4) soft shaly ss., 2 ft.; (5) massive evenly laminated ss., ranging from red at base to white at top, 15 ft. Thickness of fm. 75 ft. near Exeter P. O., where it is overlain conformably by Morrison fm. and rests uncon. on Red Beds. [The P. O. was formerly spelled *Exter.* The town is now called Johnson.]

T. W. Stanton, 1905 (Jour. Geol., vol. 13, pp. 664–665). *Exter ss.*—Massive white or pinkish ss. which Mr. Lee has described as Exter ss. varies greatly in thickness. Max. observed was 80 ft. Is in places separated from overlying Morrison fm. by 40 to 50 ft. of gyp. and gypsiferous sh. Rests on Red Beds with striking angular uncon.

J. T. Duce, 1924 (Colo. Geol. Surv. Bull. 27, pt. 3, pp. 79–93), stated that in SE. Colo. the Exeter ss. appears as a thin lentil btw. the Morrison and the Lykins fm.

E. P. Rothrock, 1925 (Okla. Geol. Surv. Bull. 34, p. 36). *Exeter ss.* underlies Morrison fm. either discon. or uncon. It overlies the red beds and wedges out to E. in Cimarron Valley before reaching Okla.

R. K. DeFord, 1927 (Okla. Geol. Surv. Press Bull. May 3, 1927). *Exeter ss.* outcrops in T. 6 N., R. 1 E. and T. 5 N., R. 1 E., Cimarron Co., Okla., where it underlies Morrison fm. (consisting of sss., variegated shales, ls.) and rests with angular uncon. on unnamed variegated shales, which are absent in places. Lee described the uncon. but did not mention the brilliantly variegated shales which in places are present beneath the uncon. and above the Triassic red shales.

R. K. DeFord, 1927 (A. A. P. G. Bull., vol. 11, No. 7, pp. 753–755). *Exeter ss.*, massive ss., underlies Morrison fm. in Cimarron Co., Okla., and rests with angular uncon. on variegated shales which were mapped as Morrison fm. in Okla. Geol. Surv. Bull. 34, but which are probably Triassic.

N. H. Darton, 1929 (U. S. G. S. Bull. 794, p. 306). One ss. which lies considerably below middle of Morrison fm. in canyon of Cimarron River in NE. part of Union Co., N. Mex., has been called *Exeter ss.* by Lee. I am confident it is same bed that appears continuously in SW. part of Union Co. and E. part of San Miguel Co. in middle of Morrison fm. but here increased somewhat in thickness. In places the underlying sh. or clay is absent and the ss. rests uncon. on Triassic "Red Beds" (Dockum group), with some local discordances of dip as described by Lee. Near center of R. 34 E. the surface of "Red Beds" slopes down to W., and 80 ft. of what seems to be typical Morrison massive clay lies btw. the white ss. (Exeter) and the eroded surface of the "Red Beds."

B. H. Parker, 1930 (Kans. Geol. Soc. 4th Ann. Field Conf., p. 132), and 1933 (Jour. Geol., vol. 41, No. 1, pp. 40–43), introduced *Sheep Pen Canyon fm.* for 0–68 ft. of ss., of Triassic (?) age, in Union Co., NE. N. Mex., which he stated overlies Sloan Canyon fm. and underlies Exeter ss., "with which it has been confused."

C. W. Sanders, 1934 (A. A. P. G. Bull., vol. 18, No. 7, p. 866). Writer believes *Exeter ss.* is a ss. lentil in lower part of Morrison fm.

B. H. Parker, 1934 (A. A. P. G. Bull., vol. 18, No. 11, pp. 1544–1546). In Cimarron Valley, N. Mex., Morrison fm. rests on Todilto (?) fm. (0 to 15 ft. thick), which rests on *Exeter ss.* (0 to 80 ft. thick), which in places lies on Sheep Pen ss., in places on the older Sloan Canyon fm., and in places on the still older Dockum group. The Sloan Canyon has been mistaken, by some geologists, for Morrison fm., which has resulted in inclusion of Exeter ss. in the Morrison.

The U. S. Geol. Survey still treats Exeter ss. as a distinct fm., older than Morrison.

†Exogyra arietina clay.

†Exogyra arietina marl.

Paleontologic names for Lower Cret. beds in Tex. that were later named *Del Rio clay.*

†Exogyra ponderosa marl.

Paleontologic name for Upper Cret. beds in eastern Tex. that were later named *Taylor marl.* The Brownstown marl of Veatch (which in Ark. includes Ozan fm.) has also been called "Exogyra ponderosa marl."

†Exogyra texana clay.

Paleontologic name for Lower Cret. beds in Tex. later named *Walnut clay.*

Extension formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 97).

Extension breccia (intrusive).

Tertiary: Central Nevada (Tonopah district).

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, p. 17). *Extension breccia.*—Name has been locally used in Tonopah dist. for an intrusive mass of breccia whose relations are best exposed in Tonopah Extension mine; and, as it is desirable to distinguish this mass, the name is retained here. In previous mapping this fm. has probably been included in either Tonopah fm. or "Montana breccia." Max. thickness probably in neighborhood of 1,000 ft. Is younger than Mizpah trachyte, for it includes fragments of that rock, and is intruded by West End rhyolite. Probably formed in same general period of volcanic activity as Tonopah fm. and its associated flows.

†Exter sandstone.

Same as *Exeter ss.*, the spelling used in original definition and most subsequent repts, although the correct spelling of the town (in Union Co., N. Mex.) for which it was named is said to be *Exter.* The town, however, is now known as *Johnson.*

Fabre series.

Pre-Cambrian: Quebec.

R. Harvie, Jr., 1911 (Quebec Dept. Colonization, Mines, and Fisheries, Mines Branch, pp. 9, 15).

Factoryville moraine.

Pleistocene (Wisconsin stage). NE. N. Y. (Essex Co.). Named for Factoryville. See N. Y. State Mus. Bull. 187, 1916.

Fagundas conglomerate.

Term applied by J. F. Carll (2d Pa. Geol. Surv. Rept. I, pp. 38–40, 1875) to the coarse cgl. that appears in hill tops at Fagundas, Warren Co., NW. Pa., which is said to be same as Olean cgl. memb. of Pottsville fm.

Fairfax formation.

Pennsylvanian (Conemaugh): Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Fairfax fm.*—Lower half has thin and impure ss. beds interstratified with thicker beds of sh. and contains two thin and poor coal beds. Upper half is clay sh. and minor bands of sandy sh., with a bed of ss. (20 ft. thick) nearly 20 ft. below top and an 18-inch coal bed 40 to 50 ft. below top. Upper limit of fm. is base of Elkgarden coal or 14-foot bed. Thickness about 300 ft. Underlies Elkgarden fm. and overlies Bayard fm. Exposed around Fairfax, Grant Co., W. Va.

Fairfax limestone.

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1923 (W. Va. Geol. Surv. Tucker Co. Rept. pp. 130, 149, 156). *Fairfax ls.*—Hard gray ls., 2 ft. thick, visible near summit of Fairfax Knob, Grant Co. Lies about 5 ft. beneath Pittsburgh coal and about 3 ft. above Morantown coal. A fresh-water deposit near top of Conemaugh series.

Fairfax.

Eocene: Western Washington (Puget Sound region).

See under *Melmont*.

Fairfield slate.

Upper Ordovician: New York.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 56–60), stated that Utica sl. is *Fairfield sl. of repts,* but compiler has been unable to find any previous use of *Fairfield*. W. W. Mather also stated (Geol. N. Y., vol. 1, p. 367, 1843) that Fairfield sl. is a synonym of Utica sl.

Fairfield member. (In Cuyahoga formation.)

Mississippian: South-central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 671). *Fairfield memb.*—Alternating sss. and shales; the sss. typically coarse, reddish, yellowish, brown or bluish gray, sometimes pebbly and commonly in massive members, 20 to 60 ft. thick, with intervening shaly members of similar thickness; the sh. strata formed of thin interbedded sss. and shales, the former likely to be very coarse even where thin. Thickness 200 to 330 ft. Included in Cuyahoga fm. of Fairfield and Hocking Counties. Overlies Lithopolis memb., and underlies Black Hand memb. [restricted use of Black Hand].

Named for development in Fairfield Co.

Fairfield coal group. (In Mesaverde group.)

Name locally applied to basal 900 ft. of Williams Fork fm. (Upper Cret.) in Meeker, Axial, and Monument Butte quads., NW. Colo. Underlies Twenty-mile ss. memb. and overlies Trout Creek ss. memb. of Iles fm. Named for Fairfield mine, Meeker quad. (See U. S. G. S. Bull. 812C, by E. T. Hancock and J. B. Eby, 1930, pp. 206, 288–230, etc.)

Fairhaven diatomaceous earth member (of Calvert formation).

Miocene: Eastern Maryland.

G. B. Shattuck, 1904 (Md. Geol. Surv. Miocene vol., p. lxxii). *Fairhaven diatomaceous earth memb.*—Characterized by presence of large proportion of diatoms embedded in a very finely divided quartz matrix. Only small amount of calc. material. Consists of (descending) 20 ft. of diatomaceous earth; 1 ft. white sand locally indurated to ss.; and 2 to 6 ft. of brownish sand. Named for Fairhaven, Anne Arundel Co.

Fairlee granite gneiss.

Cambrian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Camb. of eastern Vt., but without definition. Probably named for Fairlee Twp, McCube quad., Orange Co., or some of the geographic Fairlee features within that Twp.

J. B. Hadley (letter dated April 23, 1936). In my opinion, and in opinion of M. Billings, the fm. referred to, but not described, by Foyles and Richardson is *quartz monzonite,* and I am calling it *Fairlee quartz monzonite* in rept. in preparation.

Fairmont shale member (of Hennessey shale).

Permian: Central northern Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Fairmont sh. memb.*—The lower 250 ft. of Hennessey sh., consisting largely of deep-red clay sh., not conspicuously laminated, but blocky and breaking with a characteristic conchoidal fracture. Has scattered thin white or greenish bands or streaks, rarely more than a few inches thick. Is composed of alternating hard and soft layers. Underlies Bison banded memb. of Hennessey sh. Named for exposures near Fairmont, Garfield Co.

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 253–254). Since the beds lying above redefined top of Garber fm. are predominantly red sh. for several hundred ft., it is proposed that Fairmont memb. of Hennessey fm. include the beds btw. top of redefined Garber fm. and base of Bison banded memb. of the Hennessey. Part of the Fairmont as thus redefined was mapped as Garber by Aurin, Officer, and Gould. At least 200 ft. of lower part of Fairmont shales are exposed above the Garber in Logan Co. The Fairmont is at least 90 percent. sh., with thin beds and lenses of fine ss. throughout. The sh. is red, blocky, nonlaminated, sandy, and contains dolomitic concretions; sun cracks locally. Lenses of ss. like underlying Garber ss. occur in basal 50 ft. of the Fairmont. The sss. above basal 50 ft. are finer grained than any ss. in Stillwater, Wellington, and Garber fms.; are reddish brown to gray, thin, cross-bedded, lenticular, and rarely more than 5 ft. thick. Thin dolomitic cgls. are generally found at bases of the sss.

J. C. Ross, 1933 (A. A. P. G. Bull., vol. 17, No. 3, p. 255). [See under *Garber ss.*]

Fairmont morainic system.

Pleistocene (Wisconsin stage): Southern Minnesota and northern Iowa.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 90–93). Composed of unnamed members. The town of Fairmont, Martin Co., Minn., stands on this morainic system, which may blend with Gary morainic system in SW. Minn.

†Fairmount gneiss.

Pre-Cambrian: Southeastern Pennsylvania.

T. D. Rand, 1887 (2d Pa. Geol. Surv. Ann. Rept. 1886, pp. 1601–1603). *Fairmount gneiss.*—Fine-grained orthoclase-albite-muscovite gneiss which forms hill at Fairmount. Differs from all other gneisses in vicinity in containing numerous veins or beds of granite, generally very coarse. Has been quarried at Fairmount. Is overlain by mica schists and hornblende schists.

Is a part of Wissahickon fm.

Fairmount limestone member (of Fairview formation).

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northern Kentucky.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, p. 78). *Fairmount or Dekayia aspera beds.*—Alternating thin-bedded bluish lss. and bluish, pale yellowish, or brownish shales, 80 ft. thick. Overlain by Bellevue or *Monticulipora molesta* beds and underlain by Mount Hope or *Amplexopora septosa* beds.

Upper memb. of Fairview fm.

Named for Fairmount, a part of Cincinnati, Ohio.

Fairmount limestone. (In McLeansboro formation.)

Pennsylvanian: Central eastern Illinois (Vermilion County).

E. F. Lines, 1912 (Ill. Geol. Surv. Bull. 17, pp. 59, 75). *"Fairmount" ls.*—Important Penn. ls. outcropping over area of less than 2 sq. mi. near Fairmount, Vermilion Co. Used in manufacture of portland cement. Included in McLeansboro fm. [Used by E. F. Lines in quotation marks and probably is economic term only.]

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129–138). La Salle fm. includes the 16 to 20-foot ls. in Vermilion Co. called *Fairmount ls.*

†Fairmount slate.

Upper Cambrian: Northwestern Georgia (Gordon County).

H. K. Shearer, 1918 (Ga. Geol. Surv. Bull. 34, map opp. p. 43). [*Conasauga (Fairmount) sl.* is name used on map. In text the rocks are called "the green sl. belt of Conasauga fm."] Although Conasauga fm. is areally one of most important of Paleozoic area of Ga., the green sl. deposits are confined to comparatively small belt along E. border of outcrop of fm. In the slate-bearing area of the fm. no younger fms. are present. On account of folding and faulting it is impossible to say whether the sl. beds represent top or bottom of Conasauga fm.

Preoccupied by other uses of Fairmount.

Named for development about Fairmount, Gordon Co.

Fairport chalky shale member (of Carlile shale).

Upper Cretaceous: North-central Kansas.

W. W. Rubey and N. W. Bass, 1925 (Kans. Geol. Surv. Bull. 10, pp. 16, 40). *Fairport chalky sh. memb. of Carlile sh.*—Chalky sh. and thin beds of chalk, 85 ft. thick, forming basal memb. of Carlile sh. in Russell Co. Replaces "Ostrea shales" of Logan. Underlies Blue Hill sh. memb. and overlies Greenhorn ls. Named for exposures a few mi. S. and W. of Fairport, Russell Co.

Fairview diorite.

Tertiary: Central southern Colorado (Silver Cliff-Rosita Hills region).

W. Cross. 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 291). *Fairview diorite.*—Dikes and irregular masses. Named for Mount Fairview.

Fairview formation. (In Maysville group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 10). *Fairview fm.*—Name proposed to include J. M. Nickles' divisions *Mount Hope* and *Fairmount.* About 100 ft. thick. Overlain by McMillan fm. and underlain by Eden.

Lower fm. of Maysville group.

Named for Fairview Heights, Cincinnati, Ohio.

†Fairview formation.

Lower Cambrian: Alberta and British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 5). *Fairview fm.*—Gray qtzitic sss., 1,000+ ft. thick on E. slope of Fairview Mtn. Base not seen. Underlies Lake Louise fm. Type loc. is NE. slope of Fairview Mtn.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444), discarded this preoccupied name, and included the beds in a fm. which he named *Fort Mtn,* of which they form upper part. See under *Fort Mtn ss.*

†Fairview shale.

Upper Devonian: Colorado (Pitkin region).

J. M. Hill, 1909 (U. S. G. S. Bull. 380, pp. 24, 35–36). *"Fairview" sh.,* local name for a mottled yellow sh., 40 ft. thick, separated from overlying buff "buckskin ls." by 10 ft. of mottled red sh. and from underlying "Parting" qtzite by 18 ft. of gray dol. Crops out in Quartz Creek dist. The ore of Fairview mine (7½ mi. a little W. of N. of Pitkin) usually lies in upper part of the dol. just beneath "Fairview" sh.

R. D. Crawford and P. G. Worcester, 1916 (Colo. Geol. Surv. Bull. 10). The lss. locally called "Buckskin lss." in Gold Brick dist. are underlain by 10 to 15 ft. of brownish-gray aren. shales and shaly lss., thin-bedded and ripple-marked, which are locally called *Fairview sh.,* because they form the hanging wall in Fairview mine. They are separated from underlying white or red qtzite, locally called parting qtzite (but which is believed to lie stratigraphically lower than so-called "Parting" qtzite of Leadville dist.), by 1 ft. of qtzite underlain by 35 ft. of massive blue-gray or dark-gray sandy dolomitic ls.

Lies in lower part of Chaffee fm.

Fajardo shales.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61). Assigned to early Cret. (?).

Recent (1931 and 1933) repts by H. A. Meyerhoff assign this fm. to *Cret.*

Falkirk dolomite.

Silurian (Cayugan): Western New York.

G. H. Chadwick, 1917 (Geol. Soc. Am. Bull., vol. 28, pp. 173–174). *Falkirk dol.*—Brownish and bituminous; below massive and often producing waterfalls. Thickness 30 feet. Underlies Scajaquada dark shales and blocky waterlimes, and overlies O-atka beds. Is a part of the Bertie [ls. memb. of Salina fm.].

Derivation of name not stated.

Fall Creek conglomerate lentil (of Chemung formation).

Upper Devonian: Northeastern Pennsylvania (Bradford County) and central southern New York? (Ithaca? region).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 74–79, 82, 98, 100, 236). *Fall Creek cgl.*—Rather coarse, very hard yellow sandrock, full of shells in lower layers. Contains many fragments of coaly material derived from carbonized plants. Bottom layer is mass of shells. Type loc., Fall's Creek, in Bradford Co. Same as Cascade ss. and Panama cgl.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Final Rept., vol. 2, p. 1556). Mr. Sherwood's claim to have identified *Fall Creek cgl.* through southern counties of N. Y. with Venango third oil sand rock is hardly worth consideration.

H. S. Williams, 1906 (Sci., n. s., vol. 24, pp. 365–372). *Fall Creek cgl. lentil*, top memb. of Chemung fm. at Ithaca, N. Y., is interpreted to be=cgl. of that name in Bradford and Tioga Counties, Pa. Thickness 0 to 10 ft. Overlies Wellsburg ss. memb. of Chemung.

H. S. Williams, 1906 (Jour. Geol., vol. 14, p. 579). *Fall Creek cgl. lentil*, 0 to 10 ft. thick; top memb. of Chemung fm. at Ithaca, N. Y.

H. S. Williams, 1907 (Am. Ass. Adv. Sci. Proc., vol. 56, pp. 265–267) and 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169). A thin band of cgl. in top of Chemung fm. at Ithaca, N. Y., is supposed to be same as Fall Creek cgl. of Bradford Co., Pa. It overlies *Leptostrophia* zone, top bed of Wellsburg ss. memb. of Chemung.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included Fall Creek cgl. in Chemung of central N. Y. On p. 406 she stated: Wellsburg ss., typically exposed at Wellsburg, Chemung Co., contains near top a 10-foot lentil of cgl., the *Fall Creek cgl.*

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, p. 323). In Tioga Co., Pa., the Dunkirk sh. includes *Fall Creek cgl.*, which rests on true Chemung and belongs in Canadaway group.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 593). It looks to writer as if Fall Creek cgl. is below Luthers Mills coquinite, perhaps 50 ft. lower. I. C. White's correlation of it with Cascade ss. is perhaps nearer the truth than is usually supposed.

Fallis member (of Wellington formation).

Permian: Central northern Oklahoma (Logan and Lincoln Counties).

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 243, 248+). *Fallis memb. of Wellington fm.*—Basal 240 ft. of Wellington fm. in Logan and Lincoln Counties. At least 90 percent is ss., friable, micaceous, reddish brown. Includes red sh. lenses with max. thickness of 20 ft. Fossil wood and imperfect barite rosettes locally. Base is in places marked by bed of dolomitic cgl. 2± ft. thick, which forms ledges in T. 15 N., R. 2 E. Tops of the shales are generally marked by dolomitic cgls. The sh. increases to N., and W. of Stillwater probably 50 percent of it is sh. Overlies Stillwater fm. Named for town of Fallis, sec. 29, T. 15 N., R. 2 E., Lincoln Co. The P. O. of Fallis is about 40 ft. above base of the ss. Contact with overlying Iconium memb. of Wellington is shown 1½ mi. E. of Iconium, 50 ft. E. of SW. cor. of sec. 12, T. 16 N., R. 1 E., Logan Co., at 1,109± ft. elev.

Fall River sandstone.

Pennsylvanian: Southeastern Kansas.

Robt. Hay, 1887 (Kans. Acad. Sci. Trans., vol. 10, p. 7 and cross section). *Fall River ss.*—Massive ss., 85 ft. thick, toward top of section in Wilson Co. Overlain by 150 ft. of sh., ss., and ls., with alluvium and gravel at top. Separated from underlying Dun ls. by 145 ft. of sh., ls., and ss.

Named for Fall River, Greenwood Co.

There is no other record of this name. According to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 124), Dun ls. of Hay included Plattsburg, Vilas, and Stanton fms.

Fall River sandstone. (In Inyan Kara group.)

Lower Cretaceous: Western South Dakota (Black Hills region), northeastern Wyoming, and (in wells) southeastern Montana.

W. L. Russell, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 402). It has been shown by writer elsewhere (S. Dak. State Geol. and Nat. Hist. Surv. Bull. 14, 1927, in press) that so-called Dakota ss. of Black Hills region is in reality older than true Dakota, and it will be called *Fall River fm.* in this paper. Overlies Fuson fm. and underlies Graneros sh. [Type loc. not stated.]

W. L. Russell, 1928 (Econ. Geol., vol. 23, No. 2, pp. 136–137). The so-called Dakota ss. of Black Hills region is here renamed *Fall River fm.* According to fossil plants identified by E. W. Berry it is much older than typical Dakota ss. of eastern Nebr. It consists of 75 ft. of sss. and interbedded shales underlying Graneros sh. and overlying Fuson sh. Type loc. is at Evans quarry, on Fall River, below Hot Springs, Fall River Co., S. Dak.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A, p. 5). *Fall River ss.* is so-called Dakota ss. of previous repts on Black Hills region. It is top fm. of Inyan Kara group, of Lower Cret. age, and named for exposures along Inyan Kara Creek in NE. part of Moorcroft quad., Wyo. Conformably underlies Graneros sh. and overlies Fuson fm. Continental except upper 20 ft., which contains marine fossils.

Falls formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle and Wichita Mountains).

E. O. Ulrich in 1928, at N. Y. meeting of Geol. Soc. Am., exhibited a ms. chart (which he did not publish) in which he divided Simpson fm. of Okla. into (descending) Bromide, Criner, Tulip Creek, McLish, *Falls*, Nebo, and Joins Ranch. In Feb. 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73) Ulrich published the following as his subdivisions of Simpson fm. (descending) Bromide, Criner, Tulip Creek, *Falls*, McLish, Oil Creek, and Joins. C. E. Decker, however, in Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, p. 1495), published Ulrich's 1928 list, as "reported by Dr. Chas. N. Gould."

C. E. Decker, 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498–1505), divided Simpson fm. into (descending): Bromide (of Trenton and Black River age); Tulip Creek (of Black River? age); McLish (of Chazy age, and *same as Falls, abandoned*); Oil Creek (of Chazy age); Joins (of Chazy age); and basal cgl. (of Beekmantown? age).

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 12, 98). *Falls Creek* is approx. = McLish to E. and has been discarded. [See under *McLish fm.* On p. 28 they say: Because of interlocking of faunas, that which was temporarily called *Falls fm.* has now been included in the McLish.]

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 105). *Falls fm.* is older than McLish. [See this entry under *McLish fm.*]

C. E. Decker, 1933. See this entry under *Simpson fm.*

Named for exposures on Falls Creek, in Murray Co., sec. 33, T. 1 S., R. 2 E.

†Falls sandstone.

A name that has locally been applied to Homewood ss. memb. in southern W. Va., because it forms the falls in Kanawha River.

Falls City limestone. (In Admire shale.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 9, 17, 30). *Falls City ls.*—Usually one massive bed, brownish mottled, soft, resinous; hardens on exposure. Thickness 3 ft. to 6 ft. 4 in. Lies 18 to 37 ft. above Aspinwall ls.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser.), named the beds overlying Falls City ls. and underlying Americus ls. the *West Branch sh.*, and the beds underlying Falls City ls. the *Aspinwall sh.;* but in 1932 he discarded Aspinwall sh. and named the beds immediately below Falls City ls. the *Hawxby sh.* On p. 82 of 1927 rept. cited Condra stated type loc. of Falls City ls. to be in Lehmer quarry, sec. 32, 2½ mi. S. and 1½ mi. W. of Falls City, Richardson Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville ls. to Perm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Falls City shale.

Eocene (Jackson): Southeastern Texas (Fayette, Gonzales, Karnes, and Atascosa Counties).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1314, etc.). *Falls City sh.*—Series of chocolate-colored bentonitic shales and carbonaceous shales with thin lenses of sand, in places fossiliferous. As *Textularia hockleyensis* is found in these shales it is advisable to name them so as to differentiate them from the McElroy. The sh. also carries typical Whitsett species. Is a lower zone of Whitsett fm. as here defined. Type loc. is W. of Falls City, in bed of San Antonio River, forming the falls of the river. Occurs in Fayette, Gonzales, Karnes, and Atascosa Counties. Overlies Dilworth sand (basal Whitsett) and underlies Stone's Switch sand.

†Falls Creek formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle and Wichita Mountains).

See under *McLish fm.*

Falls Mills limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 338). *Falls Mills ls.*—Yellow, shaly ls., 0 to 5 ft. thick, with marine fossils. Underlies Falls Mills sh. and overlies Upper Fivemile sh.; all members of Hinton group [fm.]. Type loc. along Bluestone River slightly NW. of Falls Mills, Tazewell Co., Va. Also observed in Summers Co., W. Va.

Falls Mills sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 335). *Falls Mills ss.*—Greenish-gray ss., usually massive and fairly coarse, but in places shaly; 25 to 50 ft. thick. Underlies Lower Pluto sh. and overlies Falls Mills sh.; all members of Hinton group [fm.]. Noted in Mercer and Summers Counties, W. Va. Type loc. is in edge of Tazewell Co., Va., just W. of Falls Mills Station, where it makes falls across Bluestone River.

Falls Mills shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 336). *Falls Mills sh.*—A calc. or red, sandy and variegated deposit, 3 to 50 ft. thick; lenticular ss. in lower part; marine fossils. Underlies Falls Mills ss. and overlies Falls Mills ls.; all members of Hinton group [fm.]. Type loc. along Bluestone River slightly NW. of Falls Mills, Tazewell Co., Va. Also observed in Mercer and Summers Counties, W. Va.

Falmouth formation.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 101-102)

Falmouth moraine.

Pleistocene: Southeastern Massachusetts (Barnstable County).

N. S. Shaler, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 553–556).

Named for occurrence in town of Plymouth, Barnstable Co. Is of Wisconsin age. Present on Cape Cod.

Falmouth pegmatite.

Pre-Carboniferous (?): Southwestern Maine.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 175). *Falmouth pegmatite.*—Normal medium to very coarse-grained pegmatite, occurring as dikes. With it is associated a fine-grained white or light-gray garnetiferous aplite. Intrudes Berwick gneiss. Assigned to pre-Carbf. (?). Named for exposures in Falmouth Twp, Cumberland Co.

On 1933 geol. map of Maine, by A. Keith, these rocks appear to be included in pre-Camb.

†False Dove limestone.

See under *Ward ls.*

Famine series.

Devonian: Quebec.

B. R. MacKay, 1921 (Canada Geol. Surv. Mem. 127, pp. 12, 31).

Fanney rhyolite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). The only rock in Mogollon dist. in which spherulitic texture is prominent. Thickness 0 to 1,200 ft. Older than Last Chance andesite and younger than Mineral Creek andesite.

Named for prominent outcrops in vicinity of Fanney mine, on Fanney Hill.

Fant meta-andesite.

Middle Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Fant meta-andesite.*—Altered andesitic flows and tuff cgl., of greenish to reddish brown color. Thickness more than 150 ft. Is younger than Hardgrave ss. and older than Thompson ls.

Named for an unidentified locality near Taylorsville.

This fm. has been classified as Lower Jurassic, but according to C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, pp. 80–81), it is Middle Jurassic, and he calls the fm. *Fant volcanics.*

Fant tuff member (of Catahoula tuff).

Tertiary (lower Miocene or Oligocene): Southwestern Texas Coastal Plain.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645, pp. 46, 65, 66–80, 178–179). *Fant memb. of Gueydan fm.*—Essentially a number of beds of indurated creamy-white mudflow tuff, which commonly shows sun cracks, interstratified with friable grayish-white air-deposited tuffs and greenish-gray or purplish-pink fluviatile clays and sandy clays. Thickness 12 to 255+ ft. Basal memb. of Gueydan fm. Grades into overlying Soledad memb. of Gueydan fm., and rests on Frio fm. and on Fayette fm. with probable discon. and overlap. Named for numerous exposures near Fant City, northern Live Oak Co. Assigned to Olig., as it grades laterally into Catahoula ss.

The Gueydan fm. is same as Catahoula tuff, and "Gueydan" has been discarded. The fm. is of either Olig. or lower Mio. age. The U. S. Geol. Survey and the Tex. Geol. Survey (as recorded in Univ. Tex. Bull. 3232, 1933) include Fant tuff in Catahoula, but A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11), includes it in underlying Frio clay.

Farallon Grande breccia.

Oligocene: Cuba.

S. Taber, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 581).

Fargo limestone.

Pennsylvanian: Southeastern Nebraska and southwestern Iowa.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 15, 26, 27). *Fargo ls.*—Exposed btw. Weeping Water Valley and Walnut Creek, from 4 mi. NW. of Fargo to near Rulo, and in spur S. of Rulo. Makes prominent cliff in valley side near Fargo, the type loc. One-half mi. N. of Fargo it consists of: (1) Bluish, massive, brittle ls., 1½ to 2 ft. thick, which makes a natural riprap along river bank; (2) dark-blue, carbonaceous, clayey to sandy sh., 5 ft.; (3) ls., 4 ft., in 3 beds. Separated from overlying Preston [Emporia] ls. by 14 to 34 ft. of sh. and from underlying Burlingame ls. by 11 to 29 ft. of sh.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 63, 66, 67). *"Fargo" ls.* of Condra and Bengston is Wakarusa ls., which has priority.

Fargo moraine.

Pleistocene: Northwestern New York (Jefferson County).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 43–44). Extends NE. and SW. through Fargo, Antwerp quad., Jefferson Co.

Farias beds.

Upper Cretaceous: Southwestern Texas (Maverick County).

F. M. Getzendaner, 1931 (Tex. Univ. Bur. Econ. Geol., Min. Res. of Tex., p. 130). *Farias beds* is name provisionally suggested for a series of beds not described in existing literature. Known only from Humble Oil & Refining Co. No. 1 Sullivan and No. 1 City Nat. Bank, the latter in Dimmit Co. Thickness 0 to 900 ft. Top 200 ft. very glauconitic, with nonlignitic sandy shales and impure sss.; middle 400 ft. very lignitic, but containing marine fauna; basal 325 ft. very micaceous calc. sandy shales with a prolific microfauna of basal Navarro. [In section of Maverick Co. these beds are placed below Olmos fm. and above San Miguel fm. Derivation of name not stated.]

Farland.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to 75 ft. of lss. in upper part of Kootenai fm. of Mont. Derivation of name not stated.

Farley limestone bed. (In Lansing ? formation.)

Pennsylvanian: Northwestern Missouri, eastern Kansas, and southeastern Nebraska.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13, 2d ser., pp. 29, 155). *Farley ls. bed.*—Ranges from a thin layer of calc. sh. to a bed of ls. 10 ft. thick, seemingly disappearing to NE. Divides Lane sh. memb. of Lansing fm. into two parts, the overlying beds being aren. and the underlying beds chiefly argill. Is bed No. 100 of Broadhead's section. Named for exposures near Farley, Platte Co., Mo.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), named the sh. overlying Farley ls. the *Bonner Springs sh.* and the sh. underlying it the *Island Creek sh.*, and included all of them in Kansas City group.

According to N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21), the Lane sh. of Hinds and Greene is younger than true Lane sh. and corresponds to upper part of Wyandotte ls. and overlying Bonner Springs sh. of Moore and Newell; and Farley ls. is upper memb. of their Wyandotte ls. This classification is followed by R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 45, 120, 122). Moore draws top of Kansas City group at top of Bonner Springs sh. These changed definitions have not yet been considered by U. S. Geol. Survey for its publications.

Farmington sandstone member (of Kirtland shale).

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

C. M. Bauer, 1916 (U. S. G. S. P. P. 98K). *Farmington ss. memb. of Kirtland sh.*—Brown resistant ss., varying in thickness up to 455 ft., where it forms bluff on San Juan River. To S. it is gradually replaced by lenses of sh. Where thickest it lies 271 ft. above base of Kirtland and 110 ft. below top of Kirtland. Farther S. it is 20 ft. thick, lies 40 ft. below top of the Kirtland and 830 ft. above base of Kirtland, and still farther S. it is represented only by isolated ss. lenses in the Kirtland.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). *Farmington ss. memb.* is 0 to 480 ft. thick, and of fluviatile origin. Is well exposed near Farmington, San Juan Co., N. Mex.

Farmington shale. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 309), applied *Farmington sh.* to that part of McLeansboro fm. of Fulton Co. underlying Lonsdale ls. and overlying coal No. 7. Thickness and derivation of name not stated, but probably named for the town in Fulton Co.

Farm Ridge moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. See F. Leverett, 1899 (U. S. G. S. Mon. 38, pp. 260–261). *Farm Ridge* of La Salle Co. is same as *Grand Ridge*. Named for Farm Ridge P. O., La Salle Co. Now said to be same as Chatsworth moraine.

Farnham limestone.

Ordovician: Quebec.

R. W. Ells, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 17J, 25J to 27J). Included in Trenton.

Farrer non-coal-bearing member (of Price River formation).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). Top memb. of Price River fm. btw. Sunnyside and Colo. State line. Somber-colored sss. and greenish tinged gray sh., 410 to 1,095 ft. thick. Overlies Neslen coal-bearing memb. Contains fresh-water fossils. Named for local mine in Coal Canyon. Has been traced eastward into Colo., where it seems approx.="undiff. part of Mesaverde" of W. T. Lee in Grand Mesa.

Far Rockaway gravels.

Tertiary: Southeastern New York (Long Island).

J. B. Woodworth, 1901 (N. Y. State Mus. Bull. 48, pl. 1, map). Yellow gravels overlying Cret. clays and sands and underlying Pleist. gravels in Oyster Bay and Hempstead quads. Assigned to pre-Pleist. [On 1901 geol. map of N. Y., by F. J. H. Merrill, these gravels were assigned to Neocene.]

Fashing clays.

Eocene (Jackson): Southeastern Texas (Karnes County).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1315, etc.). *Fashing clays.*—Fossiliferous bentonitic green clays, weathering to heavy sticky clay. Typically exposed in creeks around town of Fashing. Crop out from Frio River to W. part of Karnes Co. Thickness 110 ft. in vicinity of Whitsett; absent (on surface and in wells) in W. part of Karnes Co. Overlies Calliham sand and underlies Olmos sand, all zones in Whitsett fm. as here defined.

Faulconer limestone member (of Perryville formation).

Middle Ordovician: Central Kentucky.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17, pp. 23, 32, 131, 132). Farther eastward, especially btw. Danville and Harrodsburg, along the railroad, this lower part of the Perryville [memb. of Lexington ls.] is even more richly supplied with silicified fossils, and the rock is whiter and less distinguishable from the so-called dove-colored lss. at the top [of the Perryville]. Should any separate designation for the lower layers with the silicified fossils be desirable, the term *Faulconer ls.* will serve.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 317–342). *Faulconer memb.* of Perryville is a gastropod horizon, 5 to 8 ft. thick, underlying Salvisa memb. of Perryville and overlying Flanagan.

A. F. Foerste, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 389, 429–430). *Faulconer memb.* of Perryville bed is 20 to 25 ft. thick; consists of fine-grained ls., grayish or bluish brown, usually containing many gastropods and underlain locally by coarser-grained gray ls. Is overlain by Salvisa memb. and underlain by Woodburn bed, the top memb. of the Flanagan.

Named for Faulconer, Boyle Co.

Faxon limestone.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Faxon ls.*—Sometimes pure ls., but more frequently siliceous. Thickness 0 to 20 ft. Included in Grenville series. Caps "Dixon" schist. Underlies Swede Pond qtzite. Type loc. Faxon Pond, Warren Co.

H. L. Alling, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 52–53). *Faxon ls.* is most erratic memb. of Grenville series. At type loc., along shore of Faxon Pond, near Graphite, Warren Co., it lies above "Dixon" schist (preoccupied name), but it is absent at Hague and at mines in South Bay dist., along shore of Lake Champlain. It seems to be confined to interior of area. About 3½ miles W.-NW. of Pottersville it is represented by two beds of paramphibolite separated by a stratum of ls., and appears to be replacing Swede Pond qtzite by progressive overlap. At some localities it seems to depart from its normal position and to occur within the "Dixon" graphite schist and even beneath it as well. It may be same as Chesterfield ls. of Geo. W. Smith property, S. of Clintonville.

Fayette breccia.

Middle Devonian: Northeastern Iowa.

W J McGee, 1884 (10th Census, vol. 10, Rept. on Building stones, pp. 262–263). *Fayette breccia.*—Bed consisting of angular fragments of compact, brittle ls. embedded in matrix of similar material. Occurs at Fayette [Fayette Co.], Quasqueton [Buchanan Co.], and elsewhere.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, pp. 22–24). Fayette breccia of McGee includes (descending): (1) Fragments, fossiliferous and shaly, involving several life zones of Cedar Valley ls.; (2) fragmental masses of tough gray crystalline or semicrystalline heavy-bedded ls., which should be separated from Cedar Valley ls.; (3) fragments of hard drab unfossiliferous [fossiliferous?] ls. of finest grain, often thinly bedded, the *Gyroceras* beds, here named *Upper Davenport beds;* (4) buff or brown matrix, fragments small, unfossiliferous, named *Lower Davenport beds.* Overlies Kenwood beds.

W. H. Norton, 1895 (Iowa Geol. Surv. vol. 4). Fayette breccia of McGee includes Upper Davenport beds (*Gyroceras* beds) and Lower Davenport beds, the 2 top members of Wapsipinicon ls., which is overlain by Cedar Valley ls.

S. Calvin, 1898 (Iowa Geol. Surv. vol. 8). *Fayette breccia* includes (descending): (1) *Spirifer pennatus* beds, 8 to 12 ft.; (2) barren bed, 10 to 15 ft.; (3) *Gyroceras* beds, 5 ft.; (4) true brecciated beds, 15 to 20 ft. Is top part of Wapsipinicon stage and younger than Independence sh. of Wapsipinicon.

T. E. Savage, 1905 (Iowa Geol. Surv. vol. 15). *Fayette breccia,* 33 ft. thick, consists of diverse lss. brecciated. Is top memb. of Wapsipinicon stage and in Benton Co. uncon. overlies Coggon beds of Wapsipinicon stage. Includes Upper Davenport and Lower Davenport.

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, p. 413). Wapsipinicon brecciated beds include (descending) *Spirifer pennatus* beds, Upper Davenport, Lower Davenport, Independence, Otis (Cedar Valley phase), Otis (Vinton phase), Coggon phase, and Bertram. [These are described under the following headings: Upper Davenport breccia, Lower Davenport breccia, Independence breccia, Otis breccia, and Bertram breccia.]

Named for Fayette, Fayette Co.

Fayette sandstone. (Of Jackson age.)

Eocene: Eastern and southern Texas and northwestern Louisiana.

E. T. Dumble and R. A. F. Penrose, Jr., 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. xxxiii, 17, 47, 57, 58, 63). *Fayette beds.*—Sands, sss., clays, and lignites, more or less calc., 300 to 400 ft. thick, overlying uppermost fossiliferous stratum of Marine

Tert. (siliceous and glauconitic sands and white, brown, and black clays with lignite) and underlying Quat. Coast clays, on Brazos, Colorado and Rio Grande. [As thus defined includes, at base, Yegua fm.]

E. T. Dumble, 1893 (Brown coal and lignite of Texas, pp. 124, 154). *Fayette div.*—Gray sss. interstratified with gray clays and gray sands, 20 to 200 ft. thick. Uncon. underlies Lapara beds, and overlies Yegua div., originally included in Fayette.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, pp. 549, 552). *Fayette sands* restricted to series of sands (coarse and angular) and sss. with some clays, which contain large amount of opaline and chalcedonic materials, overlying Yegua clays and underlying Frio clays.

A. Deussen, 1924 (U. S. G. S. P. P. 126). *Fayette ss.*, 800 ft. thick, underlies Frio clay and overlies Yegua fm. in coastal plain of Tex. W. of Brazos River.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, No. 4, pp. 424–436). *Fayette* of type section uncon. underlies Frio group and overlies Yegua fm. The upper 500+ ft. is of Jackson age, and is here named *Whitsett beds*. The lower part, or true Fayette, is 150± ft. thick, is uncon. overlain and overlapped by Whitsett beds, and is of Claiborne age. These lower beds are here named *Lipan beds*. Their separation from the Jackson is made necessary by uncon. at their top.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645). *Fayette fm.* is 135+ ft. thick. in SW. coastal plain of Tex. Is largely sss., but includes clay and sh. Conformably underlies Frio fm. and overlies Yegua clay. Is basal fm. of Jackson group.

M. A. Hanna, 1929 (A. A. P. G. Bull., vol. 13, p. 384). Age assigned to *Fayette ss.* in literature has ranged from Lower Claiborne (Eocene) to Mio. Work of Deussen, Matson, and Berry, and later work by Bailey (Univ. Tex. Bull. 2645, 1926), seems sufficient definitely to allocate the Fayette, or, to quote Deussen, "the Fayette ss. lies above Jackson fm., is overlain by Catahoula." Bailey's Gueydan is approx.=Deussen's Catahoula. Miss Alva C. Ellisor has stated to writer that she has verified this position of Fayette on the surface, and the work of the writer has verified it in subsurface. It is in sense of Upper Jackson that Fayette is used in this note.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 681). *Fayette* is employed as a fm. name for Tex. strata btw. Yegua below and Catahoula or Frio above, and *Jackson* as a group name to designate all Eo. strata above the Claiborne. [In this publication Frio was referred to Olig., thus making *Fayette* and *Jackson* equiv.] Whitsett is upper memb. of Fayette fm. (Jackson, Eocene).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, p. 1302). Jackson group divided into (descending) Whitsett fm., McElroy fm., and Caddell fm., which are=Fayette of U. S. G. S.

A. Deussen, 1934 (A. A. P. G. Bull., vol. 18, No. 4, p. 501). Jackson group is here divided into (descending) Whitsett, McElroy, and Caddell, following 1933 classification of Miss Ellisor; and, also following Miss Ellisor, *Fayette* is abandoned and *Whitsett* is substituted.

W. L. Goldston and G. D. Stevens, 1934 (A. A. P. G. Bull., vol. 18, No. 12, p. 1639). Fayette is divided into (descending): (1) Fayette (Whitsett); (2) McElroy; and (3) Caddell.

A. Deussen, and E. W. K. Andrau, 1936 (A. A. P. G. Bull., vol. 20, No. 5, p. 540). Jackson group, following Miss Ellisor, is here divided into Whitsett fm. (substituted for *Fayette*, which is abandoned), McElroy fm., and Caddell fm.

The U. S. Geol. Survey's present definition of *Fayette ss.* (of Jackson age) includes in the fm. all beds in eastern Tex. below Frio clay and above Yegua fm.

Named for Fayette Co., Tex., but F. B. Plummer states (Univ. Tex. Bull. 3232, 1933, p. 681): The section exposed at Lipan Hills, as described by Dumble in his final [1924] description of the Fayette is now regarded as the type section of the Fayette fm.

A. C. Ellisor, 1936 (Gulf Coast oil fields, A. A. P. G., p. 474). As U. S. G. S. has used the name *Fayette* as synonymous with the name *Jackson* and is using Fayette to include all Jackson sediments, F. B. Plummer of Bur. of Econ. Geol., Univ. of Tex., suggested dropping the name Fayette for the upper, third fm. of Jackson group. As the name is now applied as a group name it can not be delimited as a fm. The name Whitsett has been selected for former Fayette of the writer.

†Fayette sandstone.

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 497). *Fayette ss.*—Massive cliff-making cgl., practically without bedding planes, reaching its greatest development at Nuttall, where it is 110 ft. thick and overlain by soft ss. or sandy sh., which makes no showing in outcrop, but which is a portion of the Fayette, as shown at type loc. and at other points down the river. Total thickness of fm. 180 to 220 ft. At Gaymont the fm. is composed of two plates of coarse ss. or cgl., the lower somewhat more massive than the upper, the interval btw. being composed of soft ss. and sandy sh. Underlies Kanawha fm. and overlies Sewell fm.

Preoccupied. Replaced by Nuttall ss., which is treated as a lentil in Sewell fm.

Named for Fayette Station, Fayette Co., W. Va.

Fayette gas sand.

Local economic term for a gas sand in Fayette dist., NW. Ala. Believed by M. J. Munn to lie at horizon of Black Creek coal group of Pottsville fm. (Penn.).

Fayetteville shale.

Mississippian (Chester): Northern Arkansas and northeastern and central eastern Oklahoma.

F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. 26, 42–49). *Fayetteville sh.*—Chiefly black but also bluish and even yellowish-brown sh. Thickness 150 to 175 ft. In Washington Co., Ark., underlies Batesville ss. and overlies Wyman ss. [In this rept. Simonds gave following downward succession of fms: Archimedes [Pitkin] ls.; Marshall sh., 0 to 80 ft.; Batesville ss., 10 to 60 ft.; Fayetteville sh., 150 to 175 ft.; Wyman ss., 2 to 9 ft.; Boone chert and cherty ls.]

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24), corrected the miscorrelations made in above rept., and described the following as correct strat. succession (downward): Pitkin ("Archimedes") ls.; Wedington ss. underlain by Fayetteville sh. (=Marshall sh. of Simonds); true Batesville ss. (=ss. exposed at type loc. of Wyman ss.); Moorefield sh. (mistaken for Fayetteville sh. by Simonds); and Boone ls.; and stated that Wedington ss. seems to be the ss. called Batesville by Simonds.

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville folio, No. 119) treated Wedington ss. as a memb. near top (in places at top) of Fayetteville sh., and this is still the approved definition. In Okla. this ss. lies near middle of Fayetteville sh.; in Ark. it lies 0 to 70 ft. below top of the Fayetteville.

Named for Fayetteville, Washington Co., Ark., in valley of West Fork of White River.

Federal Hill beds. (In Patapsco formation.)

Lower Cretaceous: Northeastern Maryland.

L. F. Ward, 1905 (U. S. G. S. Mon. 48, pp. 566–569, 598). *Federal Hill beds.*—Plastic or aren. clays, 50 ft. thick, forming basal part of Patapsco fm. at Federal Hill, in Baltimore.

Felch schist.

Pre-Cambrian (middle and lower Huronian): Northwestern Michigan (Felch Mountain and Calumet districts).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 303, 307). *Felch schist.*—Schists, more than 200 ft. thick, lying btw. Randville dol. below and Vulcan fm. above. They do not outcrop in Felch Mtn dist., but have been pierced by many drill holes. Are exposed, however, at Calumet, where they have identical characters of schist here named *Felch schist.* They are chiefly fine-grained mica schists containing garnet and tourmaline. Near contact with Vulcan fm. they become more siliceous and more ferruginous. Were called "Mansfield schists" by Smyth and correlated with slates at Mansfield and Michigamme Mtn. But slates at Mansfield are older than any in Felch Mtn dist. The fm. is therefore named for typical development at Felch Mtn. Assigned to upper Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Felch schist* to middle and lower Huronian.

†Felch Mountain iron-bearing series.

A term applied by C. R. Van Hise in 1892 (U. S. G. S. Bull. 86, p. 195, and U. S. G. S. Mon. 19, p. 473) to the lower Huronian rocks of Felch Mtn dist., Mich. Later, upper and lower Huronian were found to be present there, and in 1909 (U. S. G. S. Bull. 360, pp. 317–318, by C. R. Van Hise and C. K. Leith) the "Lower Felch Mountain" was said to correspond to lower Huronian and the "Upper Felch Mountain" to upper Huronian.

Felix siltstone.

Miocene (middle): Southern California (Kettleman Hills).

H. V. Dodd and E. J. Kaplow, 1933 (Calif. Oil Fields, Calif. Dept. Nat. Res., Div. Oil and Gas, vol. 18, No. 4, pls. 1, 2). *Felix siltstone,* 50± ft. thick in wells in North Dome, Kettleman Hills. Overlies Whepley sh. and is overlain by a considerable thickness of fine gray sands. Contains abundant Sporbo at base. Included in Temblor. Occurs in Felix, Huffman, and other areas [leases] in North Dome, lying at 2,885± ft. depth.

†fence-post limestone.

Upper Cretaceous: North central Kansas.

See under †*Downs ls.*

Fennell formation.

Cambrian or pre-Cambrian: British Columbia. W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 77).

Fentress shale division. (In Lee formation.)

Pennsylvanian: Northern Tennessee (Fentress and Pickett Counties).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 276, 384, 385). *Fentress sh. div.*—Name proposed for the part of Lee fm., in Fentress and Pickett Counties, beneath Rockcastle ss. Consists mainly of shales (fine clay shales and sandy shales), but may contain some beds of ss. and usually has two coal horizons, one just above its base and the other not over a score or two of ft. below its top. The shales change locally along the bedding into shaly ss. Thickness of the div. may be as much as 175 ft. Laid down on irregular erosional surface of Pennington fm. (Miss.). Upper part has been cut away locally at least. [Type loc. not stated, but presumably the beds were named for their development in Fentress Co.]

Fergus Falls moraine.

Pleistocene (Wisconsin stage): Western Minnesota and South Dakota.

W. Upham, 1888 (Minn. Geol. and Nat. Hist. Surv., vol. 2, pp. 545, 549, 570, 605, 625, 653). Named for occurrence at Fergus Falls, Minn.

F. Leverett, 1932 (U. S. G. S. P. P. 161). The Fergus Falls moraine is a part of Bigstone morainic system.

Ferguson gypsum member (of Blaine gypsum).

Permian: Western Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 47). *Ferguson gyp. memb. of Blaine div.*—Almost pure white to dirty brown gyp. forming basal memb. of Blaine div. Overlain by red sh. Older than Medicine Lodge gyp.

N. Evans (1931) suggests abandoning Ferguson. (See 1931 entry under *Medicine Lodge gyp. memb.*)

Named for Ferguson, Blaine Co.

†Fernandan system.

Pre-Cambrian (Llano series). Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvi, 267–276). *Fernandan system.*—Consists of (descending): (1) Important calc. series; (2) slaty schists, largely chloritic but as a rule not foliated; (3) carbonaceous schists; (4) magnetite, sometimes with hematite, 50 ft.; (5) fine-grained quartz rock; (6) thick series of mica schists; (7) tough hornblendic schists probably of detrital origin. Nos. 6 and 7 named *Valley Spring series;* Nos. 2 to 5 inclusive named *Iron Mtn series;* No. 1 named *Click series.* Overlies Burnetan system and underlies Texan system.

Now included in Llano series, which is divided into Packsaddle schist (dark-colored) and Valley Spring gneiss (light-colored gneisses and schists).

Named for San Fernando Creek, Llano Co.

Fernando group.

Pliocene and lower Pleistocene: Southern California (Los Angeles and Ventura Counties).

G. H. Eldridge and R. Arnold, 1907 (U. S. G. S. Bull. 309). *Fernando fm.*—A variable series of cgls., sss., and aren. clays; thickness 1,500 to 6,000 ft. and possibly several thousand ft. more. *Fernando* is term applied by Homer Hamlin a number of years ago, on unpublished maps, to include the siliceous sh. skirting the sides of San Fernando Valley, Los Angeles Co., which is general equiv. of all post-Modelo and pre-Saugus beds in Santa Clara province. Uncon. overlies Modelo fm. in Santa Clara dist. and Puente fm. in Puente Hills region and Los Angeles dist. Uncon. underlies Pleist. sand and gravel.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753). *Fernando group.*—Restricted to post-Mio. beds and divided into two fms., Saugus fm. (2,000 ft. thick) above and Pico fm. (4,000 ft. thick) below. Both of these fms. are present at Fernando type loc., and are separated by an uncon. Is uncon. overlain by Pleist. terrace deposits and rests uncon. on Modelo fm. Fossils indicate it is of lower Plio., upper Plio., and lower Pleist. age.

Fern Glen limestone. (Of Osage group.)

Mississippian: Eastern Missouri and southwestern Illinois.

S. Weller, 1906 (St. Louis Acad. Sci. Trans., vol. 16, p. 438). *Fern Glen fm.*—Red ls., with greenish blotches; chert band at top and some chert scattered through it; 8½ ft. thick; containing Kinderhook fossils and underlain by 6 ft. of probably softer red calc. sh., which is not exposed but which probably belongs to Fern Glen fm. and is separated from underlying Bushberg ss. by 4 ft. of hard, somewhat crystalline yellow or gray ls. The Fern Glen is overlain by crystalline greenish gray ls. which probably belongs to Burlington ls.

S. Weller, 1909 (Geol. Soc. Am. Bull., vol. 20, pp. 265, 269, 322). *Fern Glen fm.*—Near Fern Glen Station, 20 mi. W. of St. Louis, central eastern Mo., consists of (descending): (1) Greenish calc. shales with much chert, 14 ft.; transition beds to overlying Burlington ls., but contains same fauna as beds 2 and 3, below; (2) red calc. shales, with 6-inch persistent chert band at top, 12 ft.; (3) hard, red, crystalline ls., with many crinoid stems and other fossils, 14 ft. Rests on [so-called] Chouteau ls. Included in Kinderhook. Lithologically and faunally closely resembles St. Joe marble.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29), assigned Fern Glen to Osage group, and defined it as underlying Lower Burlington, as younger than Chouteau ls., and as uncon. overlying his Sulphur Springs fm.

The Mo. Geol. Surv. 1922 and 1926 geol. maps of Mo. assigned Fern Glen to Osage group.

S. Weller, 1926 (Jour. Geol., vol. 34, pp. 320–335). Fern Glen is a manifestation of the very lowest Burlington.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., table opp. p. 30, p. 155), assigned Fern Glen to Osage group, but stated (p. 166): A consideration of all data would seem to indicate that it would not do serious violence to facts to consider the Fern Glen as earliest memb. of Osage div., but faunas do seem to indicate that it is older than any of typical Burlington, and if it is transferred from Kinderhook to Osage it may be necessary to transfer some portion of upper Chouteau ls. also to the Osage.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., opp. p. 282), showed Fern Glen of eastern Mo. as uncon. on Bushberg ss., the uncon. representing Chouteau ls. and most of underlying Hannibal sh. In 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245) Moore showed Fern Glen of Mo. and Ill. as uncon. on Glen Park fm.

The present generally accepted classification of Fern Glen assigns it to Osage group, but not to Burlington ls.

Fernian series.

Name introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 46, p. 217, 1926) to replace *Fernie fm.* of Alberta.

Fernie formation.

A name applied by Canada Geol. Surv. to Jurassic beds in southern Alberta and British Columbia that are approx.=Ellis fm. of Mont. (See W. W. Leach, Geol. Surv. Canada Summ. Rept. 1902–3, p. 169A; D. B. Dowling, Geol. Soc. Am. Bull., vol. 17, p. 298, 1906; Canada Geol. Surv. rept on Cascade coal basin, Alberta, p. 8, 1907; P. S. Warren, Am. Jour. Sci., 5th. vol. 27, pp. 56–70, 1934.)

Fernow rhyolite.

Tertiary (post-Eocene?): Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pl. 74), mapped Packard rhyolite and *Fernow rhyolite* (flows and sheets) in Tintic dist.

G. O. Smith, 1900 (U. S. G. S. Tintic folio, No. 65). *Fernow rhyolite* occurs in several small areas in S. part of Tintic dist. Is like Packard rhyolite but rather more glassy. Probably erupted from a different vent than Packard rhyolite but at about same time and under similar conditions.

Named for Fernow Canyon, in S. part of Tintic dist.

Fern Ridge tuffs.

Late Tertiary (?): Central northern Oregon.

See under *Stayton lavas*. Derivation of name not stated. There is a town of this name in Clackamas Co.

Fernvale limestone. }
Fernvale formation. } (In Richmond group.)

Upper Ordovician: Western Tennessee, northern Arkansas, southeastern Missouri, and southwestern Illinois.

C. W. Hayes and E. O. Ulrich, 1903 (U. S. G. S. Columbia folio, No. 95, p. 2). *Fernvale fm.*—Soft green and chocolate shales, including one or more layers of coarsely crystalline, occasionally flesh-colored ls., usually with greenish specks, the lower layer not infrequently conglomeratic and highly phosphatic. In some areas lower part of fm. is composed of 5 or 6 ft. of strongly ferruginous, often vermilion-red ls. Thickness 0 to 40 ft. Uncon. overlies Leipers fm. and uncon. underlies Clifton ls. (Sil.). Top fm. of Richmond group.

To W., in Tenn., the Arnheim (†Warren) ls. intervenes btw. Fernvale fm. and Leipers fm., and Brassfield ls. overlies the Fernvale. In northern Ark. the Fernvale uncon. underlies Cason sh. and uncon. overlies Kimmswick ls. In Mo. and SW. Ill. the Fernvale underlies Maquoketa sh. and uncon. overlies Kimmswick ls. In Tenn. the Fernvale is called *Fernvale fm.;* in Mo., Ark., and Ill. it is called *Fernvale ls.*

Named for Fernvale, Williamson Co., Tenn.

†Ferriferous limestone.

A descriptive term applied in early Pa. and W. Va. repts to *Vanport ls. memb.* of Allegheny fm.

Ferris formation.

Eocene and Upper Cretaceous: Central southern Wyoming (Carbon County).

C. F. Bowen, 1918 (U. S. G. S. P. P. 108, pp. 228, 230, etc.). *Ferris fm.*—Light-colored, dark-gray, and carbonaceous sh.; buff to brown ss., in places extremely cross-bedded and showing great irregularity of deposition; and numerous coal beds. Pockets, lenses, and thin beds of cgl. composed of pebbles of older rocks are distributed through a zone 1,000± ft. thick at base. The fm. contains fresh-water invertebrates, land plants, and vertebrate bones. The shells and plants, which occur chiefly above the cgl. zone, are regarded as of Fort Union age. The vertebrates (consisting of bones of turtles, indeterminable fragments of ceratopsians, and a few specimens of Triceratops) were found only in the cgl. zone. Fm. tentatively classified as Tert. (?). Thickness 6,500± ft. Uncon. underlies Hanna fm. (Eo.) and overlies, without proof of uncon., Medicine Bow fm. (Upper Cret.). Best exposed from old Ferris ranch, on North Platte River, E. to top of hill N. of "Middle Ditch" at its junction with "Big Ditch." Is=lower part of "Upper Laramie" of Veatch.

Triceratops-bearing beds are now assigned to Upper Cret. by U. S. Geol. Survey.

Ferron sandstone member (of Mancos shale).

Upper Cretaceous: Central eastern Utah (Carbon, Emery, Sevier, and Grand Counties).

C. T. Lupton, 1914 (U. S. G. S. Bull. 541, p. 128). *Ferron ss. memb. of Mancos sh.*—Sand and sandy material, 50 to 100 ft. thick, containing in places fossiliferous concretions. More resistant than underlying and overlying rocks. Forms a hogback in Green River field and can be definitely correlated with alternating ss., sh., and coal beds in vicinity and S. of Ferron, in Castle Valley, from which it takes its name. *Lies 2,500± ft. below top of Mancos sh. and 400± ft. above Dakota ss.* [Dakota ? now]. [In Wasatch Plateau the Ferron has been found to be 800 ft. thick in places.]

Ferron Point formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–525). *Ferron Point fm.*—Green to bluish clays, interbedded with argill. lss., all carrying abundant fossils. Thickness 35± ft. Is basal fm. of Long Lake stage. Underlies calc. sh. of Genshaw fm. and overlies Rockport ls., base of Traverse group of Alpena region. Type loc., Rockport quarry, Rockport, Alpena Co. [Dr. Cooper stated, orally, that Ferron Point is 1 mi. due N. of the big dump at N. end of Rockport quarry.]

†Ferruginous sandstone.

A term used in early Mo. repts for the Miss. ss. later named *Aux Vases ss.*

Fiborn limestone.

Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).

R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21, p. 153). *Fiborn ls.*—Ls., mainly massive, low in magnesia, of buff to grayish buff color, dense grained to lithographic, with small disseminated crystals of calcite. Thickness 18 to 30 ft. Underlies Manistique series and overlies Hendricks series, all included in Niagara. Named for exposures in Fiborn quarry, Mackinac Co.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38). [See 1933 entry under *Burnt Bluff fm.*]

†Fickett series.

Mississippian, Devonian, and Silurian (?): Northern central Alaska (John River region).

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 242). *Fickett series.*—Ranges from chloritic schists or phyllites on S. through ls., slates, ss., qtzites and grit to hard cgl. on N. To S. rests uncon. on Skajit fm.; to N. it seems to be in fault contact with Stuver series and Lisburne fm. To W. it seems to overlie Lisburne fm. and possibly extends beneath Mesozoic. Lower Carbf. fossils near base. May include rocks younger than Lower Carbf.

Named for river called Fickett River in early repts but now known as John River.

Includes Noatak fm. (Miss.), also Middle and Upper Dev. and Sil. (?) rocks.

Fidalgo formation.

Triassic (?): Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 142–146). *Fidalgo fm.*—A number of intrusive masses of serpentinized dunite. Occurs on Fidalgo Head and at several localities in SE. part of Fidalgo Island. Composes Burrows, Young, Allan, Saddlebag, Dot, and Hat islands, and Williamson Rocks, and forms major part of Cypress Island. Consists of 3 distinct rock types, which are invariably associated with each other: (1) Coarse-grained dunite, (2) fine-grained dunite, (3) both of which are cut by thin stringers of serpentinized pyroxenite. Intrudes Leech River group. Assigned to Triassic (?).

Fiddle limestone.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 294–296, 300). *Fiddle ls.*—Ls. with a good deal of clay scattered through it, although some layers are pure. Layers of it, standing on end, form a massive gateway in Fiddle Creek ½ mi. above the road. Best exposed along road S. of Disaster Point, near the old lime kilns and along ridge that faces valley of Rocky River. Thickness 300 ft. Fossils. Overlies Coronach sh. and underlies Kiln sh., Upper Dev.

†Fiddler's Green limestone.

Silurian: Western New York (Onondaga County).

T. C. Hopkins, 1914 (N. Y. State Mus. Bull. 171, p. 12). *Fiddler's Green ls.*—Thin-bedded dolomitic ls., 20 to 40 ft. thick, occurring in upper part (25 to 63 ft. below top) of *Camillus beds or group* in Syracuse quad.

Fido sandstone.

Mississippian: Southwestern Virginia.

C. Butts, 1927 (Va. Geol. Surv. Bull. 27). *Fido ss.*—Coarse, friable, brown to reddish ss. about 50 ft. thick. Underlies Cove Creek ls. and overlies lss. of Gasper age. Probably corresponds to Hardinsburg ss. of Ky. Known to extend from a point 5 mi. W.-SW. of Gate City to road btw. Lindell and Holston River in Abingdon quad. and probably extends nearly entire length of Mississippian trough SE. of Clinch Mtn. Named for exposures in vicinity of Fido, Scott Co.

Fieldian series.

Cambrian and Ordovician (?): Canada.

P. S. Warren, 1929 (Canadian Field-Nat., vol. 43, p. 24).

Fields sand.

A subsurface sand, of early Penn. (Cherokee) age, in central eastern Okla. In Morris pool, Okmulgee Co., it is 10 ft. thick, lies at 1,800 ft. depth, the Lyons-Quinn sand lying at 2,000 ft., the so-called Glenn sand at 1,725 ft., and the Morris sand at 1,600 ft.

†Fierro limestone.

Permian, Pennsylvanian, and Mississippian: Southwestern New Mexico (Silver City region).

S. Paige, 1916 (U. S. G. S. Silver City folio, No. 199). *Fierro ls.*—Gray to blue fossiliferous ls. having max. thickness of 800± ft. Contains Penn. and Miss. faunas, which suggests an uncon. btw. upper and lower parts, but even in well-exposed sections no separation can be made by lithologic differences. Includes beds ranging from light gray to dark blue or purplish. West of Silver City upper half is chiefly light gray or light blue, and lower half is darker blue except where whitened, probably by intrusions. The beds are characteristically cherty except in lower 100 ft. The chert is either black or white; near base some red chert. Rests on Percha sh. (Dev.) with apparent conformity. Is uncon. overlain by Beartooth qtzite (Cret.). Named for town of Fierro, in NE. part of Silver City quad. Fossils listed. Girty says faunas are early Miss. and early Penn. The older fauna is correlated with that of Lake Valley ls. and the younger fauna with that of Magdalena group.

Abandoned in 1933, having been subdivided into (descending) Abo redbeds (Perm.); Magdalena group (Penn.), consisting of Syrena fm. above and Oswaldo fm. below; and Lake Valley ls. (Miss.).

Fife gabbro.

Cretaceous (?): Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 9, 118° to 118°30', near 49th Par.) and 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2). *Fife gabbro;* deep green to greenish black; occurs at Fife railway station. Cret. (?).

Figuera formation.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 284).

Fincher sand.

A subsurface sand, lying 95 ft. below top of Marble Falls ls. in central northern Tex.

Finis shale member (of Graham formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 127–128). *Finis sh. memb. of Graham fm.*—Sandy sh. with interbedded ss. comprising basal portion of Graham fm. Thickness 45 to 100 or more ft. Rests on Home Creek ls. memb. of Caddo Creek fm. Underlies Jacksboro ls. memb. of Graham fm. (of Canyon group).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), transferred Jacksboro ls. and Finis sh. to underlying Caddo Creek fm., and stated that Home Creek ls. includes Jacksboro ls. But F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), and F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534), drew base of Graham fm. at top of Home Creek ls. (which is where the bdy is at present drawn by U. S. Geol. Survey), and divided lower part of Graham fm. in Palo Pinto Co. into following members (descending): Bunger ls., 6 ft.; Gonzales Creek sh., 116 ft.; Eastland ss., 10 to 15 ft.; and Finis sh., 50 ft.

Named for Finis, Jack Co.

Finlay limestone. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Western Texas.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 47). *Finlay fm.*—Almost entirely massive gray nonmag. ls., but locally containing thin beds of brown ss. At least 300 ft. exposed in Finlay Mtn region, but top not found. Top fm. of Fredericksburg group. Overlies Cox fm. and underlies residual soil and wash.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745), transferred this fm. to Trinity group. [According to P. B. King (1937 communication) the fossils collected by Baker did not come from Finlay ls.]

The U. S. Geol. Survey now classifies this fm. as belonging to Fredericksburg group.

Named for Finlay Mtns, El Paso Co.

†Finley limestone.

Lower Ordovician (Beekmantown): Southwestern Missouri.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll., Bull. 1, pt. 1, p. 42). *Finley ls.*—Ls., 150 ft. thick; the First Mag. ls. overlain by Black River and Birds Eye ls. and underlain by Marshfield ss.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12), correlated Finley ls. with Jefferson City dol.

The 1922 geol. map of Mo. shows surface fms. of Finley Creek, Christian Co., to be Mississippian rocks and Jefferson City dol.

J. Bridge, 1930 (personal communication), stated that Finley ls. of Shepard is either Cotter dol. or Powell dol.

Finley Knob shale member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 77, 100, 111, 116, 148, 151, 152, 153, 154, 158, 162–163). *Finley Knob sh. memb. of Carwood fm* — Argill. to sandy sh., gray to drab or buff, with numerous bryozoans and some crinoids, 5 to 16 ft. thick. Top bed of Carwood fm. At Finley Knob, NW¼ sec. 5, T. 2 N., R. 6 E., 6 mi. W. of Vienna, Scott Co., it consists of 13 to 15 ft. of sandy sh., gray to drab, with many bryozoans and crinoidal ls. patches in lower part. Underlies Floyds Knob ls. and is underlain by massive ss. of Carwood fm.

Finnie sandstone. (In Tradewater formation.)

Pennsylvanian: Western Kentucky and southeastern Illinois (?).

L. C. Glenn, 1912 (Ky. Geol. Surv. Bull. 17, pp. 13, 14, 23, 24). *Finnie ss.*—Ss., 0 to 50 ft. thick, in Tradewater fm., in interval btw. coals Nos. 2 and 3, Owen's coal No. 2 lying about 16 ft. below it. Lower part contains irregular shaly lenses, coal streaks, and sh. breccia or cgl.; upper part, gently cross-bedded, of alternating white and purplish laminae, medium grained.

Named for Finnie Bluff, on road N. of Milfordtown, Union Co., Ky.

Finnie Bluff sandstone.

A name applied by some Ky. geologists to *Finnie ss.* of other geologists.

†First Pentamerus limestone.

Silurian (Niagaran): New York.

T. A. Conrad, 1840 (Am. Jour. Sci., 1st, vol. 38, pp. 89–90). First Pentamerus ls. underlies Rochester sh. and overlies green sl. and iron ore; is characterized by *Pentamerus oblongus*.

Same as †Pentamerus ls. of 1839 rept.

Fish Creek sandstone member (of Greene formation).

Permian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K, p. 42). *Fish Creek ss.*—Shaly, massive ss., 40 to 100 ft. thick. On Fish Creek, in SW. part of Greene Co., Pa., it is conspicuous for miles. Overlies Dunkard coal and lies about 36 to 40 ft. below Nineveh coal. Included in Greene County group [Greene fm.].

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 22, 33). *Fish Creek ss.*—Very massive ss., lying 135 to 150 ft. below Nineveh coal, and 100 ft. below Nineveh ls. Makes the great cliffs along waters of Fish Creek, in Springhill Twp, Greene Co., Pa. Is very conspicuous in region of Deep Valley, Pa., where it forms cliffs 25 to 30 ft. high.

†Fish Creek beds.

Upper Cretaceous: Central southern Montana (Sweetgrass County).

E. Douglass, 1902 (Am. Phil. Soc. Proc., vol. 41, pp. 207–221). In area E. of Crazy Mtns and S. of Big Snowy Mtns, in basin of Musselshell River, Mont., the Niobrara is overlain (uncon. at Fish Creek) by beds that I believe belong to Belly River fm., but until they are certainly correlated I give them the name *Fish Creek beds*. They are best exposed btw. Fish and Mud Creeks, a few mi. from where latter empties into Musselshell River. They consist of rather soft sandy clay with hard, almost black concretions and hard ss. layers containing in some places plant impressions. These beds are probably of fresh or brackish water origin. They are overlain by a series of shales and hard laminated sss. (the latter containing some fossil leaves, and the shales numerous plant fragments) which I am uncertain whether to place in *Fish Creek series* or in overlying Fort Pierre shales, but for present I am including them in Fish Creek series.

These beds are considered by U. S. Geol. Survey geologists to correspond to Judith River fm.

Fish Creek shale. (In Greene formation.)

Permian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 183). *Fish Creek fire clay sh.*—Fire clay sh., 5 to 8 ft. thick. Underlies Fish Creek coal and lies higher in section than Rush Run ss. Named for association with Fish Creek coal.

Fish Creek argillite.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 80; map). *Fish Creek argillite.*—Chiefly black carbonaceous argillites and interbedded bands of argillite and dark-colored qtzite; the argillites are greatly crumpled and show considerable variation in strike and dip. Thickness 1,500± ft. Intruded by large mass of dark-gray diorite. Separated from Red Top ls. and Lead Point argillite by a fault that follows along Fish Creek. Occupies about 2 sq. mi. in NE. corner of Stevens Co.; extends into B. C., and is part of Pend Oreille group.

Fisher latite-andesite.

Miocene (?): Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 23–33). *Fisher quartz latite.*—Overlies Piedra fm. of Potosi volcanic series and underlies Hinsdale volcanic series.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Fisher quartz latite* is 0 to 3,000+ ft. thick in Platoro-Summitville dist., where it underlies Hinsdale volcanic series and overlies Piedra fm. of Potosi volcanic series. In Creede dist. it is 0 to 100 ft. thick, the Hinsdale volcanic series is absent, and the Fisher is separated from Piedra deposits by 0 to 2,000± ft. of lake beds named *Creede fm.* The Fisher was named for exposures in vicinity of Fisher Mtn, Creede quad.

W. Cross and E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Fisher latite-andesite.*

Fisher formation.

Oligocene: Northwestern Oregon (Eugene district).

H. G. Schenck, 1927 (Calif. Univ. Pub. Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 451, 459). *Fisher fm.*—A non-marine fm. overlying the Eocene sss. Composed of volcanic rocks, such as aggl. and tuff, and terrestrial clays, sands, and gravels. Estimated thickness 1,500 ft. Typically exposed in vicinity of Coyote Creek (sec. 12, T. 18 S., R. 5 W.), about 8 mi. W. of Eugene, and near Fisher Butte, ¼ mi. W. of Oak Hill. No fossils mentioned. Assigned to the lower Olig. Older than Eugene fm.

R. W. Chaney and E. I. Sanborn, 1933 (Carnegie Inst. Wash. Pub. 439). Flora of Fisher fm. is upper Eocene to lower Olig., with balance of evidence in favor of Eocene.

Fisherville coral reef. (In Waynesville limestone.)

Upper Ordovician: North-central Kentucky.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, p. 291). *Fisherville coral reef* is in lower part of Waynesville bed of Richmond fm.

Named for Fisherville, Jefferson Co. Extends from Henry Co. to NW. edge of Nelson Co.

Fish Haven dolomite.

Upper Ordovician (Richmond): Northeastern and western (Gold Hill district) Utah and southern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 407, 409). *Fish Haven dol.*—Medium-bedded bluish dol., 500 ft. thick. Underlies Laketown dol. and overlies (uncon.?) Swan Peak qtzite.

Named for exposures on Fish Haven Creek, Bear Lake Co., Idaho.

Fish House clay.

Pleistocene: Southern New Jersey.

R. D. Salisbury, 1895 (N. J. Geol. Surv. Ann. Rept. State Geol. 1894). Age of *Fish House clays* has been in dispute. At Fish House, on Delaware River [about 5 mi. N. of Camden, Camden Co.], they rest on Pensauken, so it is certain they are post-Pensauken.

L. Woolman, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, p. 201). *Fish House clay.*—Black or blue clay worked for many years. Thickness 5½ ft. at Fish House, 25 ft. at Delair. [For strat. position of this clay see 1897 entry under †*Fish House beds.*] Writer believes it belongs to Pensauken fm., but leaves determination of exact equivalency to Prof. Salisbury, who is still working on the fm.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6). *Pensauken fm.* consists (descending): (1) Gravel, etc.; (2) few ft. of clayey loam, usually with well-marked line of pebbles at base; (3) *Fish House clays* 27 or 28 ft. (of limited extent and in places uncon. on white Cret. clay); (4) ironstone a few inches; (5) coarse yellow sand.

R. D. Salisbury and G. N. Knapp, 1917 (N. J. Geol. Surv. vol. 8). Pensauken fm. includes the clays at Fish House.

†Fish House beds.

Pleistocene: Southern New Jersey.

L. Woolman, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, pp. 201+). *Fish House beds.*—Under this name we would include (descending): (1) Orange yellow clay bed, thin; (2) *Fish House clay*, blue or black clay 5½ ft. thick at Fish House; (3) orange yellow clay, 0–1 ft.; (4) ironstone crust, ½ ft.; (5) laminated and cross-bedded coarse-yellow sands and medium-coarse yellow gravels, 12½ ft. At Fish House rests uncon. on Raritan fm. Author believes these beds are Pensauken fm.

Same as Pensauken fm., as explained under *Fish House clay.*

Fishkill limestone.

Ordovician and Cambrian: Southeastern New York (Dutchess County).

J. M. Clarke, 1909 (N. Y. State Mus. Bull. 133, pp. 12–18). *Fishkill ls.*—A belt of hard ls., highly metamorphosed, weathering grayish white, but showing buff-colored markings on fresh surfaces. Outcrops in town of Fishkill, NW. of road from Fishkill Village to Matteawan, btw. it and Glenham gneiss belt, and extends 2 mi. roughly parallel with outcrop of the gneiss. Can not be traced beyond road from Fishkill Village to Wappingers Falls. Contains lowest Ordovicic and latest Camb. fossils. Rests on Poughquag qtzite. Overlain by slates of Trenton or later age. Areal survey by C. E. Gordon.

C. E. Gordon, 1910 (N. Y. State Mus. Bull. 140, pp. 16–20). The Wappinger ls. occurs within Poughkeepsie quad. in two well-defined masses, the composite Wappinger Creek belt and the *Fishkill ls.*

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148, pp. 48, 70). The eastern belt of Wappinger ls. is known as *Fishkill ls.*, as it lies chiefly in town of old Fishkill. Includes Trenton, Beekmantown, and Lower Camb. fossils.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 30). Another extensive area of Barnegat ls. (=Wappinger ls.), of Cambric and Ordovicic age, is developed just N. of Fishkill Mtns. These rocks, called *Fishkill ls.*, are in part strat. equiv. of Wappinger ls.

See also under *Barnegat ls.*

Fishpot limestone member (of Monongahela formation).

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia, and eastern Ohio.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Fishpot ls.*—Separated from overlying Sewickley coal by 10 ft. of ss., and from underlying Redstone coal by 25 ft. of ss. or sandy sh. Thickness at mouth of Fishpot Run, in southern Washington Co., Pa., 30 ft.; at W. Va. line it is thin.

Fishpot sandstone. (In Monongahela formation.)

Pennsylvanian: Eastern Ohio.

R. E. Lamborn, 1930 (Ohio Geol. Surv., 4th ser., Bull. 35, pp. 29, 32, 181, 234, 235–236). At some localities along belt of outcrops of Monongahela series of eastern

Ohio is a thin ss. lying btw. Fishpot and Sewickley coals, which W. Stout, chief of Geol. Surv. of Ohio, suggests be named *Fishpot ss.* The strat. position of this ss. is a few ft. below Sewickley coal, which suggests correlation with Lower Sewickley ss. of W. Va. In Jefferson Co., O., the type of rock usually found on this horizon is aren. sh. [In detailed sections given in this bull. Lamborn applied *Fishpot* to sh. and ss. ranging in thickness from 6 in. to 18 ft. 2 in. and lying 12 ft. 1 in. to 36 ft. 8 in. above Fishpot ls.]

†Fish Tooth sandstone.

A name locally applied, at Salt Creek, Wyo., to a ss. about 400 ft. above base of Steele sh.

Fitch formation.

Silurian (middle): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings and A. B. Cleaves, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, Feb. 28, p. 196, and Am. Jour. Sci., 5th, vol. 25, No. 146, Feb., p. 149). Ten fossil forms have been identified in material from *Fitch fm.*, and we confirm Schuchert's opinion that this fm. is middle Sil. Overlies West Bath sl. (pre-Sil.) and underlies Littleton fm. (Lower Dev.). [In 1934 Billings replaced *West Bath sl.* with *Partridge sl.*]

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55–56). *Fitch fm.* (*middle Sil.*).—Calc. sh., calc. ss., aren. dol., arkose, qtz cgl.; 700 ft. thick. In Fitch fm. the calc. shales have become biotite calcite schists and the aren. dolomites now consist of actinolite, pyroxene, plagioclase, and quartz. It underlies Littleton fm. (Lower Dev.) and overlies Clough cgl. (middle or lower Sil.).

M. Billings, 1934 (Am. Jour. Sci., 5th, vol. 28, Dec., pp. 412+). *Fitch fm.* is named for [G. E.] Fitch farm. 2 mi. NW. of Littleton, N. H. Thickness 400–700 ft. Grades into underlying Clough cgl. Contains Niagaran fossils. [See also Billings' Geology of Littleton and Moosilauke quads., N. H., a 1935 publication.]

Fitchburg granite.

Late Carboniferous or post-Carboniferous: Central Massachusetts and central southern New Hampshire.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 231–233 and map). The deep-seated central portion of central batholith, uninfluenced by the cover, is a medium-grained muscovite-biotite granite, which may be taken as the normal constituent of the batholith, and is called the *Fitchburg granite.* Crosses Fitchburg, Mass.

Fitch Hill granite gneiss.

Silurian (?): Northwestern New Hampshire (Ammonoosuc River region).

F. H. Lahee, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 231–250; map). *Fitch Hill granite gneiss.*—Metamorphosed igneous rock, pre-Sil. [?]. Intrudes Lyman schist [Sil.] and uncon. underlies Sil. (Niagaran) sediments. Called "chlorite," "chloritic rock," etc., by Hitchcock. [Probably named for proximity to same hill as that for which the arkose was named.]

M. Billings, 1935 (letter dated Aug. 27). Lahee's Fitch Hill granite gneiss is precisely same as our Highlandcroft granodiorite. It belongs to Highlandcroft magma series, which is late Ord. (?).

Fitch Hill arkose.

Silurian (Niagaran): Northwestern New Hampshire (Ammonoosuc River region).

F. H. Lahee, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 231–250). The thick mass (200–300 ft.) of arkose forming Fitch Hill, NW. of town of Lisbon, is here called *Fitch Hill arkose*, to distinguish it from basal arkose of basal series of the Sil. Lies 150± ft. higher in the series than sl. and ls. carrying Niagaran fossils. [This appears to be a part of Fitch fm. of Billings and Cleaves.]

Fite limestone.

Upper (?) Ordovician: Central eastern Oklahoma (Cherokee and Adair Counties).

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ, pp. 20–22). *Fite ls.*—Hard, light-gray, sublithographic ls. attaining thickness of 8 ft. where protected from pre-

Chattanoogan erosion by Fernvale ls. Blotches of crystalline calcite are almost invariably present in the sublithographic matrix, and often near middle there is a lens of brownish fine-grained dolomitic ls. The fm. occurs only in anticlinal area just NE. of Tahlequah. It is not present in Barren Fork area. It was included in Tyner fm. by Taff in Tahlequah folio, but because it is so distinct, and because it is absent at type loc. of Tyner, it is here named *Fite ls.*, from excellent exposures on estate of Dr. Fite in sec. 11, T. 17 N., R. 22 E. It uncon. overlies Tyner fm. [as here restricted] and is uncon. overlain by Fernvale ls. (Upper Ord.) or by Chattanooga sh. The Fernvale was also included in Tyner fm. by Taff. Underground in Okla. an occasional bed of ss. occurs btw. Fite and Fernvale lss. Fossils are now identified by E. O. Ulrich as pre-Fernvale Richmond.

I. H. Cram, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 286). The best, though inconclusive, evidence indicates that the Fite is Bromide (Black River-Trenton) in age, instead of Richmond, as meager fauna collected at outcrop suggests.

Fitzgerald limestones.

Silurian: Northwest Territory and Mackenzie.

A. E. Cameron, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 25).

Fitzhugh sands.

C. E. Jamison, 1912 (Wyo. State Geol., ser. B, Bull. 4), stated that Wall Creek ss. of Salt Creek oil field, Wyo., was formerly called "First Fitzhugh sand," and that a sand lying 220 ft. lower was called "Second Fitzhugh sand." These sands both occur in upper part of Frontier fm.

Fitzwilliam granite.

Late Carboniferous or post-Carboniferous: Southwestern New Hampshire and extreme central northern Massachusetts.

C. H. Hitchcock, 1873 (Am. Ass. Adv. Sci. Proc., vol. 21, pp. 134–135), stated that Laurentian included *Fitzwilliam granite.*

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 238 and map). *Fitzwilliam granite.*—Light-gray muscovite-biotite granite, of even, fine grain. It just enters Mass. from Fitzwilliam, N. H. Assigned to late Carbf. or post-Carbf.

Five Islands volcanics.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

Fivemile shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295–296, 338–340). *Upper Fivemile sh.*—Gray or green and calc. deposit, with marine fossils; occasionally red and variegated, with lenticular ss.; thickness 15 to 43 ft.; underlies Falls Mills ls. and overlies Fivemile coal. *Lower Fivemile sh.*—Green and sandy, with marine and plant fossils; thickness 10 to 20 ft.; underlies Fivemile coal and rests on Tallery ss. All members of Hinton group [fm.]. Type loc. of both shales is on Fivemile Creek, along Princeton-Narrows road, 4.5 mi. SE. of Princeton, Mercer Co., W. Va. The upper sh. also observed in Summers Co. and in Tazewell Co., Va. The lower sh. observed in Mercer and Summers Counties.

Five Point limestone. (In Admire shale.)

Pennsylvanian: Kansas and Nebraska.

R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.). [*Five Point ls.* is shown as underlying Stine sh. and overlying West Branch sh., all included in Admire sh. Derivation of name not stated.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 5). *Five Point ls.* was named for exposures in Five Point Valley, Richardson Co., Nebr. Has been traced S. through Kans. to Okla., and is recognized by Kans. Surv.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville ls. to Perm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of *Five Point ls.* is Five Point Creek, near Five Point School, sec. 25, T. 1 N., R. 15 E., Richardson Co., Nebr., 2 mi. S. and 4½ mi. W. of Falls City.

Flades clay.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 18, 60). *Flades clay*.—Name to include Waco ls. and Estill clay [members of Alger fm.] where Waco ls. cannot be distinguished from overlying Estill clay but where thick basal layer of Waco ls. can be recognized.

Named for Flades Creek, E. of Crab Orchard, Lincoln Co.

Flag Spring limestone. (In Conemaugh formation.)

Pennsylvanian: Gallia County, Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 889–890). *Flag Spring ls*.—Fossiliferous blue ls. in northern Gallia Co., about midway btw. Shawnee and Cambridge lss. Occurs at exact horizon of Banda iron ore, which replaces it throughout several twps.

Named for well-known locality in Walnut Twp, Gallia Co.

Flag Spring trachyte.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Compact, fine-grained red brown lava flow closely resembling Esperanza trachyte. Thickness 0 to 250± ft. Overlies Gold Road latite. Well exposed in cliffs along Cottonwood Canyon, and named for Flag Spring, in the canyon.

Flagstaff limestone.

Eocene: Central eastern Utah (Wasatch Plateau).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 150–151, 448). *Flagstaff ls. memb. of Wasatch fm*.—A remarkable memb. of fresh-water ls., 200 to 1,000 ft. thick, lying 1,000 ft. below top of Wasatch fm. and 1,200 to 2,000 ft. above base of Wasatch in Wasatch Plateau, Utah. [Named for fact it is prominent in Flagstaff Peak.]

These beds are now treated as a distinct fm. by U. S. Geol. Survey.

Flagstaff limestone.

Miners' local term for a part or all of Madison ls., of lower Miss. age, in Little Cottonwood dist., central northern Utah.

Flambeau quartzite.

Pre-Cambrian (Huronian): Northwestern Wisconsin (Rusk County).

W. O. Hotchkiss et al, 1915 (Wis. Geol. Nat. Hist. Surv. Bull. 44, econ. ser. 19, p. 50). *Flambeau qtzite*.—Varies from a predominant reddish brown to pale yellowish gray. Chiefly quartz grains, as a rule well cemented. Is vitreous, but interstices are not completely filled. Lowest qtzite beds seen are in a number of places marked by thin beds of cgl., 3 to 10 ft. thick, extending through 40 ft. of beds. Thickness 2,000 to 2,500 ft. No other beds found in contact with it. Believed to be older than Barron qtzite and to be upper or middle Huronian.

Probably named for exposures at Flambeau or on Flambeau River, Rusk Co.

†Flaming Gorge group.

Upper Jurassic: Northeastern Utah (Uinta Mountains) and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 51, 146, 151). *Flaming Gorge group*.—In descending order: (1) Bad-land sss. of lacustrine origin; (2) mid-group lss., marine, more or less aren.; (3) massive ss., 400 to 600 ft., which to S. is represented by bad-land ss. with clay and gyp.; (4) *White Cliff ls*., marine ls. 10 to 200 ft. thick. Named for Flaming Gorge, on S. side of Green River [at mouth of Henrys Fork], Utah [in Uinta Co.].

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Flaming Gorge group of Powell = Beckwith and Twin Creek fms. of SW. Wyo.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 33), showed Flaming Gorge group of Powell and of G. K. Gilbert's Henry Mtns rept = (descending) Morrison, Summerville, Curtis, Entrada, and Carmel fms. (all Upper Jurassic).

Flanagan limestone.

Middle Ordovician (Trenton): Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 2). *Flanagan chert.*—Thin-bedded gray ls. and calc. sh. containing bands of chert; thickness 0 to 40 ft. Overlain by Winchester ls. and underlain by Lexington ls. Named for exposures at Flanagan Station, Clark Co.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 8–23). The Flanagan chert of Campbell is a cherty horizon at top of Bigby substage of Lexington stage. It does not represent a constant time unit of deposition, but is due to a particular phase of weathering.

G. C. Matson, 1909 (U. S. G. S. W. S. P. 233). *Flanagan chert memb.*—Gray crystalline ls., usually lighter colored and more cherty than underlying ls. Thickness 75 ft. Is top memb. of Lexington ls.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 317–342). *Flanagan,* 55 ft. thick, divided into Woodburn above and Brannon below. Underlies Perryville and overlies Bigby fm. [named *Benson bed* by Foerste in 1913].

W. C. Phalen, 1917 (Ky. Geol. Surv. rept. on phosphate rocks of central Ky.). *Flanagan ls.* divided into Woodburn phosphatic memb. (30 to 40 ft. thick) above and Brannon cherty memb. (13 to 15 ft. thick) below. [This is present accepted definition of U. S. Geol. Survey.]

Flat Creek beds.

Tertiary: Canada (Yukon).

R. G. McConnell, 1905 (Canada Geol. Surv. Ann. Rept., vol. 14, pt. B, p. 24).

Flat Gap limestone member (of Olive Hill formation).

Lower Devonian (Helderbergian): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 738). *Flat Gap memb.*—Heavy-bedded coarsely crystalline or granular ls. of white or pinkish color, very sparingly fossiliferous. Thickness 0 to 53 ft. Top memb. of Olive Hill fm. Uncon. underlies Birdsong sh. and overlies Bear Branch memb. of Olive Hill fm. [Type loc. not stated.]

Flathead quartzite.

Middle Cambrian: Montana and northwestern Wyoming.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Flathead qtzite.*—Remarkably persistent qtzite or ss., which has long been recognized in Rocky Mtn region as lying in most cases at base of Paleozoic section. Is usually qtzitic. In some places there are interlaminated beds of reddish or reddish brown sss. in which cementing material is partly an iron oxide. Thickness 125 ft. In places rests on Belt series and in places on Archean schists or gneisses. No fossils. Is overlain by Flathead shales, from which it is in places separated by a layer of eruptive rock. The *Flathead qtzite* and *Flathead shales* comprise *Flathead fm.*

Named for exposures in Flathead Pass, in NE. corner of Threeforks quad., Mont.

†Flathead formation.

†Flathead shales.

Middle Cambrian: Montana and northwestern Wyoming.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Flathead fm.*—Divided into *Flathead shales* above and *Flathead qtzite* below. The shales are soft, green, shaly beds interlaminated with thin beds of glauconitic ls.; toward base are beds of very dark reddish-brown and green ss. Thickness of the shales 290 ft. Overlain by Trilobite ls., the basal memb. of Gallatin fm. [For description of the qtzite see *Flathead qtzite.*]

The use of *Flathead* in 3 senses being objectionable, the name has for many years been restricted to the qtzite, and the so-called "Flathead shales" have been combined with the overlying trilobite-bearing lss. and *Obolella*-bearing shales (originally included in Gallatin fm.) into a fm. named *Gros Ventre fm.*

Named for exposures in Flathead Pass, in NE. corner of Threeforks quad., Mont.

Flatiron andesites.

Age (?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 21, No. 8, pp. 214–376, map). *Flatiron andesites.*—Pyroxene andesite, 1,700+ ft. thick. Occurs on Flatiron Ridge. Extends from White Mtn to head of Warner Valley. Believed to be younger than Twin Lakes andesites.

Flat Lick sandstone. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky (Knox County).

W. R. Jillson and J. M. Hodge, 1919 (Ky. Dept. Geol. and Forestry, ser. 5, Bull. 3, pp. 1, 2, 3, 9–10, 34). *Flat Lick ss.*—A strong ss., 50 to 75 ft. thick, underlying Lily coal, and prominent in cliffs along river near Artemus; also forms base of Flat Lick plateau. Named because it is well exposed by the doming at Flat Lick, Knox Co. Included in Upper Pottsville.

Flat Rock stone.

Silurian: Indiana.

See *Greensburg or Flat Rock stone.*

Flat Rock dolomite member (of Detroit River dolomite).

Lower Devonian: Southeastern Michigan (Wayne County) and western Ontario.

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 541). *Flat Rock dol.*—Hard, porous, compact gray dolomitic calcilutite, 47 ft. thick. Fossils. Oldest memb. of Upper Monroe [Detroit River dol.]. Underlies Anderdon ls. Discon. overlies Sylvania ss. [On later pages (553–556) thickness of 40 to 150+ ft. is given.]

Named for exposures at Flat Rock, Wayne Co.

Flat Rock sand.

See under *Robinson sand.*

Flat Run sand.

Drillers' term; SW. Pa.; probably at same horizon as Gordon sand, and of Catskill age. Is younger than McDonald sand and older than Campbells Run sand. In W. Va. the name has been applied to a sand that may be older than Gordon sand.

Flat-top sandstone.

Pennsylvanian: Southeastern Oklahoma.

H. M. Chance, 1890 (Am. Inst. Min. Engrs. Trans., vol. 18, pp. 653–661). *"Flat-top ss."*—M-ssive ss., 100 ft. thick, which caps Roundtop and Long Mtn in Grady Basin, and forms Adams Ridge. Lies 600 ft. above Grady group of coals and 550 ft. below McAlester coal in Choctaw coal field.

Flattop schist.

Pre-Cambrian: Western North Carolina.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 4). *Flattop schist.*—Black, dark blue, bluish-green, and greenish gray very fine-grained schists (composed of quartz, feldspar, and mica of secondary origin), which weather to yellowish gray or greenish gray. Commonly marked by light-gray bands more feldspathic than rest of rock, being made up of quartz and feldspar grains of varying sizes with a little fine muscovite. Other portions of the schist contain porphyritic crystals of feldspar and amygdules, which show its volcanic nature. Grades into older Montezuma schist. Is pre-Camb. (Algonkian?).

Named for Flattop Mtn, Cranberry quad., in Watauga Co.

Flat-top limestone.

Devonian or Mississippian (?): Western Colorado.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 281, 292). *Flat-top ls.*—Drab lithographic unfossiliferous dol., 150 ft. thick, underlying Leadville ls. and uncon. overlying Ouray ls. in Colo. May be of Kinderhookian age. Named for Flat-top Mtn, N. of Glenwood Springs.

E. Kirk, 1931 (Am. Jour. Sci., 5th, vol. 22, p. 229). Flattop dol. of Keyes is hard to identify. It was probably taken from one of older Territorial Survey publications and might be either Dev. or Miss.

Flattop Mountain sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, p. 13). Pocahontas group divided into (descending): (1) *Flat Top Mtn ss.;* (2) Pocahontas coals Nos. 6, 5, 4, 3, 2, and 1, with intervening sss. and shales; and (3) Pocahontas sss.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 217). *Flattop Mtn ss.,* top memb. of Pocahontas group or Lower Pottsville series, rests on sh. here named *Rift sh.* Is generally massive to current bedded, medium grained to coarse, micaceous, bluish gray to brown, 22 to 50 ft. thick. Named for Flattop Mtn, 2 mi. NW. of Pocahontas, Va.

Flat Top Mountain sandstone. (In Pottsville group.)

Pennsylvanian: Northeastern Kentucky.

J. B. Hoeing, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 81). *Flat Top Mtn ss.*—Top memb. of Lower Pottsville or Pocahontas group in upper Big Sandy Valley and headwaters of North Fork of Kentucky River.

†Flatwoods clay.

Eocene (lower): Western Tennessee, northeastern Mississippi, and southwestern Alabama.

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 110–111, 275). *Flatwoods clay.*—Hard gray or whitish clay, sometimes laminated but more usually of massy cleavage, with tendency to conchoidal or nodular forms, which are conspicuous in most outcrops found on whitened hillsides in the Flatwoods. Shows little tendency to disintegrate by atmospheric agencies alone. Is a phase of Northern Lignitic fm.

Same as Porters Creek clay, of Midway group.

Named for low, flat land, covering several counties in NE. Miss., resembling broad bottom of large river and generally known as the "Flatwoods country."

†Flatwoods group.

Eocene: Western Tennessee.

J. B. Killebrew and J. M. Safford, 1874 (Resources of Tenn., p. 44). *Flatwoods group.*—Sands and clays, 200 to 300 ft. thick, underlying LaGrange group and overlying Ripley group (Cret.). In geol. rept. of Tenn. was called "Porter's Creek group," because a heavy bed of laminated clay, 100 ft. thick, occurs on Porter's Creek.

Includes Porters Creek clay and Clayton fm. of present nomenclature, or all of Midway group.

†Flatwoods shale.

Upper and Middle Cambrian: Eastern Alabama.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 148, map, and structure section opp. p. 162). [See under †Coosa sh.]

Named for level, badly drained lands in valley region of eastern Ala. which are generally known as "Flatwoods."

Flaxman formation.

Pleistocene (Wisconsin): Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103, 142, map). *Flaxman fm.*—Foreign glacial till, possibly containing glacial ice, scattered along Arctic coast line of America. Well exposed on Flaxman Island. From its youth it must be ascribed to last advance of continental ice—the Wisconsin.

Flaxville gravel.

Miocene (upper) or Pliocene: Northern Montana and adjacent parts of Saskatchewan and Alberta.

A. J. Collier, 1917 (Wash. Acad. Sci. Jour., vol. 7, pp. 194–195). *Flaxville fm.*—Brownish to ash-gray, silt, sand, and gravel, and white marl, from a few ft. to 100 ft. thick. Generally noncoherent but locally cemented with calcite, and forms prominent outcrops, often marked by cross-bedding. The gravel is characterized by material from Rocky Mtns. Is found on four extensive plateaus ranging in elevation from 2,700 ft. S. of Redstone, to 3,200 ft. in W. side of Boundary Plateau. Fragments of vertebrate fossils from the fm. at 27 localities (in wells, railroad cuts, badger holes, and natural exposures) pronounced by J. W. Gidley to be not older than Mio. nor younger than lower Plio.

A. J. Collier and W. T. Thom, Jr., 1918 (U. S. G. S. P. P. 108J, pp. 179–184). *Flaxville gravel.*—Named for town of Flaxville, Mont., on Scobey branch of Great Northern Ry. Deposited in Mio. or early Plio. time. [Lists fossils.] Caps a series of even-topped plateaus ranging in altitude from 2,600± ft. at its E. end, a few mi. S. of Redstone, to 3,200 ft. in W. front of Boundary Plateau in Cherry Creek quad. Is from a few ft. to 100 ft. thick. Rests on eroded surfaces of Fort Union, Lance, and Bearpaw fms. [Mapped over area extending from E. of 105° to W. of 110°, both N. and S. of 49° par.] Generally composed of yellowish to ash-gray gravel, clay, and sand, but in some places contains beds of white marl and volcanic ash. The gravel consists of well-rounded pebbles from less than 1 in. to 1 ft. or more diam., of qtzite and argillite derived from Rocky Mtns. Pebbles of ls. from same source may have been dissolved and the lime redeposited as cementing material and beds of marl. Materials mostly noncoherent and easily excavated by well diggers, though beds of hard ss. and cgl. cemented with calcite from 1 ft. to several ft. thick are encountered in most wells. In places thoroughly cemented with calcite and forms prominently outcropping ledges of ss. and cgl. In railway cuts W. of Flaxville, where best collection of fossils was made, about half of exposed material is gravel and remainder clay and sand, with about 1 ft. of marl or concretionary calcite. Bedding irregular.

Fleener facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 77, 184, etc., 1931) to a local facies of his Carwood fm. of southern Ind.

†Fleming clay.

†Fleming group.

Miocene (upper) and Pliocene (?): Eastern Texas and northwestern Louisiana.

W. Kennedy, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 45, 62). *Fleming beds.*—Clays and sands or sandy clays, dark blue, pale blue, brown, red, yellow, and pale green, thinly laminated and partially stratified and massive. Thickness 260 ft. Overlies Fayette sands and sss. and underlies Quat. clays.

A. Deussen, 1914 (U. S. G. S. W. S. P. 335). *Fleming clay* consists of 200 to 500 ft. of gray, white, and bluish white, bedded, calc. clays with numerous small concretions of lime and some lenses of sand, underlying Dewitt fm. and uncon. overlying Catahoula ss. Assigned to basal Mio.

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 447–475). *Fleming beds* include all sediments btw. Corrigan sands and Lafayette or Reynosa sands btw. Sabine and Navasota rivers. Is=Lagarto, Lapara, and possibly Oakville. Thickness 1,500± ft.

G. C. Matson, 1916 (U. S. G. S. P. P. 98), divided Fleming clay of eastern Tex. into Pascagoula clay (above) and Hattiesburg clay (below).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 81, 88–89). *Fleming beds* (Mio. and Plio.) overlie Corrigan or Catahoula and are=Lagarto, Lapara, and Oakville. Thickness, 1,500± ft.

W. Kennedy, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pp. 36–37). It is probable that some, if not all, of Lagarto clays, Lapara sands, and Oakville sands may be correlated with some of various phases of *Fleming beds*.

A. Deussen and L. L. Lane, 1925 (A. A. P. G. Bull., vol. 9, pp. 1031–1052). *Fleming fm.* immediately underlies Lafayette fm. and overlies Catahoula ss. Thickness, 1,100 to 2,600 ft. Is=Lagarto clays, Lapara sands, and Oakville ss. of region W. of Brazos River.

C. W. Cooke and J. Gardner, 1930 (personal statement). *Fleming clay* is of upper Mio. and possibly lower Plio. age; is=Pascagoula clay; and is younger than Oakville ss. and Hattiesburg clay.

The U. S. Geol. Survey discarded this name from its classification in 1932.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 727), applied *Fleming group* to the Mio. and Plio. beds btw. Catahoula fm. and Goliad fm., and divided the group into Lagarto fm. [restricted] and Oakville fm.

Named for Fleming, Tyler Co.

Fleurant conglomerate.

Upper Devonian: Quebec (Gaspe Peninsula).

E. M. Kindle, 1930 (Canada Geol. Surv. Dept. Mines Summ. Rept. 1928, pt. C, pp. 82C–84C, pl. opp. p. 82C). Boulder cgl., 45 ft. thick, underlying Escuminac beds and overlying 450 ft. of barren coffee-colored sh. Type loc. Fleurant Point; also seen at Mushroom rock and ⅛ mi. SE. of Englishman Creek.

Flint moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Flint, Genesee Co.

†Flint Creek beds.

Tertiary (middle Miocene?): Central western Montana (Philipsburg region).

E. Douglass, 1903 (Carnegie Mus. Annals, vol. 2, pp. 153–154). *Flint Creek beds* are typically exposed in a line of bluffs 100 to 150 or more ft. exposed high on W. side of valley of Flint Creek, beginning about 1 mi. N. of village of New Chicago and extending southward several miles. [Fossils listed. In 1908 (Carnegie Mus. Annals, vol. 4, Nos. 3 and 4, pp. 256–266) Douglass assigned these beds to upper Mio.]

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65, 114). "Flint Creek beds" are middle Mio.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem, n. s., vol. 2, pt. 1, pp. 9, 16), assigned "Flint Creek beds" to middle Mio. on p. 9, but on p. 16 stated that they are "probably lower Plio."

†Flint Hills division.

Permian: Central Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 6–9). *Flint Hills div.*—Lower div. of Big Blue series. Divided into Chase lss. above (265 ft. thick) and Neosho shales below (130 ft. thick). Overlain by Sumner div.

Not used in later classifications of Kans. Geol. Survey.

Named for Flint Hills, Cowley and Butler Counties.

Flint Ridge limestone. (In Allegheny? formation.)

Pennsylvanian: Central Ohio.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 86, 91–93) and 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 89, 94–95). *Flint Ridge ls.*—Highly fossiliferous ls. in Coal Measures at Flint Ridge. Dark blue, almost black, thin bedded, and contains some iron; 12 to 14 ft. thick. Supposed=Putnam Hill ls. [On p. 93 is called "The Flint Ridge Putnam Hill ls."] At Flint Ridge is separated from underlying Flint Ridge cannel coal by 4 ft. of blue clay sh., 4 inches of bituminous coal, and 5 inches of bituminous sl. Overlain by iron ore. In Hopewell Twp, Muskingum Co., it partakes more of nature of a highly calc. sh.

Named for Flint Ridge, Licking Co.

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 170), stated that Flint Ridge ls. is in upper part of Pottsville fm.

Flint Ridge flint. (In Allegheny formation.)

Pennsylvanian: Central Ohio

E. B. Andrews, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pl. opp. p. 242). *Flint Ridge flint.*—[Name applied, in cross-country section of 2d geol. dist. of Ohio, to flint occurring in Lower Coal Measures at a considerably higher horizon than Putnam Hill ls. (supposed equiv. of Flint Ridge ls.). According to E. Orton, 1878

(Ohio Geol. Surv., vol. 3, p. 894), the Putnam Hill ls. of Flint Ridge, Licking Co., is *replaced by 6 to 8 ft. of fossiliferous flint.*]

Named for Flint Ridge, 2½ mi. SE. of Newark, Licking Co.

Flint Ridge shale. (In Pottsville formation.)

Pennsylvanian: Central Ohio.

C. L. Herrick, 1887 (Denison Univ. Sci. Lab. vol. 2, pt. 1, pp. 10–12). *Flint Ridge sh.*—Thin layer of black sh. immediately over the coal at Flint Ridge, and about 100 ft. below summit of ridge.

Named for Flint Ridge, Licking Co.

Flint Ridge clay. (In Pottsville formation.)

Name for many years applied to the clay, 1 to 7 ft. thick, underlying Flint Ridge coal in Vinton Co., Ohio.

Flint Ridge flint.

Pennsylvanian: Eastern Kentucky (Breathitt County).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 296, 305). *Flint Ridge flint.*—A 3-foot bed of yellow, non-fossiliferous flint, lying 30 ft. below top of Flint Ridge at head of Leatherwood Branch of South Quicksand Creek, Troublesome quad., and near 1,500-foot contour line; it also lies 550 ft., by barometer, above Magoffin beds, and 370 ft. above Lost Creek ls. Loose dolomitic or leached ls. blocks associated with the flint are very fossiliferous. The Flint Ridge flint has not been recognized outside of this area.

†Flint River lower zone.

†Flint River upper zone.

Oligocene (middle): Southwestern Georgia.

Terms that have been applied (C. J. Maury, Am. Jour. Sci., 4th, vol. 48, pp. 209–215, 1919) to a single faunal zone characterizing Glendon fm., according to C. W. Cooke.

Named for exposures on Flint River.

Flint River formation. (Of Vicksburg group.)

Oligocene (middle): Northwestern Florida, southeastern Alabama, southern Georgia, and southwestern South Carolina.

C. W. Cooke, 1935 (A. A. P. G. Bull., vol. 19, No. 8, pp. 1170–1171). My 1923 tentative correlation of the chert beds of Ga. and SE. Ala. with Glendon ls. now appears doubtful, and these beds, which are present in northern Fla., SE. Ala., Ga., and SW. So. Car., are here given the tentative name *Flint River fm.*, from exposures on Flint River btw. Red Bluff, 7 mi. above Bainbridge, SW. Ga., to Hales Landing, 7 mi. below Bainbridge. Their fauna appears to be more closely related to Chickasawhay marl memb. of Byram marl of SE. Miss. than to Glendon ls. In S. C. the fm. is present in Allendale Co. only.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867, on Coastal Plain of S. C.). In S. C. *Flint River fm.* occurs only in narrow strip bordering Savannah River in Allendale Co. from vicinity of Johnsons Landing to Cohens Bluff. The beds consist chiefly of broken lumps of yellow vitreous chert in reddish yellow sand. Few fossils. These beds are tentatively correlated with the upper or Chickasawhay memb. of Byram marl of Miss. and SW. Ala., and so far as now known they are the sole representative of Vicksburg group in SE. Ala., Ga., and S. C.

Florena shale member (of Garrison shale).

Permian: Eastern Kansas and southeastern Nebraska.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 712). *Florena shales.*—Yellowish fossiliferous shales, 2 to 13 ft. thick, heretofore called "Cottonwood shales" (preoccupied). Underlies Neosho memb. and forms lower part of Garrison fm. Overlies Cottonwood ls.

Adopted by U. S. Geol. Survey as lower memb. of Garrison fm. Overlain by Neosho sh. memb. of Garrison and underlain by Cottonwood ls.

See also under *Beattie fm.* and under *Garrison sh.*, which R. C. Moore discarded in 1936.

Named for exposures in quarries near Florena, Marshall Co., Kans.

Florence flint. (In Chase group.)

Permian: Eastern Kansas, central northern Oklahoma and southeastern Nebraska.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 771–786, 798). *Florence flint.*—Two beds, each 10 ft. thick, of massive fossiliferous ls. with prominent layers of flint, separated by 2 ft. of white cellular ls. Included in middle of Chase fm. Underlain by 31 ft. of yellowish, chocolate, and greenish shales and overlain by buff shaly ls.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 714). *Florence flint* is overlain by Fort Riley ls. and underlain by Matfield shales.

Named for Florence, Marion Co., Kans.

†Florence limestone. (In Chase group.)

Permian: Central Kansas.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 771–786, 798). *Fort Riley or Florence ls.*—Massive buff ls., 5 or more ft. thick. Separated from overlying Marion flint by 22 ft. of buff shaly lss. overlain by 62 ft. of varicolored sh. with thin ls. layers, and separated from underlying Florence flint by 15 ft. of buff shaly lss.

In 1902 (Jour. Geol. vol. 10) Prosser redefined *Fort Riley ls.*, to include at base the 15 ft. of shaly lss. and at top the 22 ft. of buff shaly lss., both of which he had excluded in his original definition. He also stated that Fort Riley ls. (40 ft. thick) rested on Florence flint and was separated from overlying Marion flint by Doyle sh.; that *Florence ls.* is Fort Riley main ledge; and that Florence ls. is abandoned.

In succeeding years Prosser's 1902 definition of Fort Riley ls. was adopted generally, *Florence ls.* fell into disuse, and *Florence flint* was name applied to the fm. underlying Fort Riley ls. In 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12) R. C. Moore revised the terminology of the Perm. rocks of Kans. by (1) restricting *Fort Riley ls.* to the original 5-foot massive ledge; (2) introducing *Oketo sh.* for underlying 5 ft. of shaly ls.; (3) applying *Florence ls.* to underlying 30 ft. of beds bearing the symbol of flinty ls. and apparently corresponding to *Florence flint* of previous repts. He called the beds immediately overlying his Fort Riley ls. the *Holmesville sh.*, and the beds immediately underlying his Florence ls. the *Blue Springs sh.*

Named for Florence, Marion Co.

Florence gravel.

Pleistocene: Northwestern Illinois (Stephenson County).

O. H. Hershey, 1895 (Am. Geol., vol. 15, pp. 7–12). *Florence gravel.*—Blue-gray loose aggl. of small gravel and sand, a few ft. thick, underlying Valley loess and comprising basal memb. of Columbia fm. Regarded as northern representative of Port Hudson memb. of Columbia fm. [In 1897 Hershey treated this as basal memb. of his Florencia fm.]

Named for Florence Twp, Stephenson Co., but "typical localities are in banks of Yellow and Crane's Creeks, a few mi. W. and S. of Freeport."

Florencia formation.

Pleistocene: Northwestern Illinois.

O. H. Hershey, 1897 (Am. Jour. Sci., 4th, vol. 4, pp. 90–98). *Florencia fm.*—Consists of two members: (1) A series of dark blue-green silt, light brownish-gray sand, and dark-brown carbonaceous clay or muck, everywhere resting on irregular surface of (2), a moderately coarse subangular gravel, called *Florence gravel* in earlier rept and *Florencia gravel* in this rept. The fm. lies uncon. on Kansan drift and is overlain, with perfect conformity, by basal memb. of Iowan loess. The name Florencia is derived from Florence Twp, Stephenson Co., and is slightly modified because of common use of name Florence in Europe and America.

F. C. Baker, 1920 (Univ. Ill. Bull., vol. 17, pp. 294–296), stated that Kansan drift of Hershey in rept cited above is correlated by Leverett (U. S. G. S. Mon. 38, p. 167) with Illinoian drift, and that *Florencia fm.* of Hershey therefore falls into Sangamon interglacial stage.

Florida gravel.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Florida gravel.*—Gravel deposited by streams after melting of ice of Cerro glacial stage. Thickness 10 to 50 feet. Materials range from coarse sand and grit to large cobbles and bowlders. Caps Florida Mesa and other extensive mesas.

†Floridian series.

†Floridian group.

Pliocene (lower): Southwestern Florida.

A. Heilprin, 1887 (Wagner Free Inst. Sci. Trans., vol. 1, pp. 28–32, 64A–64B, May, 1887). I would propose to designate the Pliocene series of the Caloosahatchie as the "Floridian," by this name indicating the region where the fm. has its furthest, and, as far as we know, only development. What its precise equiv. among the trans-Atlantic fms., if any such exist, may be, still remains to be determined. Thus far I have been unable to discover any whose fauna can be strictly, or even approx., correlated with the present one. Consists of highly fossiliferous deposits extending from a short distance above Daniels practically without intermission to Fort Thompson, a distance along the river of 10 to 12 mi. Appears in most places as a partially indurated marl or earthy ls. of yellowish buff or white color, and either largely destitute of organic remains or so densely charged with them as to constitute a pure shell rock. Thickness 2½ to 8 ft. Overlain by post-Plio. *Venus cancella* bed. Referred to basal Plio.

Replaced by Caloosahatchee marl, introduced in September 1887 and a better-established name.

Named for development on W. coast of Fla.

†*Floridian* epoch.

A term introduced by W. H. Dall (Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, pp. 201–216, 1892) for *Pliocene*. "As peninsula of Florida has preserved an unbroken record of this [Plio.] era, it would seem appropriate to apply to it the name of *Floridian epoch*, and slightly modifying Prof. Hilgard's [Heilprin?] use of the term, to refer all deposits of similar paleontologic contents to a single assemblage in the system under the name of *Floridian group*." "Includes Lafayette group and Floridian group (Caloosahatchie beds)."

Florissant lake beds.

Miocene (upper): Eastern Colorado (Pikes Peak region).

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Florissant lake beds.*—Almost wholly volcanic ashes, which were probably showered upon waters of the lake forming soft and crumbling tuffs and mud shales. Predominantly andesitic, with detritus of basalt and rhyolite. Thickness 50 ft. Older than Alnwick and High Park lake beds.

Named for Florissant, Teller Co.

Flower-pot shale. (In Cimarron group.)

Permian: Central southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 24–27). *Flower-pot shales.*—Chiefly highly gypsiferous varicolored clays, 150 ft. thick, overlying Cedar Hills sss. and underlying Cave Creek gypsums. Included in Salt Fork div.

Named for Flower-pot Mound, Barber Co., Kans.

Floyd shale.

Mississippian: Northwestern Georgia, northeastern and northern central Alabama, and southern Tennessee.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 143). *Floyd sh.*—Shales, 2,500 ft. thick, overlying Fort Payne chert and underlying Oxmoor [Hartselle] ss.

Floyd sh. as above defined is now known to constitute only a small part of the black sh. unit to which this name was evidently intended to apply, since part of the sh. underlies Hartselle ss. and part of it overlies the Hartselle. According to C. Butts it includes beds equiv. to Ste. Genevieve ls. and overlying fms. of Chester group of Miss. Valley region up to top of Palestine ss., or up to base of Parkwood fm. of Ala., except in N. part of Shades Valley, where it extends up to base of the Penn. and includes shales contemp. with the Parkwood. The Hartselle as now restricted is treated as a distinct fm. in some areas, where it underlies Bangor ls. restricted, and as a memb. of Floyd sh. in other areas. (See C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1926.)

Named for development in Floyd Co., Ga.

Floyd limestone.

Upper Devonian: Central northern Iowa.

A. O. Thomas, 1912 (Sci., n. s., vol. 36, pp. 569–570). A new substage, tentatively called *Floyd ls.,* is added at base of Lime Creek stage. Uncon. overlies Cedar Valley stage in Floyd Co. [The Nora ls. of Thomas, to which this ls. may correspond, has been referred by C. L. and M. A. Fenton to Cedar Valley ls.]

Floyds Knob formation. (In Borden group.)

Mississippian: Southeastern Indiana.

P. B. Stockdale, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170). [See under *Borden group.*]

P. B. Stockdale, 1930 (Ind. Acad. Sci. Proc., vol. 39, pp. 213–214). Study of Borden rocks throughout unglaciated area of southern Ind. and incidental observation in adjacent parts of Ky., revealed a persistent unit in upper part of Borden group which has served as vital key to subdividing the rocks and to properly associating uppermost Borden fms. with overlying Harrodsburg and Salem lss. The name *Floyds Knob fm.* is being suggested for this fm. It exhibits several lithologic facies, the most common being ls. that is itself of differing traits from place to place. For this ls. facies the name *Goss Mill ls. facies* is being suggested. Thickness is commonly 3 to 4 ft., but at a few places it is as much as 8 ft. or more. Various Ind. workers have referred to the different ls. facies of Floyds Knob fm. as "Stevens Creek ls.," although the name has never been formally proposed in the literature. Preemption of the term by Stevens Creek slates of S. Car. and confusion in interpretation of different beds which have been referred to same horizon in N. part of unglaciated area, preclude continuation of "Stevens Creek." Floyds Knob fm. will be fully described in rept. for publication by Ind. Dept. Cons. Div. of Geol.

P. B. Stockdale, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, pp. 708–710). *Floyds Knob fm.* is key unit in subdividing the upper Borden rocks and correlating the units of southern Ind. with those of adjacent parts of Ky. It exhibits several lithologic facies. The most common is ls., which varies markedly from place to place. Throughout S. half of unglaciated Ind. outcrop belt, and in adjacent parts of Jefferson Co., Ky., the fm. varies from fairly pure crinoidal, oolitic, or crystalline rock to ferruginous siliceous ls. Average thickness 3 to 4 ft. In Jefferson Co., Ky., and in adjoining regions the fm. is the one described by C. Butts (Ky. Geol. Surv., ser. 4, vol. 3, 1915, pp. 157–158, and Ky. Geol. Surv., ser. 6, vol. 7, 1922, p. 73) as the "layer of oolite" at "base of the Warsaw." Locally in So. Ind. the fm. is ss. North of T. 6 N., Ind., the fm. is a peculiar mixture of calc., ferruginous cherty, shaly rock. Extending upward from this locally, and involving the basal portion of overlying Edwardsville fm., are the prominent bioherms of Edwardsville fm., mainly in Monroe and Morgan Counties, Ind. Overlies Carwood fm.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 54, 76, 193–219). *Floyds Knob fm.*—Variable ls., 1 to 6 ft. thick. Parts are finely granular, crystalline, light gray; in places it is crinoidal; in some places it is oolitic; again it is impure, sandy, buff to chocolate colored. This ls., which is an excellent key fm., has often been spoken of as the "Stevens Creek ls." by Ind. workers, although the name has never been definitely proposed. For Jefferson Co., Ky., Butts erroneously referred to it as the "oolitic ls." at the "base of the Warsaw." No name has been specifically proposed for it in the literature. Most Ind. workers entirely overlooked it. Locally, especially in northern region, the calc. condition continued well into Edwardsville time. This dominantly calc. interval comprises

Floyds Knob fm. [Describes and names several local *facies* of the fm.] At some exposures a single characteristic dominates the fm.; at others another trait is predominant; whereas at still others a combination characterizes the zone. [See also under *Stevens Creek ls.* and *Stobo ls.*, by both of which names the ls. has been known.] Named for Floyds Knob, ¾ mi. E. of post office of same name, 3 mi. NW. of New Albany, Ind., where the fm. is overlain by heavy angular ss. bed and underlain by soft, massive siltstone of Carwood fm. [On p. 265 he gives thickness of Floyds Knob fm. slightly W. of old Stobo post office as 15 ft.]

Fluffy sand.

A term that has been applied (C. P. Berkey, N. Y. State Mus. Bull. 146, 1911) to deposits in SE. N. Y. classified as Mio.

Flume dolomite.

Middle Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 295, 300). *Flume dol.*, 400 to 1,800 ft. thick. Overlies Mons dol. (Lower Ord.) and underlies Perdrix sh. (Upper Dev.). [Appears to be a nongeographic name, a stream having excavated a narrow flume along the strike of the ls. in cliffs on Roche Miette.]

Fly Creek limestone.

Upper Cretaceous: Central southern Montana.

J. F. Kemp and P. Billingsly, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 474, in chart). [No description or definition, but shown as=Greenhorn ls. in cross section from Greenhorn to Hardin, Mont., to Porcupine.]

Foix oil zone.

Name applied to 180 to 185 ft. of sandy shales and interbedded sands, shales, and shells, the basal 20–40 ft. of which consists of sticky brown sh., in Santa Fe Springs field, Los Angeles Co., Calif. It directly overlies Bell oil zone. Named for Foix No. 1 well, which yields oil at depth of 3,500 ft.

†Folley limestone.

Lower Ordovician (Chazy): Central eastern Missouri.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 61). *Folley ls.*—Light-yellow, rather heavily bedded mag. ls. containing few fossils, but locally containing thin sh. and sandy beds. Thickness 65 ft. Underlies Bryant ls. and overlies Cap-au-Gres ss.

Same as Joachim ls., older name.

Named for *Foley*, Lincoln Co.

Fond du Lac sandstone.

Pre-Cambrian (Keweenawan?): Northeastern Minnesota (St. Louis County).

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 567). *Fond du Lac ss.*—Exposed on both banks of St. Louis River from Fond du Lac westward to point at which it is replaced by the quartzose pebbly cgl. that lies nonconformably on Thomson slates. Is about contemp. with some of Manitou flows of Keweenawan. Upper strata are almost free from the shaly red sediment that characterizes lower portion. The rock thus gradually becomes a pinkish and finally a nearly white sandrock well known as building stone at Hinckley and on Kettle River. Lower part consists of fine red cgls., red shales, and sss.

W. Upham, 1901 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 6, Atlas, pl. 37, map, and text describing pl. 56), placed *Fond du Lac ss.*, 157 ft. thick, below Hinckley ss. (381 ft. thick) and above Potsdam red qtzite. "To these sss., therefore, the name Potsdam is also extended. They are of the date of the waning stages of the Keweenawan."

C. R. Stauffer, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 469–475). The best Minn. outcrop of Red Clastic Series, free from glacial debris, is that along St. Louis River at Fond du Lac, where measured thickness lies somewhere btw. 412 ft., as given by Winchell, and 730 ft. as given by Thwaites.

Fond du Lac moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota and northwestern Wisconsin.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Waterlaid moraine. At N. end connects with Highland morainic system and at S. end connects with Nickerson morainic system. Named for Fond du Lac, St. Louis Co., Minn.

Fond du Lac brownstone.

Commercial term for stone of Keweenawan (?) age quarried at Fond du Lac, *Minn*.

Fontana shale

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southwestern Iowa.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 91, 97). *Fontana sh.*—Basal memb. of Cherryvale fm. Underlies Block ls. and overlies Winterset ls.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 19, 36–37). *Fontana sh.*—Argill. or calc. sh., greenish gray or buff, 5 to 25 ft. thick, comprising basal fm. of Kansas City group as restricted by R. C. Moore. Overlies Winterset memb. of Dennis ls. and underlies Block ls. Type exposures near Fontana, Miami Co., Kans., in road cuts at NE. cor. sec. 11, T. 18 S., R. 23 E., and at middle of W. side of NW¼, sec. 36, T. 18 S., R. 23 E.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Foothills series.

Tertiary (?): Alberta.

J. A. Allan and R. L. Rutherford, 1934 (Alberta Research Council Rept. 30, p. 34).

Foraker limestone. (In Wabaunsee group, Kansas.)

Foraker limestone member (of Sand Creek formation, Oklahoma).

Pennsylvanian: Central northern and central Oklahoma and southern Kansas.

K. C. Heald, 1916 (U. S. G. S. Bull. 641, pp. 21, 25). *Foraker ls.*—Chiefly ls., but much of rock is so soft and thin-bedded as to give no outcrop. Some soft sh. is present. The heavy ls. can easily be recognized by the large number of Fusulinas which it contains, the rock in places being fairly jammed with them. Another distinguishing mark is great abundance of chert concretions it contains. The fresh surface of the chert is generally light blue gray, and the concretions usually include fossils which show white against the bluish background. Most common fossil in the chert is *Fusulina secalica*. Thickness 74± ft. The ls. forms the rim of Ekler Canyon, and is prominent along line of bluffs in E. part of Foraker quad. It lies 18 ft. below Red Eagle ls. and is underlain by sh. A ss. which occurs 28± ft. below the Foraker is a good horizon marker.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, pp. 45+). Thick-bedded ls. containing chert and minor proportion of sh. and shaly ls., with thickness of 50 ft., constitutes *Foraker ls.* in Cowley Co., Kans. Lowermost bed of fm. is Americus(?) ls. memb. It is separated from upper thick-bedded ls. memb. by 10 to 13 ft. of soft sh. The Foraker overlies Admire sh. and underlies Elmdale sh. as here restricted. The beds above Americus(?) ls. were formerly included in Elmdale sh.

R. C. Moore, 1929 (Kans. Geol. Surv. Bull. 12, pp. 45, 50, footnotes). (See under *Americus ls. memb.*)

In Okla. is top memb. of Sand Creek fm.; in Kans. is treated by U. S. Geol. Survey as a fm. in Wabaunsee group.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 8), carried this name into NW. Mo. and SE. Nebr.; called it *Foraker ls. fm.* (45 to 50 ft. thick); defined it as underlying his Johnson sh. fm. and overlying his Hamlin sh. fm.; and divided it into (descending): Long Creek ls., Hughes Creek sh., and Americus ls. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this ls. to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Named for Foraker, Osage Co., Okla.

†Forbes limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and southeastern Nebraska.

C. R. Keyes, June, 1898 (Am. Geol., vol. 21, p. 349). *Forbes ls.*—Thick ls., top exposed in top of bluffs of Missouri and Nodaway rivers, near town of Forbes, Holt Co., Mo., being highest heavy ls. in Missourian series until capping Cottonwood ls. is reached.

J. A. Gallaher (Mo. Geol. Surv. 5th Bien. Rept., p. 56, 1898) mentioned *Forbes ls.*, but did not define it.

In Mo. the name *Forbes ls.* was for many years applied to the beds beneath Calhoun sh. and above Tecumseh sh., or to Deer Creek ls. memb. of present nomenclature.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 49). The *upper unit* of Deer Creek ls. has been called *Forbes ls.* in Mo., Iowa, and Nebr. Writer is of opinion this name should be retained for this unit, but U. S. Geol. Survey holds that it would be preferable to select some other name. Replaced by *Ervine Creek ls.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 181). †*Forbes ls.* of Gallaher, is poorly defined designation of ls. at Forbes, Holt Co., Mo., recognizable from description as = Deer Creek.

Ford sandstone.

Pennsylvanian: Central southern Iowa.

H. Hinds, 1909 (Iowa Geol. Surv. vol. 19, pp. 99, 131, 178). *Ford ss.*—Heavy ss. overlying Ford-Runnels coal in Polk and Warren Counties. On N. side of river is represented by sss. and sandy shales. Included in Des Moines stage.

Probably named for Ford, Warren Co.

Fordham gneiss.

Pre-Cambrian: Southeastern New York.

F. J. H. Merrill, 1890 (Am. Jour. Sci., 3d, vol. 39, pp. 388–389). Thinly bedded gray qtzite gneiss, containing little feldspar, its beds varying from almost pure quartz to a mixture of quartz and biotite or hornblende. Occasionally layers of pure biotite schist an inch or two thick are intercalated with white, coarsely granular qtzite. Forms anticlinal ridge of Fordham Heights, which borders E. shore of Harlem River, from which it is proposed to call it *Fordham gneiss.* In a few places it varies widely from the normal type, through presence of hornblende and garnet and an increase in feldspar and mica. Intercalated at a great many localities are hornblendic and augitic strata, usually a few ft. thick, which resemble diorites and diabases, are granular, and may have originally been eruptive rocks, but whatever their origin they are now metamorphic and may be called amphibolites and pyroxenites. The Fordham gneiss overlies Yonkers gneiss and underlies Inwood ls., from which it is in a few places separated by 5 to 10 or more ft. of thinly bedded qtzite [later named *Lowerre qtzite*]. Thickness undet., but is at least 200 ft. Included in Manhattan group, which is believed to be metamorphosed Paleozoic. [The Yonkers gneiss is now known to intrude the Fordham.]

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). *Fordham gneiss* is certainly pre-Camb., and if it is sedimentary it may be called *Algonkian.* Overlain by Lowerre qtzite, of probable Camb. age. [Lowerre is now classified as pre-Camb.]

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83). *Fordham gneiss.*—Gray thin-banded gneiss; some bands highly quartzose, some composed largely of biotite, some consist of pegmatite or granite which seems to have been injected parallel to regular banding of the gneiss. The rock is thoroughly gneissoid. Is certainly pre-Camb. If of sed. origin it may be called Algonkian. Is oldest rock in dist. Overlain by qtzite that is called *Poughquag qtzite* because of probable equivalence to Poughquag qtzite (Camb.) of Dutchess Co. [This qtzite is now classified as pre-Camb. and is called *Lowerre qtzite.*]

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). *Fordham gneiss* of Harlem quad. (folio 83) is not different in position or significance or general character from same gneiss series of Tarrytown quad., with which it is continuous; and writer sees no essential point of difference btw. these and the basal gneisses of West Point quad., from which they are separated by only a belt of later lss. and schists occupying the synclinal fold of lower Croton valley. In northern Highlands interbedded lss. and qtzites and schistose graphitic beds are common, whereas in southern localities the lss. at least are not so frequently seen. No subdivision of the gneiss at present seems possible. There is no natural strat. break. Because of abundance and regularity of igneous injections and close folding and frequent faulting, it is not even clear as to order of superposition of constituent members.

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 47–57). *Fordham gneiss* is chiefly sed. and consists of granitic and quartzose banded gneisses and schists of very complex development. Included in Grenville series. [Referred to "interbedded lss." as "associated with Fordham gneisses;" and included Fordham gneiss, the interbedded ls., and the intrusives in Grenville series.]

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). *Fordham gneiss series* (pre-Camb.) includes metamorphosed ancient sediments and igneous intrusives, some of which are very extensive. Includes Yonkers gneiss, Ravenswood granodiorite, and banded black and white gneisses, black mica schists, thin beds of very impure serpentinous ls., qtzite schist, quartzose gneisses, and graphitic schists, forming a unit through which and into which the igneous masses have been injected. Believed to be very old pre-Camb. and a local representative of Grenville series of Adirondacks and Canada.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 19). *Fordham gneiss*, a complex sed. series of conformable and interbedded gneisses, schists, qtzites, and lss. Constitutes oldest and lowest fm. in SE. N. Y. May be=Grenville series of Adirondacks and Canada.

J. F. Kemp, 1912 (Int. Geol. Cong., 11th sess., Stockholm, Compt. rend., vol. 1, pp. 702–711). *Fordham gneiss* is=Grenville series of northern area. Sedimentary character established by discovery in it of coarsely crystalline marbles.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, p. 140). Pre-Camb. rocks of N. Y. City and Westchester Co. divided as follows (descending) :

Post-Grenville (very old pre-Cambrian).	Basic dikes.	Later igneous.
	Pegmatites.	
	Yonkers gneissoid granite.	
	Pegmatites.	
	Ravenswood granodiorite.	
	Injection granites and pegmatites.	Laurentian (?).
	Fordham gneiss, in part (injection gneiss).	
	Occasional basic injections.	Earliest igneous.
	Staten Island serpentine.	
	Stevens Point serpentine.	
	The Hornblende schists.	
Later Grenville (sedimentary).	Manhattan schist.	
	Inwood ls.	
	Lowerre qtzite.	
Older Grenville (sedimentary).	Interbedded lss. and schists.	
	Fordham gneiss, in part (paragneiss).	

Keewatin apparently not represented.

H. L. Alling, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 27–29). *Fordham gneiss* is a syntectic—sed. and igneous. In West Point quad. Berkey assigns the Fordham in part to the Grenville, in part to the Laurentian, and in part to the Algoman. This means that origin has been deciphered. The dark-green hornblende (amphibolitic) portion is regarded as a metamorphosed sed. rock of Grenville age, the igneous portion assigned to Laurentian and Algoman, respectively. Writer thinks name Fordham should be limited to the bands believed to be sedimentary. But until agreement is reached he suggests the hyphenated terms *Fordham-Grenville, Fordham-Laurentian,* and *Fordham-Algoman*.

E. B. Knopf and A. I. Jonas, 1929 (U. S. Geol. Bull. 799). Manhattan schist correlates with Wissahickon fm.; Inwood ls. with Cockeysville marble; Lowerre qtzite with Setters fm.; and the paragneiss parts of Fordham gneiss with Baltimore gneiss. The injection-gneiss parts of Fordham gneiss are of post-Manhattan but pre-Camb. age. The Wissahickon, Cockeysville, and Setters are classified as Algonkian and Baltimore gneiss as Archean.

The terms "Algonkian system" and "Archean system" have now been discarded, and the Fordham is classified simply as pre-Camb.

Fordyce Knob sandstone facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 197, etc., 1931) to a lithologic development of his Floyds Knob fm. in a part of southern Ind.

Forelle limestone.

Permian: Southeastern Wyoming and northeastern Colorado.

N. H. Darton, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 430, etc.). *Forelle ls.*—Heavy-bedded pure ls., locally gypsiferous and thin bedded. In places contains Carbf fossils, but for which the Forelle and underlying Satanka sh. might be regarded as part of Chugwater fm. (Perm. or Triassic). Thickness 4 to 20 ft. May possibly represent Embar fm. Underlies Chugwater fm. (red) and overlies Satanka sh. (red). Named for R. R. station a few mi. S. of Laramie.

H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, p. 1666). *Forelle ls.* seems to be an extended tongue of Phosphoria fm., and consequently may be considered as *Forelle ls. tongue of the Phosphoria.* It underlies red beds here named *Freezeout tongue of Chugwater fm.* and overlies Satanka sh.

Foreman formation.

Upper Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Foreman beds.*—Sixteen hundred ft. of slates and sss. with several beds of cgl. Plants identified by Prof. Fontaine as "clearly Mesozoic and most probably Rhaetic." Regarded as older than Hardgrave ss. and younger than Trail beds. [Later proved to be much younger than Hardgrave ss.]

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Foreman fm.*—A succession of sh., ss., and cgl. in which the sediment is for most part derived from rocks which are not clearly volcanic. Shales often slaty and with pencil structure, and range in color from dark carbonaceous with traces of leaves through gray, which predominates, to shades and tints of red and yellow. Most of sss. are very fine, decidedly shaly, and of reddish brown and gray colors. The cgl. is less abundant than the sh. and ss. Overlies, probably uncon., Hinchman ss., and in places uncon. overlaps Mormon ss. and even Robinson and Peale fms. Fauna determined to be not earlier than Middle Jurassic.

Named for exposures at Foreman and in Foreman's Ravine, NE. of Taylorsville, Plumas Co.

Foreman argillite.

Upper Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81, and No. 5, pp. 895–903). *Forman argillite.*—Named by Diller, 1892. Consists of light-gray argillite composed of fine volcanic waste. Thickness 350 ft. [Diller gave thickness of his *Foreman* fm. as 1,600 to 2,500 ft., and his lithology differed.] Fossils listed. Of early Upper Jurassic age. Occurs at Taylor's Diggings, in S. fork of Forman [Foreman] Ravine, and elsewhere.

Foremost formation.

Upper Cretaceous: Southern Alberta, Canada.

D. B. Dowling, 1917 (Canada Geol. Surv. Mem. 93, p. 37). Shales and shaly silts, with many coal or carbonaceous beds and with subordinate amounts of ss., underlying Pale beds and overlying Pakowki fm. in southern Alberta. The beds are chiefly brackish water lagoonal deposits, and of Judith River age. Top memb. is Taber coal; basal memb. is Verdigris ss. Thickness 400± ft. Named for exposures in Chin Coulee, near town of Foremost.

Corresponds to lower third of Judith River fm. of Mont.

Forest conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on mining interest and details of geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863, map and p. 19). A belt of cgl., 86 ft. wide, exposed 500 ft. N. of old Forest mine is termed *Forest cgl.* Distinguished by varied character of enclosed pebbles, among which occur ls. and ss.; a coarse gravelly appearance; and a tendency to disintegrate on exposure. Older than Minesota cgl., from which it is separated by 2,540 ft. of traps.

Same as Bohemia cgl. of Bohemian Range group.

Forest amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. The fm. belongs in Central Mine group. Is younger than Lake amygdaloid. The mineralized part is the Forest lode. Probably named for occurrence in old Forest mine, in Ontonagon Co.

Forest flow.

Includes Forest amygdaloid and the underlying trap.

Forest clay.

Forest sands.

Miocene: South Trinidad.

G. W. Halse, 1935 (Inst. Pet. Tech. Jour., vol. 21, No. 145, pp. 940–951).

Forest Rock.

A term formerly applied by miners to the White porphyry of Leadville dist., Colo. So called from profusion of deposits of dendritic oxide of manganese on its surface.

Forest City sand rock. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., pp. 55, 57). ***Forest City sand rock,*** alternating with clay sh. Underlies Forest City ls. and overlies Curzon's ls. Included in Perm.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 101), named subdivisions of Topeka ls. memb. of Shawnee fm. at Forest City, Mo. (descending): Coal Creek ls., 3½± ft.; Holt sh., 1 ft. 10 in.; DuBois ls., 1 ft. 1 in. to 1 ft. 2 in. [Forest City ls.]; Turner Creek sh., 4½ ft. to 6 ft. [Forest City sand rock of Gallaher]; and Curzen ls. 6± ft.

Named for Forest City, Holt Co.

Forest City limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., pp. 55, 57). ***Forest City ls.***—Overlies Forest City sand rock and underlies calc. shales at and near Forest City. Included in Perm.

G. E. Condra, 1927. (See 1927 entry under *Forest City sand rock.*)

Named for Forest City, Holt Co.

Forestdale marble.

Pre-Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 362, 394). ***Forestdale marble.***—Massive marble, greatly metamorphosed in most localities, with growth of many silicate minerals. Colors from white to light gray, buff, and cream mottled; usually weathers with marked reddish-brown surface. Minimum thickness (perhaps 200 ft.) is in dist. NE. of Brandon. Thickens to SE. of Brandon until it is nearly 2 or 3 times that figure; thins again to E. of Rutland. To N. it is fairly continuous to Canadian border. At Forestdale [Brandon quad.], 5 mi. NE. of Brandon, there is an excellent section from the upper graywacke cgl. of underlying Nickwaket graywacke up to basal cgl. of the uncon. overlying Camb. Is considered older than Moosalamoo phyllite.

Forest Grove formation. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). ***Forest Grove fm.***—Top fm. of Chester series in Tishomingo Co., Miss., and NW. Ala. Consists of Highland

Church ss. memb., 25 ft. thick, at top, underlain by 90± ft. of sh. and ss. that is nowhere completely exposed, but is believed to include clay, sandy shales, and shaly sss. Contains Chester fossils. Overlies Southward Bridge fm. Named for the school located on top of the fm. near old Mingo Village and Southward Bridge, Tishomingo Co., Miss.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23) gave many details of the fm. and stated that old Mingo village is at confluence of Bear Creek and Cedar Creek Valleys, which is in Ala., according to his map.

Forest Hill sand. (In Vicksburg group.)

Oligocene (lower): Southern Mississippi.

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, pp. 187, 191–193). *Forest Hill sand* introduced to replace preoccupied name "Madison sands" of Lowe. In type area consists chiefly of cross-bedded or laminated, more or less ferruginous, siliceous sand and some clay. West of type area the fm. becomes more argill. and contains lenses of lignite and lignitic clay. Thickness 50 to 70 ft. A shallow water or nonmarine deposit. Basal fm. of Vicksburg group in western Miss. Appears to rest conformably on Yazoo clay memb. of Jackson fm. Overlain conformably by Mint Spring calc. marl memb. of Marianna ls. Believed to be contemp. with marine Red Bluff clay.

Some geologists and paleontologists have included Forest Hill sand in upper Eocene Jackson fm., but according to studies of C. W. Cooke it is of Olig. age and more properly belongs to Vicksburg group, being of different lithology from Jackson. (See also *Red Bluff clay.*) Cooke says (A. A. P. G. Bull., vol. 19, No. 8, 1935) its Vicksburg age is proved because it overlies Red Bluff clay where the two interwedge.

Named for Forest Hill, 5½ mi. SW. of Jackson.

Forestville shale.

Mississippian: Michigan (Sanilac County).

C. H. Gordon, 1900 (Mich. Geol. Surv. vol. 7, pt. 3, p. 23). *Forestville shales.*—Blue shales, 100 to 200 ft. thick, forming upper part of Coldwater shales in Sanilac Co. Overlie Richmondville ss. [Probably named for exposures at Forestville, Sanilac Co.]

Forked Deer limestone.

Ordovician (Lower): Northeastern Tennessee (Morristown quadrangle).

G. M. Hall and H. C. Amick, 1934 (Tenn. Acad. Sci. Jour., vol. 9, No. 2, pp. 158–161). *Forked Deer ls.*—Approx. 185'10" of ls. and dol., including a few thin beds of sh. The ls. and dol. occur in about equal proportions and are interbedded. The sh. is mostly in thin partings. The ls. is predominantly "dove-like" and is the "brown rock" of the miners at Mascot, Tenn. It is less massively bedded than the dol. Chert is less conspicuous than in Copper Ridge and Nittany dolomites, and is almost entirely confined to the dol. Many beds are more or less brecciated. The fm. is in general lighter colored than underlying fms. Underlies Thorn Hill fm. and overlies Nittany dol., all of which belong to Knox dol. Is approx.=Jefferson City fm. of Ozark region. Section studied is along U. S. Highway 25 E, btw. Indian Creek and Bean Gap. The fm. is named for the creek in valley in which the highway is located.

†Fork Mountain slate.

Pennsylvanian: Southwestern Arkansas (Polk County).

A. H. Purdue, 1909 (Slates of Arkansas, Ark. Geol. Surv., pp. 30, 40) and 1914 (U. S. G. S. Bull. 586). *Fork Mtn sl.*—Gray to greenish and chocolate-colored slates, containing thin layers of qtzite in lower part; much jointed, but withstands weathering, and usually forms a bluff where it outcrops on mtn side. Thickness 0 to 125 ft. Overlies Arkansas novaculite and uncon. underlies Stanley sh.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 66). Some sh. at base of Stanley sh. has in places been altered to sl., to which the name "Fork Mtn sl." has been earlier applied. [This name has been discarded. The beds are only a local facies of Stanley sh.]

Named for Fork Mtn, Polk Co.

Fork Ridge sandstone member (of Mingo formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 39, 40). *Fork Ridge ss. memb.*—Cliff-making ss. in Mingo fm., lying about 40 ft. below Mingo coal. Thickness few ft. to 50 ft.

Named for Fork Ridge, Bell Co., Ky.

Forman argillite.

Upper Jurassic: Northern California (Mount Jura).

See *Foreman argillite.*

Forrest shale.

Lower Cretaceous: Southeastern Arizona.

C. [R.] Keyes, 1935 (Pan-Am. Geol., vol. 64, No. 2, pp. 129, 138, 139). *Forrest sh.*—The reddish shales forming lower half of Cinturan series (Cintura fm. of Ransome) in SE. Ariz. Thickness 800+ ft. Underlies Mexican ss. and overlies Comanche ls., top div. of Muralian series. Named for well-known Forrest ranch, a few mi. E. of Bisbee.

†Fort Adams or Ellisville phase.

See †*Ellisville phase.*

Fort Ancient division. (In Richmond group.)

Upper Ordovician: Southwestern Ohio.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, p. 292). *Fort Ancient div.*—Lower part of Waynesville bed of Richmond fm., characterized by abundant presence of *Dalmanella jugosa*, with exclusion of all other Brachiopoda and corals considered characteristic of the Richmond. The assemblage of lamellibranchs suggests that Fort Ancient div. of Waynesville bed belongs with upper part of Arnheim rather than with Clarksville and Blanchester divisions of Waynesville bed.

Is treated by U. S. Geol. Survey as top beds of Arnheim fm. According to E. O. Ulrich and C. Butts the beds more appropriately belong to Arnheim than to Waynesville, from which they are separated by an uncon. Later repts of Foerste, however, describe an uncon. at base of his Fort Ancient div.

Named for Fort Ancient, Warren Co.

Fort Apache limestone. (In Supai formation.)

Permian: Southeastern Arizona (Fort Apache Indian Reservation).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 533–536). In his work on geol. of Ariz. Darton mentions "a thick memb. of ls. about 100 ft. below top of Supai fm." in Fort Apache Ind. Res. area, and stated that it carries Manzano fossils. This ls. is herein described as *Fort Apache ls.* It lies considerably above the Perm. plant-bearing beds (pink ss. and sh.) here named ***Kinishba beds of Supai fm.*** In Plateau wall there are 400± ft. of Supai beds above Fort Apache ls. The Fort Apache [memb.] consists of gray ls., 70 ft. thick at Kelly Butte (the flat top of which it forms), very fossiliferous [fossils listed], and lying 489 ft. above Kinishba beds, 20 ft. thick. The latter beds (which occur in basal part of Supai fm.) are named for occurrenee in walls of an old Indian pueblo, known as Kinishba, on bank of a dry wash SW. of White River settlement and NW. of Fort Apache, at foot of Kelly Butte.

Fort Atkinson limestone. (In Maquoketa group.)

Upper Ordovician: Northeastern Iowa and western Wisconsin.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 98). *Fort Atkinson ls.*—Heavy beds of yellow cherty dol. and associated ls., 40 ft. thick, constituting second fm. of Maquoketa stage [group]. Overlain by Brainard sh. (top fm. of Maquoketa stage) and underlain by Clermont sh., also of Maquoketa stage.

Named for exposures in quarry W. of old fort at town of Fort Atkinson, Winneshiek Co., Iowa.

†Fort Benton group.

A term applied in early repts on Rocky Mtn region to Upper Cret. deposits now generally called *Benton sh.*

†Fort Bridger series.

A name applied by H. Engelmann, 1876 (Engr. Rept. U. S. A., Rept. Expl. Great Basin Terr. Utah, made in 1859 by J. H. Simpson, p. 287), to *Bridger fm.* (Hayden, 1869).

Fort Cassin formation.

Lower Ordovician (Beekmantown): Northwestern Vermont (Addison County) and eastern New York.

See explanation under *Beekmantown group.*

Named for Fort Cassin, Port Henry quad., Addison Co., Vt.

Fort Creek shale.

Devonian: Mackenzie.

E. M. Kindle and T. O. Bosworth, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 47).

Fort Dodge gypsum.

Permian(?): Central northern Iowa.

W J McGee, 1884 (Rept. 10th Census, vol. 10, Rept. on building stones, pp. 257, 258). *Fort Dodge stage.*—Nearly pure, light-gray, regularly bedded gyp., 35 ft. thick. Rests uncon. on St. Louis and Lower Coal strata and is uncon. overlain by drift. Assigned to Lower Cret. Covers an area of 25 sq. mi. in vicinity of Fort Dodge, Webster Co. [Some authors regard this gyp. as of Perm. age.]

Forteau formation.

Lower Cambrian: Labrador.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, pp. 18, 21).

Fort Ellis beds.

Pliocene(?): Central southern Montana (Threeforks quadrangle).

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 287). *Fort Ellis beds.*—In vicinity of Fort Ellis [near Bozeman] Peale (U. S. Geol. and Geog. Surv. Terr., 1873, pp. 112-113) described bluffs composed of Plio. sss., marls and cgls. 175 ft. thick, which are remnants of Plio. fms. that once spread over entire valley and formed bottom of vast lake that spread over what are now the valleys of Jefferson, Madison, and Gallatin Rivers, reaching to junction of the 3 streams.

Fort Erie moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Named for Fort Erie, Ont. Probably same as Buffalo moraine.

†Fort Gaines.

Eocene (lower): Southern Alabama and western Georgia.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). [On this map *Fort Gaines* is applied to rocks btw. the Midway above (probably only upper part of Midway group of present usage) and the Ripley below. As thus used the name applies to lower part of Midway fm. of eastern Ala. The Nanafalia fm. is also well exposed at Fort Gaines, Ga.]

Probably named for Fort Gaines, Clay Co., Ga., near Ala. line.

Fort Hall formation. (Of Thaynes group.)

Lower Triassic: Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492). *Fort Hall fm.*—Middle fm. of Thaynes group in Fort Hall Ind. Res. Thickness 600 ft. Underlies Portneuf ls. and overlies Ross ls.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 37). *Fort Hall fm.*—In descending order: (1) Yellow to grayish cherty and sandy lss. in thin beds, 600± ft.; (2) at two localities only a set of sandy and shaly gray lss. 50± ft. thick including an oolitic bed 6 to 10 ft. thick; (3) gray or yellowish siliceous dense ls. containing large pectinoids and irregular cherty nodules and streaks that weather with rough surface and project along bedding planes, 100± ft.; (4) soft and somewhat sugary yellow calc. ss., 50± ft. [Fossils listed.] Middle fm. of Thaynes group in Fort Hall Ind. Res. Underlies Portneuf ls. conformably and overlies Ross [Ross Fork] ls. conformably. Named for old Fort Hall, the site of which is in valley of Lincoln Creek, which appears on some maps as Fort Hall Creek. The fm. occupies a prominent ridge along N. side of valley.

†Fort Hays division or group.

Upper Cretaceous: Western Kansas.

B. F. Mudge, 1876 (U. S. Geol. and Geog. Surv. Terr. Bull. 2, pp. 218–221). *Fort Hays div. or group.*—Upper part massive ls. or yellow chalk 60 ft. thick; lower part varicolored shales and thin lss. 140 ft. thick. Included in Niobrara, but lower part may be=upper part of Benton. Underlies Niobrara proper and overlies Dakota group.

Includes lower part of Niobrara fm. and upper part of Benton sh.

Named for old Fort Hays, in western Kans.

Fort Hays limestone member (of Niobrara formation).

Upper Cretaceous: Western Kansas and eastern Colorado.

S. W. Williston, 1893 (Kans. Acad. Sci. Trans., vol. 13, pp. 108–109). The very characteristic heavy stratified chalk, or soft white ls., at base of this [Niobrara] fm., about 80 ft. thick, extends across the State, from near Mankato, Jewell Co., on N., to N. of Coolidge, in Hamilton or Greeley Co., on W. Its character and thickness, wherever seen, are so unmistakable that it is at once recognized. [Further on he speaks of "*the stratified, or Fort Hays beds,* as I will call them in Ness and Trego Counties," and states: "The divisional line btw. Benton and Niobrara I take at top of the stratified beds already mentioned, following Mudge, but I am not at all certain that it should not be placed below this, or even below the subjacent dark-blue sh."]

As above defined *Fort Hays ls.* was tentatively included in the Benton. In 1896, however, Cragin, also Williston, included it in the Niobrara, as its basal memb., underlying Smoky Hill chalk memb. This is commonly accepted definition. The ls. is top memb. of Fort Hays div. or group of Mudge.

In 1933 the U. S. Geol. Survey and Kans. Geol. Survey agreed to change the name to *Hays ls.*, "the name of the town having been changed from *Fort Hays* to *Hays*, and geologists working in Kans. having become accustomed to calling the ls. *Hays ls.*" (See A. A. P. G. Bull., vol. 18, 1934, p. 1494.) Later the Kans. Geol. Soc. reported that the beds were named for old Fort Hays, a well-known landmark in western Kans., and *Fort Hays ls. memb.* was therefore restored.

†Fort Knox sandstone.

Pennsylvanian: Southwestern Indiana.

J. Collett, 1874 (Ind. Geol. Surv. 5th Rept., p. 323). *Merom or Fort Knox ss.*—Coarse soft red and white ferriferous ss. 30 to 80 ft. thick, in Knox Co., Ind. Overlain by soil and drift; underlain by coal-bearing strata.

Same as Merom ss.

Named for Fort Knox, Knox Co.

Fort Littleton formation.

Upper Devonian: Eastern Pennsylvania.

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1199, 1218, etc.). *Fort Littleton fm.*—Upper fm. of Portage group, divided into (descending): Parkhead memb., Trimmers Rock ss. memb., Losh Run [sh.] memb., Braillier memb., and Harrell memb. (redefined by exclusion of Burket sh). [Willard stated that Burket memb. is of nearly equal distribution to Harrell.] Named for Fort Littleton, a village in NE. part of Fulton Co. There is a sharp lithologic change (practically a break) at base of Harrell memb., accompanied by appearance of a plentiful Naples fauna.

Fort Logan beds.

Miocene (lower): Western central Montana (Meagher County).

E. Douglass, 1903 (Carnegie Mus. Annals, vol. 2, pp. 150–151). *Fort Logan beds.*—Heretofore called *Lower Deep River*, but fauna [listed] is different from Upper Deep River fauna and is considered to be upper Olig. Cope's collections of fossils all came from Upper Deep River, to which name Deep River is here restricted. Named for military post [in Meagher Co.] near which the beds are best exposed.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65, 76, 112). Fauna of upper part of Deep River sequence is middle Mio. and of Fort Logan beds is lower Mio.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1). [On p. 9 the Fort Logan beds are assigned to lower Mio., but on pp. 12 and 15 they are said to be upper Olig. or lower Mio.]

Fort Mountain sandstone.

Lower Cambrian: British Columbia and Alberta.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444, pp. 4–6). *Fort Mtn fm.*—Consists of (descending): (1) Qtzitic ss. (called "Fairview fm." by author in 1908, but Fairview is preoccupied), 350 ft.; (2) coarse ss., 570 ft.; (3) siliceous sh., 44 ft.; (4) aren. qtzitic cgl., 360 ft. Since 1908, when upper part of this fm. was named "Fairview," the basal part of fm. has been found exposed at several places on E. side of Bow River Valley, where (on Fort Mtn, about 5 mi. NE. of Lake Louise station on Canadian Pacific R. R., Alberta) its basal cgl. is in contact with pre-Camb. shales. The fm. is overlain by Lake Louise sh.

†Fort Niobrara formation.

See 1909 and 1918 entries under †*Niobrara group* (Tert.).

Fort Payne chert.

Mississippian: Northern and eastern Alabama, northwestern Georgia, Tennessee, and northeastern Mississippi.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, pp. 155–156, section opp. p. 162, and map). *Fort Payne chert.*—The siliceous memb. of the Sub-Carbf., consisting of a great series of cherty lss. somewhat analogous to Knox. dol.; lower part more cherty than upper part in Tennessee Valley, but S. of the Tennessee the entire memb. shows, at least on surface, little else than chert. Usually very fossiliferous. Thickness not great. Probably represents both subdivisions of Siliceous group. Overlies Dev. black sh. and underlies Bangor ls. in some areas and Oxmoor ss. and shales in other areas.

As thus defined the Fort Payne chert included (according to E. A. Smith's 1894 rept) the rocks which in 1894 he differentiated into "Tuscumbia ls. (=upper part of Fort Payne chert)" and "Lauderdale cherty ls. (=lower part of Fort Payne chert)." In subsequent repts the noncherty beds equiv. to Tuscumbia ls. were, according to C. Butts, included in Bangor ls. of some areas, and the name Fort Payne was thus actually applied to beds of pre-Tuscumbia age. In 1910 (U. S. G. S. Bull. 400 and Folio 175) C. Butts definitely restricted the name *Fort Payne chert* to rocks of pre-Warsaw (=pre-Tuscumbia) age, and since then detailed work has proved that in Ky., western Tenn., and northern Ala. the Ste. Genevieve, St. Louis, and Warsaw lss. can be separated as fms., so that the name *Fort Payne chert* is now applied to pre-Warsaw rocks underlain by Chattanooga sh. In western Tenn. the Fort Payne is uncon. underlain by New Providence fm. or Ridgetop sh., both of post-Chattanooga age. According to E. O. Ulrich and C. Butts the Fort Payne contains fossils of Keokuk, lower Burlington, and Fern Glen age (comprising Osage group), and of late Kinderhook age. (See also C. Butts, 1926, Ala. Geol. Surv. Spec. Rept. No. 14.)

Named for development at Fort Payne, De Kalb Co., Ala.

Fort Peña formation.

Middle or Lower Ordovician: Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066, 1070+). *Fort Peña fm.*—Chiefly alternations of thick-bedded ls. and bedded chert. The lss. are coarsely granular and in part sandy and pebbly, and crop out in conspicuous ledges several ft. thick. There are some thin partings of sh. In middle and upper parts considerable thicknesses of granular, purplish, reddish, and bluish chert, mostly in thin beds. In S. part of area, as in Garden Springs region, upper part is marked by a very massive chert memb. in beds 3 or 4 ft. thick. At base are 5 or 10 ft. of coarse massive cgl. composed of subrounded pebbles of chert, ls., and ss., from ¼ inch to 6 in. diam. Thickness 125 to 200 ft. Overlies Alsate sh. and grades into overlying Woods Hollow sh. Is chief ridge maker in Marathon succession below Caballos novaculite. Most of fauna suggests Black River (Middle Ord.), but occurrence here and there of primitive genera *Didymograptus* and *Tetragraptus* suggests that fm. is possibly Chazyan (Lower Ord.). Type loc. is on one of these ridges directly N. of old Fort Peña Colorada, Brewster Co.

†Fort Pierre group.

A term applied in early repts on Rocky Mtn region to Upper Cret. deposits long known as *Pierre sh.*

Fort Plain.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Fort Plain* introduced for uppermost Canajoharie or zone of *Climacograptus spinifer* in Mohawk Valley.

Fort Riley limestone. (In Chase group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 14). *Fort Riley ls.*—Thick-bedded buff porous mag. ls., 8 to 10 ft. thick, forming bed No. 52 of geologic section of eastern Kans. Included in Lower Perm.

C. S. Prosser, 1895. [See 1st entry under *†Florence ls.*]

C. S. Prosser (1902) redefined Fort Riley ls. as explained in 1902 entry under *†Florence ls.*

R. C. Moore (1936) restricted Fort Riley ls. as explained in 1936 entry under *†Florence ls.* This restricted definition has not been considered by U. S. Geol. Survey for its publications.

Named for Fort Riley, Geary Co., Kans.

Fort St. John shales.

Upper Cretaceous: British Columbia.

G. M. Dawson, 1881 (Canada Geol. Surv. Rept. 1879–80, p. 15B). Partial synonym of Benton sh.

Fort Scott limestone (distinct formation in Kansas and Oklahoma).

Fort Scott limestone member (of Henrietta formation) in Missouri.

Pennsylvanian: Northwestern Missouri, eastern Kansas, and northeastern Oklahoma.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 25). *Fort Scott ls.*—Bluish-drab and brown, irregularly bedded fossiliferous ls., 8 to 18 ft. thick, forming top memb. of Fort Scott coal series and constituting bed No. 212 of geol. section of eastern Kans.

E. Haworth, 1896 (Univ. Kans. Geol. Surv. vol. 1, p. 42). *Fort Scott* is suitable as alternative designation for *Oswego ls.*, but should not include the upper heavy ls. which caps the hills on all sides of Fort Scott. Oswego ls. consists of (descending): (1) ls., 5 to 15 ft.; (2) black sh., 4 to 7 ft.; (3) ls., the "cement rock," 5 to 15 ft.

J. Bennett, 1896 (pp. 86 to 98, pl. 4 of book last cited). *Oswego or Fort Scott ls.* consists of (descending): (1) ls., 10 to 14 ft.; (2) clay and bituminous sh.; (3) ls. ("cement rock"), 4½ ft. [This definition of *Fort Scott ls.* is still in current use.]

The present commonly accepted definition of *Fort Scott ls.* in Mo. applies name to basal memb. of Henrietta fm., underlying Labette sh. memb. and overlying Cherokee sh. It includes at top the Fort Scott ls. of Swallow and at base the †*Fort Scott cement rock* of later repts, the two being separated by 5 to 20 or more ft. of sh., coal, and clay. In Kans. the Henrietta has for years been treated as a group by U. S. Geol. Survey, and Fort Scott ls. as a fm. In Okla. the Fort Scott ls. is also treated as a distinct fm. But R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), has discarded Pleasanton and Henrietta fms., and treats Fort Scott ls. as a fm. in his Marmaton group. These changes have not been considered by U. S. Geol. Survey for its publications.

See also under *Cherokee sh.*

Named for exposures at Fort Scott, Bourbon Co., Kans.

†Fort Scott coal series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol Surv. Prel. Rept., pp. 25–26): *Fort Scott coal series.*—Series of lss., shales, slates, sss., coals, and clays, 142 ft. 10 in. thick, including beds Nos. 212 to 223, inclusive, of geol. section of eastern Kans. Underlies Pawnee ls. series, overlies Fort Scott marble series, and includes Fort Scott ls. as top memb.

Includes lower part of Henrietta group and upper part of Cherokee sh.

†Fort Scott marble. (In Cherokee shale.)

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 26). *Fort Scott marble.*—Black marble, weathering brown, with numerous yellowish veins and crystallized shells; thickness 1½ ft. Constitutes bed No. 227 of geol. section of eastern Kans. Included in Fort Scott marble series.

†Fort Scott marble series. (In Cherokee shale.)

Pennsylvanian: Eastern Kansas.

G. C. Broadhead, 1866 (Kans. Geol. Surv. Prel. Rept., p. 26). *Fort Scott marble series.*—Series of lss., shales, and slates, 22 ft. 8 in. thick, including beds Nos. 224 to 230, inclusive, of geol. section of eastern Kans. Underlies Fort Scott coal series and overlies Lower coal series. Includes Fort Scott marble (bed No. 227).

†Fort Scott cement rock.

See under *Fort Scott ls. memb.*

†Fort Scott flagstones.

Trade name of ss. in Pleasanton group (Penn.), quarried near Fort Scott, Kans. Is younger than Fort Scott ls. See under †*Robinett flags.*

Fort Shafter gravel.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 62, 64, 65–71). There are 5 principal fms. in Salt Lake dist. The oldest is Koolau basalt, which is followed by the older parts of the reef ls. Next younger is *Fort Shafter gravel,* a coarse alluvial gravel, commonly made up of cobbles and boulders from 10 to 40 cm. diam. embedded in matrix of poorly sorted finer alluvium. Thickness of beds 2 to 10 ft. At many places the gravel rests on the basalt. It is deeply weathered; of Pleist. age; and the combined work of several streams draining this part of Koolau Range probably when sea stood about 40 ft. higher than now. Inner margin of Fort Shafter terrace in places stands 125 ft. or more above sea level. Most striking remnant of the terrace is that on which Fort Shafter military post is located, and which is here called Fort Shafter terrace. The lowest (oldest) tuff of Salt Lake region is interbedded with Fort Shafter gravels at a number of places. Over Fort Shafter terrace the upper tuff is

1 to 5 ft. thick and lies on the weathered and soil-covered surface of Fort Shafter gravel.

Not differentiated by H. T. Stearns, 1935 rept (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1).

†Fort Sill series.

Tertiary (?): Southwestern Oklahoma.

T. B. Comstock, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 322, 324, 328). The ss. overlying the Perm. red clays (in SE. part of Wichita Range) is what Mr. Cummins calls *Fort Sill series*, and our observations make me think it may be Tert. It is persistent along S. base of the Wichitas for many miles westward, and in most places is overlain by thick deposits of Quat. gravels and boulders of local origin.

T. W. Vaughan, 1899 (Am. Geol., vol. 24, pp. 44–55). Comstock considered Fort Sill series of Cummins to be Tert. He does not give any reason for this opinion. The material resembles in lithologic character the Perm., composed of reddish argill. material. This fm. is still problematic, and we probably shall not be able to ascertain its relations until the area has been the subject of detailed investigation.

Abandoned because later workers are unable to identify the beds to which the name was applied.

Named for Fort Sill, Comanche Co.

Fort Sill formation.

Upper Cambrian: Arbuckle and Wichita Mountains, Oklahoma.

E. O. Ulrich, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 742–747). *Fort Sill fm.*—Basal unit of Arbuckle ls. in both Arbuckle and Wichita Mtns, Okla. Rests uncon. (locally overlaps) on *Honey Creek fm.*, and in Wichita Mtns is everywhere overlain by Signal Mtn fm. In Arbuckle Mtns, however, the Royer marble, 100 to 600 ft. thick, wedges in btw. Fort Sill and Signal Mtn fms. The Fort Sill is named for exposures in a small quarry on Fort Sill Military reservation on E. side of the highway btw. Fort Sill and Lawton (SE¼ sec. 8, T. 2 N., R. 11 W.), where only 40 ft. of fm. is exposed. A complete section of fm. is found about 6 mi. W. of Fort Sill and 1 mi. S. of Signal Mtn, in sec. 7, T. 2 N., R. 12 W., where 150 ft. of beds assigned to this fm. are exposed, as follows (descending): (1) 70 ft. of rather massive fine-grained gray to dove-colored ls.; sponge spicules abundant in zone near top; gastropod and trilobite zone in upper 50 ft.; (2) 34 ft. of thin-bedded, laminated fine-grained gray to dove-colored fossiliferous ls. in beds 2 to 6 inches thick, separated by thin sh. partings, with trilobite fragments throughout entire thickness; (3) 6 ft. of ls. similar to No. 12, with large trilobite fragments at base; (4) 40 ft. of ls. similar to above but with dove-colored varieties predominating; base irregular, marked by a thin green seam of weathered and redeposited material; fossils (chiefly trilobites) throughout. A much thicker bed (368 ft.) is exposed on N. side of Wichita Mtns, sec. 17, T. 4 N., R. 12 W. It is here divided into several faunal zones [described and named].

†Fort Smith formation.

Pennsylvanian (Allegheny): Western Arkansas coal field.

A. J. Collier, 1907 (U. S. G. S. Bull. 326, pp. 12, 18–20, and map). *Fort Smith fm.*—Thin and somewhat variable sss. with interbedded shales; sss. ripple-marked, the markings presenting considerable variety in size and form, and many beds are characterized by wavy cleavage approx. parallel to minor undulations of bedding planes. False bedding or cross-bedding unusual; shales nearly everywhere more or less aren. and resulting soils reddish or yellowish and sandy. Thickness 375 to 425 ft. Usually consists of (descending) hard sss. and shaly sss., 100 to 200 ft.; sh., 40 to 200 ft.; and at base, 20 to 50 ft. of hard, flaggy, ripple-marked ss., locally called "Tennessee ss." Coal beds in upper part. Overlies Spadra sh. and underlies Paris sh. Middle fm. of McAlester group.

Named for Fort Smith, Sebastian Co.

Has been discarded. See explanation under *McAlester fm.*

Fort Stanton shale.

Upper Cretaceous (Benton): Southern central New Mexico (Sierra Blanca region).

G. H. Hansen, 1931 (Geo. Wash. Univ. Bull., Summaries of doctoral theses 1925–28, p. 84). *Fort Stanton sh.*—Dark-gray to blue soft shales that carry near base a few thin beds of ls. and bentonite. Thickness 500 ft. Fossils [listed] collected by M. R. Campbell from this fm. near Fort Stanton Reservation are Benton, according to T. W. Stanton. Overlies Dakota (?) ss. and underlies Tucson ss.

Fort Thompson formation.

Pleistocene: Southern Florida (Palm Beach and neighboring counties).

E. H. Sellards, 1919 (Fla. Geol. Surv. 12th Ann. Rept., pp. 71–72, 75, 76, 118). *Fort Thompson beds.*—Alternating fresh- and brackish-water and marine shell marls and lss., typically exposed at Fort Thompson [just above LaBelle, Hendry Co.], just below Goodno's Landing. Relations to Miami oolite not determined. Underlies Coffee Mill Hammock marl.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *Fort Thompson fm.*—Here redefined to include Sellards' †Coffee Mill Hammock marl, a thin shell bed of marine origin containing a great profusion of *Chione cancellata*. The name "Coffee Mill Hammock marl" is not needed and is discarded. In type area the Fort Thompson fm. as here redefined lies uncon. on Caloosahatchee marl. Is overlain by peaty muck of Recent age. Thickness 0 to 10 ft.

Fortuna sand.

A series of subsurface sands which were in 1920 the principal producing sands in Cement oil field, Caddo Co., SW. Okla. They are correlated with part of Wellington fm. (Perm.).

Fort Union formation.

Eocene (early): North Dakota, northwestern South Dakota, Wyoming, Montana, northwestern Colorado.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, p. 433). *Fort Union or Great Lignite group.*—Clay and sand, with round ferruginous concretions, numerous beds, seams, and local deposits of lignite, and great numbers of dicotyledonous leaves, stems, etc., of [listed] genera. Thickness 2,000+ ft. Overlies Fox Hills beds (Cret.) and underlies Wind River deposits. Occupies whole country around Fort Union and extends N. into British possessions unknown distances and southward to Fort Clark. Seen under White River group on North Platte River above Fort Laramie and on W. side of Wind River Mtns. Is probably Eocene.

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 89–92). *Fort Union group* extends along E. flanks of the mtns probably to Denver, Colo., and perhaps farther. The coal beds of Raton Hills, which I have called Raton Hills group, I suspect are also a portion of the great lignite group. The coal strata of Canyon City, which I have called Canyon City group, I have little doubt are also a fragment of the great lignite group.

In 1876 King and Hayden agreed to replace the descriptive term "Lignitic group" with the geographic name *Laramie group*. (See under *Laramie fm.* See also under †*Lignitic group* and *Laramie fm.* for early views regarding age and distribution of Fort Union fm.)

F. V. Hayden, 1876 (U. S. Geol. Terr. Bull. 5, pp. 405–411). Those who have worked from the S. and SW. toward the N. have been thoroughly impressed with Cret. age of Lignitic group, while those who have studied the deposits from the N. and NW. toward the interior basin received their first impressions they were of Tert. age.

F. B. Meek, 1876 (U. S. Geol. and Geog. Surv. Terr. Mon. 9, p. lix). The section of Fort Union group beds at Fort Union is as follows:

(1) ferruginous marl, with aren. concretions, the upper part being sometimes, for several ft. in thickness, composed of concretionary ss. forming ledges, 20–30. Most common fossil *Viviparus trochiformis*.

(2) drab indurated aren. clay, 20.

(3) impure lignite, with numerous crystals of selenite, 1.

(4) gray and drab indurated clay, with, at some localities, numerous impressions of leaves of dicotyledonous trees and of a species of fern, 50–70.

(5) impure lignite, with much silicified wood, 1½.

(6) gray indurated sand, with a slight mixture of clay. Contains numerous * * * (fossils) also many fragments and entire stumps of silicified trees, 30.

(7) impure lignite, ⅛ ft.

(8) yellowish-gray indurated clay, 2.

F. V. Hayden, 1878 (U. S. Geol. Surv. Terr. Mon. 7, pt. 2, p. iv), stated that his "Lignitic group" included Laramie and Fort Union, and that latter was probably identical with whole, or at least a part, of Wasatch group. (See quotation under *Laramie fm.*)

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 351–354), stated that he had never visited Fort Union locality, but that "the correlation of the upper plant beds of Fort Union with the Wahsatch (my Vermilion Creek) seems the most prodigious strain."

In 1893 (U. S. G. S. Bull. 105) and 1896 (Am. Geol., vol. 18, pp. 201+) W. H. Weed divided *Fort Union or Lignitic group* of Hayden ("also called Laramie group by Hayden") near Livingston, Mont., into (descending): (1) *Fort Union fm.* (Eocene), 4,000 to 8,000 ft. of rather massive cross-bedded sss. with gray silty shales and local lenses of impure ls., "believed to be a distinct fm., corresponding in lithology, strat. position, and fossil contents to beds exposed along Missouri River at mouth of Yellowstone, so long known in geological literature as Fort Union beds," resting uncon. on (2), Livingston beds, 7,000± ft. of chiefly assorted and water-worn volcanic material, somber-colored sss., shales, and grits, which rest uncon. on (3), 1,000 ft. of massive, light-colored coal-bearing sss. and intercalated shales containing leaf remains and invertebrates and corresponding to Cret. Laramie fm. of King, Newberry, Emmons, and Cross. (The Livingston fm. was not assigned to either Eocene or Cret. by Weed.)

Later and more detailed work in Crazy Mtn region, Mont., by R. W. Stone and W. R. Calvert resulted in differentiating, in that region (Econ. Geol., vol. 5, pp. 551–557, 652–669, 741–764, 1910), the following fms. (descending): (1) *Fort Union fm.*, 4,000+ ft. thick, consisting of massive sss. and shales, with Lebo andesitic memb. at base, the latter 450 to 2,200 ft. thick and containing Fort Union (Eocene) fossils; (2) Lance fm. ("Ceratops beds"), 1,000 to 2,400 ft. of light-gray ss. and variegated sh.; (3) Lennep ss., 250 to 400 ft. of ss. with intercalated shales, which may correspond to Fox Hills ss.; (4) Bearpaw sh.; (5) Judith River fm.; (6) Claggett fm.; (7) Eagle ss.; (8) Colorado sh.; and (9) Kootenai fm. (Lower Cret.). They also ascertained that the andesitic Livingston fm. of Weed included equivalents of Lebo andesitic memb. of Fort Union fm. and all other fms. mentioned above down to top of Eagle ss., which was called *Laramie* by Weed.

Repts of different geologists published since 1910 have described and mapped the Fort Union fm. (Eocene) over large areas in Mont., N. Dak., S. Dak., and down into central Wyo. (See 1924 geol. map of Wyo., where Fort Union is shown resting on Lance fm. and overlain by Wasatch fm.) More recent work by J. B. Reeside, Jr., resulted in discovery that Wasatch fm. of 1924 Wyo. geol. map as mapped in southern Wyo. (where it was shown as resting on Lance fm.) included a representative of Fort Union fm., and that both Fort Union and Lance fms. are traceable into Yampa coal field of NW. Colo. A rept. on Yampa field by J. B. Eby and others describes the Fort Union of that area (called *post-"Laramie"* in earlier repts) as consisting of 1,345 ft. of sh. and ss., with coal near top and base, with a cgl. at base, and usually an indurated ferruginous platy ss. at top. These beds are uncon. overlain by Wasatch fm., and uncon. underlain by

Lance fm. (called "*Laramie*" in previous repts on the region), consisting of 1,020 ft. of ss., sh., and coal beds underlain by 500 ft. of sh. with small ss. lenses and coal bed near base. The Yampa coal field is southernmost area in which Fort Union and Lance fms. have been certainly identified. That the Fort Union fm. is of Eocene age, and that it underlies Wasatch fm. and overlies Lance fm. is definition now accepted by most if not all geologists.

Named for exposures at Old Fort Union, near mouth of Yellowstone River, later called Fort Buford and now town of Buford, N. Dak.

Fort Washington gneiss.

R. P. Stevens, 1867 (N. Y. Lyc., Nat. Hist. Annals, vol. 8, pp. 116–120). [On his "Section across New York [Manhattan] Island along southern shore of Spuyten Duyvel Creek and Harlem River" *Fort Washington gneiss* is applied to upturned body of gneiss along Hudson River. It is bounded on E. by King's Bridge ls. According to 1911 map of C. P. Berkey in N. Y. State Mus. Bull. 146, the Manhattan schist occurs in and around Fort Washington Park, and to E. Inwood ls. and Fordham gneiss occur.

Fort Washington.

Eocene: Southern Maryland (Prince Georges County).

T. A. Conrad, 1830 (Acad. Nat. Sci. Phila. Jour., vol. 6, pp. 205–217), listed fossils from Fort Washington and vicinity, but did not name the deposits.

A. Heilprin, 1884 (Phila. Acad. Nat. Sci. Jour., 2d ser., vol. 9, pt. 1, pp. 124–128), divided Eocene of Md. into (apparently descending): Upper Marlborough or Marlborough rock, Piscataway sands, and Fort Washington.

Probably is basal part of Aquia fm.

Fort Wayne moraine.

Pleistocene (Wisconsin stage): Northern Ohio and Indiana and southern Michigan. Shown on moraine map (fig. 8) of U. S. G. S. Columbus folio (No. 197), p. 12, 1915; also on moraine map (pl. 32) in U. S. G. S. Mon. 53, 1915. Named for Fort Wayne, Ind. Replaces "St. Marys" moraine of Gilbert.

Fort Worth limestone. (In Washita group.)

Lower Cretaceous (Comanche series): Eastern Texas, central southern and southeastern Oklahoma, and southwestern Arkansas.

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, pp. xiv, xxi, xxii). *Washita or Fort Worth ls.*—Comparatively massive, impure, chalky, sparsely fossiliferous ls., base and top compact; middle more disintegrated. Contains shell breccia and calc. marls in alternating strata. Has same general aspect upon weathering as Comanche Peak beds. Thickness 150+ ft. Overlies upper Caprotina ls. or Austin marble and underlies *Exogyra arietina* clays [Del Rio clay].

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 503–528). *Fort Worth ls.* of Tex.-Ark. region is overlain by Denison fm. and underlain by Duck Creek chalk. Included in Washita div. [group]. [This is present generally accepted definition of Fort Worth ls.]

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13, pp. 318, 319). At Austin *Fort Worth beds* as originally defined underlie *Exogyra arietina* beds and overlie Caprina, the top div. of Fredericksburg group [and are=Georgetown ls.]. They include (descending) *Kingena wacoensis bed* (probably southern attenuation of Marietta bed of Denison section); *Gryphaea pitcheri* bed, 10 ft.; and Fort Worth ls. as name should be restricted.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2). *Fort Worth ls.* of Edwards Plateau and Rio Grande Plain consists of 75± ft. of impure white ls. underlying Del Rio clay and overlying Edwards ls. [This broad definition corresponds to Georgetown ls., and Fort Worth ls. is no longer used in this area, where the unit described includes much more than typical Fort Worth ls.]

W. M. Winton and W. S. Adkins, 1919 (Univ. Tex. Bull. 1931), in rept on Tarrant Co. (typical Fort Worth ls.), advocated the transfer to Fort Worth ls. of the two upper members of Duck Creek fm., which they called Kingena memb. or *Duck*

Creek marl (top) and Scaphites memb. or *Duck Creek limy marl.* The underlying members (to which they restricted name *Duck Creek fm.*) they designated as Schloenbachia memb. or *Duck Creek marly lime* (above) and Desmoceras memb. or *Duck Creek ls.* (below). "The Duck Creek marl and limy marl are distinct from the overlying Fort Worth ls. and the underlying *Duck Creek ls.*, both lithologically and paleontologically, and have as much justification for ranking as a separate fm. as either of them. If they are to be placed with either it should be with Fort Worth ls., since the faunal changes are very abrupt at end of Duck Creek ls." [basal memb. of Duck Creek fm.].

Named for exposures at Fort Worth, Tarrant Co.

†Fortymile series.

†Fortymile group.

Paleozoic and pre-Cambrian: Central eastern Alaska (Fortymile Creek).

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 145–155). *Fortymile series.*—Interbedded marbles, qtzites, and schists of various kinds—hornblendic, micaceous, garnetiferous, and sometimes graphitic. The marble beds occur throughout fm. and are its distinctive feature. The series is calc. at bottom and rather shaly at top. Intrusive rocks abundant; two sets of quartz veins. Folded, faulted, sheared. Overlies Birch Creek series, and appears to underlie Rampart series. Named for exposures along canyonlike valley of Fortymile Creek. Age undet.

These rocks were later called *Fortymile group*, but the name was finally discarded. In its type area it included part of Birch Creek schist (pre-Camb.) and also Paleozoic rocks.

Fortymile granite.

A term applied by J. E. Spurr (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 135, 137, 1898) to the basal granite in Fortymile dist., Alaska, where it underlies Birch Creek schist.

Fossil Creek volcanics.

Middle Ordovician: Northeastern Alaska (Yukon-Tanana region).

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Fossil Creek volcanics.*—Basic lavas, tuffs, breccias, and aggls. of greenstone habit, with a small proportion of granular basic intrusives. Lower part consists mainly of bedded lavas and interbedded pyroclastic rocks. Thickness probably 2,000+ ft. Typically exposed in White Mtns, about 50 mi. N. of Fairbanks, where they crop out just N. of Fossil Creek, in a belt 40± mi. long. Overlain by Tolovana ls. (Sil.), without observed structural uncon., but in reality there is a great discon. btw. them. Middle Ord. fossils. Included in †Tatalina group of Prindle.

Fossil Lake formation.

Pleistocene: Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Fossil Lake fm.*—Lake silt, 8 to more than 10 ft. thick, containing Pleist. fossils. Type loc., Fossil Lake, N. part of Lake Co.

Fountain formation.

Pennsylvanian: Eastern Colorado.

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Fountain fm.*—Series of red sss., grits, and cgls., *a part of so-called "Red beds,"* found in typical development on Fountain Creek below Manitou Springs [in Colorado Springs quad.] and at head of same stream in NE. corner of Pikes Peak quad. The beds of upper exposures on Fountain Creek belong to basin of Manitou Park. They are chiefly coarse-grained, crumbling arkose sss., in heavy *banks* showing cross-bedding; are locally conglomeratic, mottled with gray and various light shades of red; near base and at intervals throughout the series are very dark-red or purplish layers of aren. sh. or fine-grained ss. Thickness near Woodland Park estimated at nearly 1,000 ft. The characteristics above noted are also found in lower 1,000 ft. of section of reddish sss. and grits to E. of Manitou Springs, referred by Hayden to upper Carbf., while the *finer grained* "Red beds" succeeding them, together with the strata of Manitou Park, were called "Triassic." In Garden Park the Fountain beds reach max. thickness of about 1,000 ft.; they are heavy bedded, with much feldspathic material derived from adjacent granite; the cgl. layers contain many pebbles of hard Algonkian qtzites, while a few ls. and chert pebbles were noted in lower part; dark sh. is less prominent than in Manitou Park. The Fountain beds rest uncon. on edges of entire Silurian section in Red ridge, at upper end of Garden Park; along S. end of Colorado Range they rest on Harding ss. While greater part of "Red beds" series E. of Colorado Range has been considered Triassic, no fossil or other definite evidence has as yet been found to show correctness of this conclusion. It is more probable lower part at least of these "Red beds" belong to Carbf. than that the whole complex is Triassic.

The geol. map of Colorado Springs folio (No. 203) shows that Fountain Creek cuts across Fountain fm. for 2 mi. to E. of Manitou Springs, and that about 2 mi. E. of latter place it cuts across Lyons ss. and Lykins fm. as described in that folio. From this it would appear that Lyons ss. and Lykins fm. of that folio were included in foregoing original definition of Fountain fm. But Cross distinctly states that his Fountain fm. is only a *part* of the "Red beds." The latter term was replaced by "Wyoming fm." in 1896, and still later was subdivided into Lykins, Lyons, and Fountain fms. There are also differences in the thicknesses. The Fountain of Colorado Springs quad. is 800 to 4,500 ft. thick, while Lyons ss. of that folio is 850 ft. thick, and Lykins fm. is 180 ft. thick. The author of Colorado Springs folio (G. I. Finlay) interpreted the Fountain fm. as originally defined to be=Fountain fm. plus lower part of Lyons ss. as mapped by him in Colorado Springs folio.

Fourmile sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686D, pp. 17-20). *Fourmile ss.*—Massive ss., about 25 ft. thick, overlain and underlain by some thinner sss. and interbedded red shales, the whole having a thickness of about 40 ft., but this varies considerably from place to place. The basal bed is distinguished from other sss. in this part of section by being coarse and gritty, but not conglomeratic. Rests on gray sh. A thin ls. lies 10 to 15 ft. below base of Fourmile ss. The Fourmile ss. lies 40± ft. below top of section in T. 24 N., R. 10 E., and 350± ft. above Birch Creek ls. Named for exposures on the point S. of Fourmile Creek in SW¼ sec. 30, T. 24 N., R. 10 E.

Fourmile limestone. (In Wreford limestone.)

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 31). Fourmile ls.—Basal memb. of Wreford ls. Named for Fourmile Creek, in SW. part of Richardson Co., Nebr. Type loc. head of a branch of Fourmile Creek, near Kans.-Nebr. line, about 10½ mi. S. and ½ mi. E. of Humboldt, Nebr. Thickness in Nebr. about 7½ ft.; increasing southward to 20 or more ft. at Strong, Cambridge, and Dexter, Kans. With exception of about 1 ft. of gray sh. above a thin basal cherty ls., the Fourmile memb. is massive gray to bluish-gray chert-bearing ls., but its chert content decreases somewhat from southern Kans. into Okla. Underlies Havensville sh. memb. of Wreford ls.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), replaced Fourmile ls. of Condra and Upp with new name *Threemile ls.*, probably because of prior use of *Fourmile* for a ss. in Okla.

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Nebr. State Surv. continues to use *Fourmile* for the ls. for which Kans. Surv. has substituted *Threemile.*

Fournier group.

Ordovician to Devonian: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 47).

Fowkes formation. (In Wasatch group.)

Eocene: Southwestern Wyoming.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Fowkes fm.*—"White beds;" light-colored rhyolitic ash beds with interbedded lss. containing fresh-water shells, fish, and plants. Thickness 0 to 2,500+ ft. Middle fm. of Wasatch group in

SW. Wyo. Uncon. underlies Knight fm. and overlies Almy fm. (basal fm. of Wasatch group). Named for Fowkes ranch, about 9 mi. from Evanston, around which the fm. is well exposed.

Fowler limestone.

Upper Ordovician: Southern Kentucky.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, p. 434). *Fowler ls.*—Dense ls., 1 to 1½ ft. thick, at top; in middle shaly bluish ls., 1 to 2 ft. thick, carrying Richmond fossils; at bottom ls. layer with branching bryozoans. Included in Richmond group. Overlain by Rennix lss. and underlain by 15 ft. of thin-bedded ls. and other unnamed strata of Richmond group.

Named for Fowlers Landing, Cumberland County (?).

Fowler moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Fowler, Clinton Co.

Fox sandstone.

An abbreviated form of *Fox Hills ss.* employed by C. [R.] Keyes.

†Fox rocks.

A name applied locally in W. Va. to Gilmore ss. memb. of Greene fm.

Fox Bush sand.

A subsurface sand in southern Kans. that is said to lie at about horizon of Bartlesville or Burbank sand.

Foxen formation.

Pliocene (middle): Southern California (Santa Maria district).

W. W. Porter, II, 1932 (A. A. P. G. Bull., vol. 16, No. 2, p. 136). *Foxen fm.* (*middle Plio.*).—This fm. was described by C. F. Tolman at joint meeting of Le Conte Club and Cordilleran section of Geol. Soc. Am. at Stanford Univ., Jan. 29, 1926. Abstract in Geol. Soc. Am. Bull. 38 (1927), and use of term *Foxen* by writer is essentially same as Tolman's. The fm. is younger than lower Plio. Sisquoc fm., on which it lies, and is tentatively referred to middle Plio. Above it, in some localities conformably and in others uncon., lie the fossiliferous yellow sss. generally known as "Fernando." The Foxen is a clay sh. varying locally to diatomite. Characterized by distinctive micro-fauna which has been found in many well cores and in pit samples from surface outcrops on Harris Grade road. An easily accessible outcrop is on N. side of Purisima Hills near foot of Harris Grade road which connects Lompoc with Coast Highway at Harris Station. It is exposed in cuts on W. side of creek just S. of small bridge about 1 mi. S. of Harris Station. Foxen diatomite can be seen in Solomon Hills near summit of Howard Canyon road, and above Sisquoc fm. S. and E. of Sisquoc Ranch House. Thickness 40 ft. in surface sections in Solomon Hills to several hundred ft. in wells in Santa Maria Valley; is approx. 600 ft. on Harris Grade road.

W. W. Porter, II, 1933 (letter dated Nov. 9). *Foxen fm.* was discussed and described in reference to Tolman given above, but in condensing material for G. S. A. abstract the column with means (including Foxen) was omitted. I know of no actual publication of name *Foxen* except in my paper, and more recently in R. D. Reed's book "Geol. of Calif."

R. D. Reed, 1933 (Geol. of Calif., p. 233), divided Plio. of Santa Maria dist. into (descending): *Dendraster* cgl., 0–200 ft.; *Upper Foxen sand* (well-sorted fine yellow sand), 0–1,000 ft.; *Middle Foxen* (foraminiferal and diatomaceous claystone), 800± ft.; and *Lower Foxen* (sand near margins, diatomaceous sh. and claystone in middle of basin), 1,800± ft.

H. W. Hoots and S. C. Herold, 1935 (Geol. of nat. gas, A. A. P. G., p. 156). Etchegoin of Santa Maria dist. underlies (with local uncon.) Schumann fm., overlies (with local uncon.) Santa Margarita fm., and is divided into (descending): Upper Foxen sand, 1,000 ft.; local uncon.; Foxen foraminite, 700 ft.; Foxen diatomite and Lower Foxen sand (contemporaneous), 1,800 ft.

Fox Ford bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 378). *Fox Ford bed.*—Ss., about 500 ft. thick. Memb. of Strawn div. Overlies bed No. 8 (250 to 300 ft. of clay interstratified with ss. at base) and underlies Horse Creek clays and shales.

Named for Fox ford on Colorado River in central Tex. mineral region.

Fox Hills sandstone. (In Montana group.)

Upper Cretaceous: South Dakota, North Dakota, eastern Montana, Wyoming, and eastern Colorado.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 419, 427). *Fox Hills beds (Formation No. 5 of Cret.).*—Gray, ferruginous and yellowish ss. and aren. clays. Occurs at Fox Hills, near Moreau River, along base of Bighorn Mtns, and on North and South Platte Rivers. Thickness 500 ft. Top fm. of Upper Cret. in Nebr. [which at that time included Wyo., Mont., and Dak.]. Underlies the Tert. Fort Union or Great Lignite group and overlies Fort Pierre group [Pierre sh. of present nomenclature]. [The Fox Hills ss. is not present in Nebr. as now delimited.]

In 1876 the name *Laramie* was introduced for deposits formerly called "Lignitic group," and the Laramie was defined as resting on the Fox Hills.

C. A. White, 1878 (U. S. Geol. and Geog. Surv. Terr. 10th Ann. Rept., pp. 21, 22, 30), transferred "Fort Pierre group" (Pierre sh.) from Colorado group, in which it had for many years been included, to overlying Fox Hills "group." (See 1878 entry under *Colorado group.*) The term "group" as used in early repts was applied in a formational sense, e. g., Fort Pierre "group," Fox Hills "group," Fort Union "group," etc.

C. A. White, 1879 (U. S. Geol. and Geog. Surv. Terr., 11th Ann. Rept., pp. 186–187). *Fox Hills group,* a consolidation of Fort Pierre group (Cret. No. 4) and Fox Hills group (Cret. No. 5) for Colo. and adjacent territories, but not for Upper Missouri River region, where it will continue to be used in restricted sense applied to it by its authors. In Colo. and adjacent territories neither the lithological nor paleontological characteristics of the equivalents of Fort Pierre and Fox Hills groups, respectively, are such as to afford any satisfactory ground for a separation, such as has been made in Upper Missouri River region, and even in that region a blending of the fossils of each has frequently been found.

In 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, p. 93, footnote) G. H. Eldridge, "with the approval of Dr. C. A. White," introduced *Montana group* to replace Fox Hills in broad sense of White—i. e., to include Fox Hills ss. and Pierre sh. of present nomenclature, which were mapped by Hayden Survey as *Fox Hills group* and *Fort Pierre group.* The original restricted definition of Fox Hills is the one that has been in use for many years.

Rocky Mtn Assoc. Pet. Geol., by its committee, composed of T. S. Lovering, H. A. Aurand, C. S. Lavington, and J. H. Wilson, 1932 (A. A. P. G. Bull., vol. 16, No. 7, pp. 702–703). After field conference [in eastern Colo.] with J. B. Reeside, Jr., of U. S. G. S., *the Rocky Mtn Ass. Pet. Geol. has agreed to restrict term Fox Hills as follows:* The base of Fox Hills fm. shall be considered as horizon below which the section is predominantly gray marine clay shales and sandy shales of Pierre age, and above which the section changes rapidly to a buff to brown ss. containing numerous large gray to brown hard sandy concretions. This lower concretionary memb. is commonly overlain by a series of light-gray to brown sss. and sandy shales. The top of Fox Hills fm. shall be considered as horizon above which the section is composed predominantly of fresh- and brackish-water deposits accompanied by coals and lignitic shales, and below which it is predominantly marine.

Named for exposures in Fox Ridge, NW. Armstrong and SW. Dewey Co., S. Dak. (shown on pl. 1 of U. S. G. S. Bull. 575).

†Fox Hills group (broad sense).

Upper Cretaceous: Rocky Mountain States.

See 1878, 1879, and 1888 entries under *Fox Hills ss.*

Foxian series.

A term applied by C. R. Keyes to Fox Hills ss. and its supposed equivalents.

Foy's limestone. (Allegheny formation.)

Pennsylvanian: Western Pennsylvania (Lawrence County).

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, pp. xxii, 320). *Foy's ls.*, 2 ft., Foy's Knob, Wayne Twp, Lawrence Co. May be Freeport Upper ls. "The name *Foy's ls.*, given to the bed in the Third Index [at back of volume], is merely a convenience for avoiding the difficulty in making the Index, and is not intended to advocate the insertion of a third coal bed in the Freeport group." Lies 35 ft. under Brush Creek coal.

Fraction breccia.

Miocene (upper): Central Nevada (Tonopah and neighboring districts).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 39+, map, etc.). *Fraction dacite breccia.*—Soft brownish or greenish rock of volcanic origin, sometimes solid, occasionally dimly horizontally layered or packed, at times definitely stratified, and even contains well-bedded tuffs. Is dacitic, essentially like Heller and Brougher dacites. In places is nonfragmental and a flow. Thickness varies, but in New York Tonopah shaft it is 745 ft. thick. Overlies Heller dacite and underlies Tonopah rhyolite dacite. [The fm. is mapped at and around Fraction No. 1 and Fraction No. 2 mines, which appear to be the geographic feature for which the fm. was named.]

A. Knopf, 1921 (U. S. G. S. Bull. 715, pp. 150–154). *Fraction rhyolite breccia of Siebert fm.*—Rhyolite breccia predominates in the Fraction throughout Divide dist., and the rock is therefore renamed *Fraction rhyolite breccia.* Thickness 600+ ft. The intercalated beds of soft fine-grained white tuff range in thickness from a few inches to 200 ft. Some thin beds of gritty tuff occur with the fine-grained tuffs. The intercalated white tuffs correspond in composition to Spurr's Siebert tuff of Tonopah dist.

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, p. 21). For the fm. which was first described by Spurr as *Fraction dacite breccia,* and whose southern continuation in Divide dist. was renamed by Knopf the *Fraction rhyolite breccia,* the writer proposes the simplified name *Fraction breccia,* because at Tonopah the basal portion of the fm. contains locally very large amounts of andesitic-appearing debris, with result that there has at times been considerable confusion as to proper correlation of the beds, which have, for example, been considered to represent the "Midway andesite." All examples of "Midway andesite" cappings of veins that were seen by writer proved to be basal part of Fraction breccia. The Fraction breccia is considered by H. G. Ferguson (U. S. G. S. Bull. 723, pp. 42–43, 1924) to be basal memb. of Esmeralda ("Siebert") fm. and is therefore of upper Mio. age.

Fraction dacite breccia.

Fraction rhyolite breccia.

See *Fraction breccia.*

Frame shale member. (In Hamilton group.)

Middle Devonian: Central Pennsylvania (Bedford County).

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, June 1935, p. 361). [See this citation under *Mahantango fm.* Not defined.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, Aug. 31, pp. 1279, 1283). Near Chaneysville, Bedford Co., Pa., Mahantango fm. is divided into 3 intergrading members (descending): *Frame sh. memb.,* 343 ft.; Chaneysville ss. memb., 182 ft.; and Gander Run sh. memb., 850 ft. The Frame memb. is gray to olive sandy sh. with local sss. and an occasional thin ls. lens. Fossils. Named for Frame School, about 6 mi. N. of Chaneysville. Tentatively recognized in Blair Co.

Francis formation.

Pennsylvanian: Central southern and central Oklahoma (Pontotoc, Seminole, and Okfuskee Counties).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 113–119, pls. 3, 27, and map). [Name was also used by Morgan, but not defined, in Okla. Geol. Survey Circ. 12, pl. and p. 15, 1923.] *Francis fm.*—Consists of (ascending): (1) DeNay ls. memb.; (2) dark-blue and black shales 30± ft.; (3) nearly 20 ft. of sss.; (4) 250± ft. of dark and sometimes calc. shales; (5) 100± ft. of coarse brown sss. and chert cgls.; and (6) 100± ft. of sh. with few thin sss. and one rather persistent conglomeratic ls., often very fossiliferous. Underlies Belle City ls. and overlies Seminole fm. Large fauna.

Named for town of Francis, Pontotoc Co., which is situated on E. edge of outcrop.

Franciscan formation (group, where subdivided).

Jurassic (?): Western California.

A. C. Lawson, 1895 (Am. Geol., vol. 15, p. 347, and U. S. G. S. 15th Ann. Rept., p. 415). *Franciscan series.*—Several thousand ft. of sed. and volcanic rocks with which are associated various basic intrusives, notably peridotite serpentines. Is of either Cret. or Jurassic age. Includes foraminiferal lss., great fms. of peculiarly bedded radiolarian cherts, and certain highly crystalline schists. The San Francisco ss. is dominant sed. fm. of series. In vicinity of San Pedro Point a basal fm. of cgls., coarse grits, sss., shaly sss., shales, and argill. lss. is exposed.

The Franciscan rocks, which attain thickness of several thousand ft., are usually treated as a fm., but in San Francisco folio (No. 193) of U. S. Geol. Survey they were divided into five named and mapped fms. (descending)—Bonita ss., Ingleside chert, Marin ss., Sausalito chert, and Cahil ss., the latter including Calera ls. memb. The broader term *San Francisco ss.* is no longer used. The intrusive serpentine is not a part of the fm. The Franciscan rests uncon. on granite, and is uncon. overlain by Knoxville fm.

Named for extensive exposures at San Francisco.

Francis Creek shale and limestone. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Mercer and Fulton Counties).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 309). *Francis Creek sh. and ls.*, 0 to 65 ft. thick in Fulton Co. Rests on Colchester (No. 2) coal and uncon. underlies Vergennes ss. in Fulton Co.

H. R. Wanless, 1929 (Ill. Geol. Surv. Bull. 57, pp. 49, 89). *Francis Creek sh.* [*restricted*].—In Alexis quad. [chiefly in Mercer Co.] consists of 0 to 9 ft. of soft gray sh. resting on Colchester (No. 2) coal, and lying 21± ft. below Pleasantview ss., all included in Carbondale fm. The name *Francis Creek* has been applied (Savage, 1927) to all strata of suite IV above Colchester (No. 2) coal, because they are well exposed along Francis Creek, Fulton Co., but the cited type exposure does not well exhibit the upper members of the suite, and so it is proposed that name be applied only to the soft gray sh. btw. the coal and the black laminated concretionary sh. (1 ft. thick) in lower part of Carbondale fm.

Francoisian series.

A term introduced by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 22, p. 253, 1915) to include Skrainka diabase, Iron Mtn porphyry, and Knob Lick granite of SE. Mo., which are now commonly considered to be pre-Camb. Derivation of name not stated.

Franconia breccia.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region).

N. H. Geol. Surv. 4th Ann. Rept., 1872, as interpreted by J. D. Whitney and M. E. Wadsworth in Harvard Coll. Mus. Comp. Zool. Bull., vol. 7 (geol. ser. I), opp. p. 396. *Franconia breccia* included in Laurentian. Younger than White Mtn gneiss and Bethlehem gneiss.

C. H. Hitchcock, 1873 (Boston Soc. Nat. Hist. Proc., vol. 15, pp. 304–309). *Franconia breccia* (Laurentian?) is younger than White Mtn and Bethlehem gneisses, of which it contains fragments.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545). *Franconia breccia group* covers a few sq. mi. in Franconia. Younger than White Mtn series.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 137–141, by J. H. Huntington, and btw. pp. 251 and 270). *Franconia breccia* occurs in Franconia and Lincoln. Younger than Montalban gneisses and schists. [On a later page, btw. 658 and 675, he seems to include it in his Montalban.]

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4). *Franconia breccia* is composed of angular fragments of Kinsman granodiorite in a matrix of fine-grained granite very similar to Bickford granite. Well exposed in Franconia Notch and on Eagle Cliffs. Carbf. (?).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., p. 20). *Franconia breccia* is result of shattering of Kinsman quartz monzonite by some unknown process, and the filling of the fractures with a granite very similar to Bickford granite. [The map states, beneath block labeled *Intrusive breccia: "The 'Franconia breccia' of Hitchcock.* Consists of angular fragments of Kinsman quartz monzonite and older schists in a matrix of fine-grained gray granite." The rock is assigned to New Hampshire magma series, late Dev. or late Carbf.

†Franconia gravel.

Pleistocene: Eastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., pp. 326–330, 339). *Franconia gravel* is applied to disturbed sands, gravels, and cobbles that occupy a wide belt on landward margin of Potomac fm. throughout greater part of its length. If of Potomac age they were deposited toward close of Aquia Creek period. Most complete exposure at gravel pits of Alexandria & Fredericksburg R. R. at Franconia Station, 6 mi. SW. of Alexandria. *May possibly belong to the Lafayette.* Overlain by Columbia (Pleist.) fm.

In U. S. G. S. Washington folio, No. 70, 1901, the deposits at the gravel pits at Franconia Station are mapped as Columbia fm.

Franconia sandstone.

Upper Cambrian: Southeastern Minnesota, southwestern Wisconsin, and eastern Iowa.

C. P. Berkey, 1897 (Am. Geol., vol. 20, btw. pp. 345–383). *Franconia ss.*—Compact and thick-bedded layers overlain by fine incoherent sand; contains thin seams of green sh. Thickness 100 ft. Underlies St. Lawrence dolomites and shales and overlies *Dresbach shales* at St. Croix Dalles. Named for exposures in vicinity of Franconia, Chisago Co., Minn.

C. W. Hall, 1901 (Int. Min. Cong., 4th sess., pp. 165–171). *Franconia* (sss. and shales) underlies St. Lawrence and overlies *Dresbach ss.* in SE. Minn.

C. P. Berkey, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 229–250). *Franconia ss.*, 75 to 100 ft. thick, underlies St. Lawrence dolomites and shales and overlies *Dresbach shales* in St. Croix Dalles region.

F. F. Grout and E. K. Soper, 1914 (Minn. Geol. Surv. Bull. 11). *Franconia ss.*, 100 ft. thick, underlies St. Lawrence fm. and overlies *Dresbach ss.*

F. W. Sardeson, 1916 (U. S. G. S. Minneapolis-St. Paul folio, No. 201). *Franconia ss.*—Coarse white water-bearing ss. above, and beds of greensand and calc. sh. below. Thickness 85 to 100 ft. Underlies St. Lawrence fm. and overlies *Dresbach ss.*

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 549). *Franconia ss.* of Wis. underlies Mazomanie fm., overlies Dresbach fm., and includes, at base, Ironton memb. The fm. is fine-grained, gray to green, and for most part somewhat calc., but varies considerably in different parts of State. Greater part is highly glauconitic, especially near bottom and top. Above Ironton memb. is about 15 ft. of micaceous sandy sh.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). *Franconia* underlies Mazomanie ss. in Wis. and overlies Dresbach ss.

Mazomanie ss. of Ulrich is now considered by many geologists to be a part of Franconia ss. (See under *Mazomanie ss.*) The fm. overlying Franconia ss. is called *St. Lawrence fm.* by U. S. Geol. Survey and *Trempealeau fm.* by Ulrich and some others. The basal memb. of the Franconia is Ironton ss. memb.

See Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 199, 467 for details of beds at Franconia type loc. In this rept several names are introduced for the members of the Franconia above the basal Ironton ss. memb.

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, p. 709). At Dresbach, Minn., the *Franconia ss.* consists of 102 ft. of massive yellowish to white medium- to fine-grained ss., with occasional shaly partings. It underlies St. Lawrence fm. and overlies Dresbach fm. (ss. with some shaly beds).

E. Peterson, 1929. (See 1929 entry under *Dresbach ss.*)

In some early repts Franconia ss. appears to have been included in St. Lawrence fm.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 45–50). *Franconia beds* are of formational rank. The fm. should include the greensands, sss., shales and lss., many of which are glauconitic, that lie btw. the nonglauconitic Dresbach sss. below and the St. Lawrence sh. or dol. above. It includes Ironton memb. at base. We can not agree with Ulrich that Mazomanie ss. is younger than Franconia. The Mazomanie fauna, according to Raasch (personal communication), has been found in upper part of the Franconia of western Wis. and the Franconia fauna has been found below the Mazomanie fauna in the Mazomanie areas of eastern Wis.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 13). [See digest under *Mazomanie ss.*]

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1687–1744). *Franconia fm.* divided into (descending): Bad Axe memb. (*Dikelocephalus postrectus* zone); Hudson memb. (*Ptychaspis-Pensaukia* zone); Goodenough memb. (*Conaspis* zone); and Ironton memb. (*Camaraspis* zone). The fm. was named for Franconia, Minn., where cliffs along Lawrence Creek expose 100± ft. of strata assigned thereto. Upper members of fm. are not exposed at type loc. Most conspicuous characteristic of fm. is presence of glauconite, which is present throughout. Overlies Galesville memb. of Dresbach fm. and underlies Basal greensand and cgl. memb. of Trempealeau fm.

Franconia moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

R. T. Chamberlin, 1905 (Jour. Geol., vol. 13, pp. 247–250). Runs almost N. and S. westward from St. Croix River. Occurs on uplands back of Franconia, Chisago Co.

Franey granite.

Age (?): Cape Breton Island.

W. J. Wright, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 276).

Frankenfield.

Cretaceous: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

Frankford gneiss.

Pre-Cambrian: Southeastern Pennsylvania (Philadelphia County).

T. D. Rand, 1900 (Phila. Acad. Nat. Sci. Proc. 1900, pt. 1, p. 279). *Frankford gneiss.*—Highly feldspathic gneiss containing little mica and hornblende, very hard. Valuable building stone. Exposed at Frankford, Philadelphia Co. Is a part of Philadelphia mica schists and gneiss group.

Is a part of Wissahickon fm.

Frankfort shale.

Upper Ordovician: Central and east-central New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 372–373). *Frankfort sl.*—Underlies Pulaski shales and grades imperceptibly into underlying black sl. or sh. [Utica] that rests on Trenton ls. Is lighter colored than underlying rocks. In many places upper part alternates with layers of fine-grained ss. Seen to greatest advantage on Frankfort [Moyer] Creek, back of the village, from whence it takes its name.

In 1911 (N. Y. State Mus. Bull. 149, p. 12) J. M. Clarke introduced *Indian Ladder beds* for upper several hundred ft. of *Frankfort sh.* as formerly identified in Mohawk Valley, which he stated carry a different fauna from lower beds of the Frankfort as then known. In 1912 (N. Y. State Mus. Bull. 162) R. Ruedemann restricted *Frankfort sh.* to fm. as exposed in Utica region, which is absent in Mohawk Valley, where sh. formerly called Frankfort has been found to be much older, and here named by him *Schenectady fm.* As thus restricted, basal limit of true Frankfort is defined as top of true Utica sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 42). In final rept by Vanuxem the Frankfort sh. is described as lower memb. of Hudson River group. Typical exposure is along Moyer Creek, SW. from Frankfort, Herkimer Co., where it is overlain by Oneida cgl., the Pulaski being absent. From Mohawk Valley it extends N. and W. into Lewis and Jefferson Counties, where it forms basal part of Lorraine of Emmons. Indian Ladder beds is a local fm.=in age to Frankfort sh.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258), restricted Frankfort sh. to Utica Basin and to 500+ ft. of rocks older than Indian Ladder beds. He showed Frankfort as thus restricted is=his Atwater Creek and Deer Creek shales and some younger beds of the unit in Black River region to which he applied the name "Whetstone Gulf fm." His subdivisions of Lorraine group are Upper Lorraine or Pulaski fm. and Lower Lorraine or Whetstone Gulf fm. [new name], the latter=Indian Ladder beds and Frankfort sh. "The Frankfort is a local shore facies of the lower Whetstone Gulf horizons."

†Franklin type.

Pre-Cambrian: Northern New Jersey.

F. L. Nason, 1889 (N. J. Geol. Surv. Ann. Rept. 1889, p. 31). *Franklin type.*—Occurs at Franklin Furnace in ledges btw. hotel and Mine Hill. Not correlated with fms. of Smock and Britton. Is probably mentioned as a biotite gneiss. At Franklin Furnace is intimately associated with Montville type.

Is a facies of Pickering gneiss, formerly considered to be of Archean age, but now classified simply as *pre-Camb.*, "Archean system" having been abandoned.

Franklin limestone.

Pre-Cambrian: Western New Jersey, eastern Pennsylvania, and Delaware.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 431–456). *Franklin white ls.*—Coarsely crystalline rock, frequently containing graphite in disseminated scales. Is typically white, but often has a bluish tinge. Is pre-Camb., and older than Hardistonville [Hardyston] qtzite. [Named for occurrence at Franklin Furnace, N. J.]

A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). *Franklin ls.*—White, highly crystalline ls. or marble, varying greatly from place to place in texture and composition, and to less degree in color. As a rule coarsely granular, but some of rock is finely granular or even nearly amorphous. Color usually milky white, but locally it has a pink or yellow tinge and elsewhere it is grayish. Some of it is rather siliceous, and in a few places thin beds of ss. have been noted. Uncon. underlies Hardyston qtzite and Kittatinny ls. Although Pochuck gneiss and Franklin ls. are regarded as older than Byram and Losee gneisses, which appear to cut them, the original relations btw. them are not determinable. In Franklin Furnace area the Pochuck gneiss passes beneath Franklin ls.

The name *Franklin ls.* is now restricted to the white ls. to which it was originally applied. The associated siliceous rocks (formerly in large part included in Pochuck gneiss) are now regarded as older than Franklin ls. and are by definition included in Pickering gneiss, although in places some siliceous rocks are so intimately associated with the ls. that they are not readily separable from it and for convenience are mapped with the ls. The Franklin ls. was formerly classified by U. S. Geol. Survey as Archean, but, that term having been discarded, the fm. is now classified as pre-Camb.

Franklin limestone. (In Washington formation.)

Permian: Southwestern Pennsylvania (Greene County).

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 97, 102). *Franklin ls.*—Coarsely brecciated and very hard. Rarely more than 6 ft. thick and often much less. Lies 20 to 35 ft. below Upper Washington ls. and 25 to 40 ft. higher than Jollytown coal. Its characteristic fragments were found in Franklin and Amwell Twps very close to its proper position.

Franklin sandstone.

Eocene: Western Washington (Puget Sound region).

See under *Franklin series.*

Franklin series. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

G. W. Evans, 1912 (Wash. Geol. Surv. Bull. 3, pp. 42–49). *Franklin series.*—Middle div. of Puget fm. in King Co. Chiefly sss. and shales, with 27 coal and bony beds. Basal 210 ft. (massive close-grained ss.) is called *Franklin ss.* It forms div. line btw. Franklin series and underlying Bayne series. Thickness of Franklin series 3,620 ft. Underlies Kummer series. [Apparently named for town in King Co.]

Franklin group.

Carboniferous: British Columbia.

C. W. Drysdale, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 135), and 1915 (Canada Geol. Surv. Mem. 56, p. 48).

Franklin granodiorite.

Jurassic: British Columbia.

C. W. Drysdale, 1915 (Canada Geol. Surv. Mem. 56, p. 61).

Franklin monzonite.

Oligocene: British Columbia.

C. W. Drysdale, 1915 (Canada Geol. Surv. Mem. 56, p. 77).

Franklindale limestone lentil (of Chemung formation).

Upper Devonian: Central northern Pennsylvania (Bradford County).

H. S. Williams and E. M. Kindle, 1905 (U. S. G. S. Bull. 244). *Franklindale ls. memb. of Chemung fm.*—A belt of ls. bands associated with purple shales and sss. in upper part of section, comprising zones 58 to 75. Is a constant feature over most of W. half of Bradford Co. Replaces Burlington ls. of Sherwood (2d Pa. Geol. Surv. Rept. G, p. 37), which is preoccupied. Exposed in Gulf Brook section, W. of Franklindale, Bradford Co.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571–592). Franklindale ls. of Williams and Kindle is older than "Burlington ls." of Sherwood, and is lithologically different. Writer therefore replaces "Burlington ls." of Sherwood with *Luthers Mills coquinite.* [See also under *Luthers Mills coquinite.*]

Franklin Furnace band.

Name applied by A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161), to a part of Pochuck gneiss, which is well exposed in zinc mines at Franklin Furnace and at other places in the vicinity.

Franklin Mountain formation.

Silurian: Mackenzie.

M. Y. Williams, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 78).

†Franks conglomerate.

Pennsylvanian: Central southern Oklahoma.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Franks cgl.*—Coarse ls. and chert cgls., gritty ss., ls., and sh., 200 to 500 ft. thick. Probably represents upper portion of Glenn fm. Lies uncon. on all older Paleozoic rocks. Is youngest Carbf. fm. present in quad. A broad belt of this cgl. extends across NW. part of Arbuckle region from W. end of Arbuckle Mtns to vicinity of Franks. From NW. corner of Tishomingo quad. northeastward it crosses eroded edges of Ord., Upper Sil., and Dev. fms. From a nearly flat position on Hunton ls. near Franks it extends SE. uncon. across Woodford chert and Caney sh. Occupies approx. strat. position of Wapanucka ls.

B. F. Wallis, 1915 (Okla. Geol. Surv. Bull. 23, pp. 23–31). *Franks cgl.*—A coarse ls. cgl., 0 to 500 ft. thick. Covers broad area to N. of Arbuckle Mtns. To SE. of Franks it thins rapidly and changes from heavy cgl. to thin ls., ss., and sh. Two mi. S. of Jesse it can not be distinguished from underlying Caney sh., on which it rests uncon., or from overlying Atoka fm. A short distance E. of Jesse the Wapanucka ls. occupies approx. same position as Franks cgl.

K. F. Mather, 1917 (Am. Jour. Sci., 4th, vol. 43, pp. 134–139). *Franks cgl.* is probably near-shore equiv. of Wapanucka, Atoka, and possibly even higher strata. It overlaps Caney sh. and rests on early Paleozoic strata to SW.

R. C. Moore, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 48). *Franks cgl.* contains an upper Penn. fauna in interbedded lss. It has been traced northward and found= Seminole cgl.

G. E. Burton, 1921 (A. A. P. G. Bull., vol. 5, p. 176). During summer of 1919 E. H. Bauman traced *Franks cgl.* at Sulphur northward into Seminole cgl. at Ada.

G. D. Morgan, 1923 (Okla. Geol. Surv. Circ. 12). *Franks cgl.* is=Boggy, Savanna, and McAlester fms. Suggest name be abandoned. But in view of long use of term it will probably be more satisfactory to retain it, with restrictions that have not heretofore been applied to it. It is writer's opinion the Franks should be restricted to (1) the Penn. strata occurring near town of Franks and (2) to those exposures of ls. cgls. and their immediately associated strata which occur in Arbuckle area and which, in common with the strata at Franks, have the 3 characteristics of being (a) fossiliferous, (b) highly folded or faulted, or both highly folded and faulted, and (c) nonarkosic. The Franks represents shoreward phase of McAlester, Savanna, Boggy, and possibly younger fms. In no way is it=Wapanucka ls.

S. Weidman, 1923 (Jour. Geol., vol. 31, No. 6, pp. 466+). Prefer *Franks series* (instead of *Franks cgl.*), since at least as many as 5 distinct cgl. beds can be distinguished at Franks and at other places on N. side of Arbuckle Mtns. The beds of cgl. are each 100 to 350 ft. thick, interstratified with ls., sh., and ss. There are places where thicknesses may reach 1,000 ft. or more. Such great thicknesses of cgl., it is believed, are rarely if ever formed upon shores of ancient or present seas under ordinary conditions. [Discusses probability they are of glacial origin.] The lowest cgl. bed is 150± ft. thick, and overlies eroded edges of pre-Penn. rocks at Franks and vicinity.

G. D. Morgan, 1924 (Okla. Bur. Geol. Bull. 2, pp. 119–123). *Franks cgl.*—In vicinity of town of Franks (type loc.) conglomeratic strata are exposed through a section of approx. 1,500 ft. Many beds are fossiliferous and all are nonarkosic and highly folded and locally faulted. They were followed eastward and traced into McAlester, Savanna, and Boggy fms. The Wapanucka ls. was found to emerge from beneath the cgls. at a point 2± mi. SE. of town of Franks. The lower part of typical Franks cgl. is=parts of McAlester, Savanna, and Boggy fms., and upper part correlates with parts of Wewoka, Holdenville, Seminole, and Francis fms. It is advisable to abandon Franks cgl. and refer to the conglomeratic strata of Franks area by the names of the several fms. which the section there is known to include. If Franks is retained it should be restricted to the strata in type area, around Franks, and to those Penn. ls. cgls. of Arbuckle region that are (a) fossiliferous, (b) highly folded or faulted, and (c) nonarkosic. The cgls. near Sulphur, which have in some previous repts been mistaken for Franks cgl., are traceable into outcrops of the arkosic Vanoss fm., a much younger fm.

C. N. Gould, 1927 (Obsolete Okla. names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, p. 235). *Franks cgl.* has been shown by Morgan to consist not of a single geologic horizon, but to represent the shoreward phase of McAlester, Savanna, Boggy, and possibly younger fms. However, the term "Franks" will probably continue to be used, to apply in a general way to the various cgls. of Arbuckle Mtn region.

Named for exposures in vicinity of Franks, Pontotoc Co.

Fraser River formation.

Cretaceous: British Columbia.

L. Reinecke, 1920 (Canada Geol. Surv. Mem. 118, p. 13).

Freda sandstone. (In Oronto group.)

Pre-Cambrian (upper Keweenawan): Northern Michigan and northern Wisconsin.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 692). *Freda ss.*—Red ss. with some felsitic and basic debris and salt water. Thickness 900+(?) ft. Composes lower part of Lake Superior ss. of earlier repts, or the part of that ss. W. of the Copper Range. Overlies Outer cgl. [Is shown in section as underlying Jacobsville ss. See quotation under Jacobsville ss. In his 1911 rept.

(Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 41) Lane expressed opinion that Freda and Jacobsville sss. are same fm.]

See under *Oronto group.*

Named for exposures at new stamp mills at Freda, Houghton Co., and along adjacent shore.

Frederick limestone.

Upper Cambrian: Central northern Maryland.

C. R. Keyes, 1890 (Johns Hopkins Univ. Circ. 84, vol. 10, p. 32). *Frederick ls.*—Has geographic extent of nearly 100 sq. mi. Greatest length perhaps 30 mi.; max. breadth, near Frederick City, 6 mi. Along W. border Frederick Valley lss. are covered by Mesozoic red sss. ("Newark fm." of Russell). To E. the lss. pass gradually into shales and slates, the whole forming apparently a conformable series. The lss. are in great part bluish, compact, and heavily bedded, but on approaching the shales they become more and more thinly bedded and very dark blue or nearly black, owing to bituminous matter present. In places the rock is highly siliceous. From the thin-bedded belt the ls. passes into a more earthy facies and grades into dark-colored calc. shales and these into slates or sandy shales. The shales and lss. form a continuous series and probably represent a fm.=Chazy, Trenton, and Hudson River groups of N. Y. section, according to Chazy-Trenton fossils recently obtained in Frederick Valley lss.

G. H. Williams, 1891 (Geol. Soc. Am. Bull., vol. 2, pl. 12, pp. 303, 311, 317). *Frederick ls.* [mapped]. Overlain by Triassic ss. and trap. We now know *Frederick Valley ls.* to be of same age (Trenton-Chazy) as the valley ls. of Va., from Chazy-Trenton fossils obtained from it by C. R. Keyes. It is oldest fm. of Piedmont plateau of Md. To E. the Frederick ls. is succeeded and apparently overlain by carbonaceous and hardly altered shales, which may represent Hudson River horizon.

R. S. Bassler, 1919 (Md. Geol. Surv. Camb. and Ord. vol., pp. 115–117 and map). *Frederick ls.* is new name proposed for the strata in Frederick Valley uncon. overlying Beekmantown ls. and containing a fauna probably of Chazyan age. The rocks are shown to advantage in numerous quarries and natural outcrops around Frederick. Fossils rare, but suggest a Chazyan or early Mohawkian age, with possibility more in favor of the former. The Frederick ls. consists of thin-bedded dark-blue argill. strata separating into layers usually less than 2 in. thick. Thickness seems to be not less than 200 ft. On W. side of valley it is covered by Newark series; on E. side it is faulted against pre-Camb. shales and slates.

A. I. Jonas, 1927 (Geol. Soc. Am. Bull. vol. 38, p. 119), stated Frederick ls. is of upper Chazyan age.

G. W. Stose and A. I. Jonas, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, p. 565). On E. and W. sides of Frederick Valley the *Frederick ls.* lies uncon. on Antietam qtzite. East of Le Gore quarry [Frederick Co.] it lies on Le Gore ls. [Upper Camb.].

G. W. Stose and A. I. Jonas obtained additional fossil collections which were pronounced Upper Camb. by several paleontologists, and age was changed to Upper Camb. Jan. 1936. They found †Le Gore ls. to be same as Grove ls. (Lower Ord., lower Beekmantown).

Fredericksburg group.

Lower Cretaceous (Comanche series): Texas and southern Oklahoma.

R. T. Hill, 1887 (Am. Jour. Sci., 3d, vol. 33, pp. 296–299). *Lower or Fredericksburg div. (Comanche Peak) of Comanche series or Lower Cret.*—Lss., with some flints and chalk. Overlies Dinosaur sand [Trinity group] and underlies Washita div. Includes: *Ammonites acutocarinatus* horizon; *Hippurites* ls. (="Caprina ls."); Comanche Peak fauna (="Fredericksburg" of Roemer); *Gryphaea pitcheri* (="Comanche Peak group"); and *Requienia texana* (="Caprotina ls.").

R. T. Hill, Oct. 1887 (Am. Jour. Sci., 3d, vol. 34, p. 303), placed provisional bdy line btw. Washita and Fredericksburg groups at top of "Caprina" [Edwards] ls.

R. T. Hill, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 105–136), divided Fredericksburg into (descending) Caprina chalky lss., Comanche Peak chalk beds, and Basal or Alternating beds, the latter including 1st *Caprotina* horizon.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 503–528). *Fredericksburg or Comanche Peak div.* includes Caprina ls. [Edwards ls.]; Comanche Peak chalk;

Gryphaea rock and Walnut clays or *Exogyra texana* beds; and, tentatively, Paluxy sands. Overlies Trinity div. (which includes Glen Rose or Alternating beds, above, and Trinity or Basal sands) and underlies Kiamitia clays.

J. A. Taff, 1892 (Tex. Geol. Surv., 3d Ann. Rept., pp. 269–279, 327, etc.) included Kiamichi clay in Fredericksburg, at top, and Walnut clay at base, and excluded Paluxy sand. Taff in 1893 (Tex. Geol. Surv., 4th Ann Rept.) included Kiamichi in Fredericksburg and excluded Paluxy.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13, pp. 317–319), divided *Fredericksburg group* into Caprina ls., Comanche Peak chalk, and Walnut clays, and included Kiamichi clay in Washita group and Paluxy sand in Trinity group. Hill also followed this classification in 1901 (U. S. G. S. 21st Ann. Rept., pt. 7), as did Udden, Baker, and Böse in 1916 (Univ. Tex. Bull. 44, pp. 59–77); Adkins, 1920 (Univ. Tex. Bull. 1856, p. 10); and Dumble, 1920 (Univ. Tex. Bull. 1869).

W. M. Winton, 1925 (Univ. Tex. Bull. 2544), included Kiamichi in Fredericksburg and treated it as "final phase of the Goodland." G. Scott, 1926 (Am. Jour. Sci., 5th, vol. 12, pp. 157–161) excluded Kiamichi from Washita group.

H. P. Bybee and F. M. Bullard, 1927 (Univ. Tex. Bull. 2710, p. 21), excluded Kiamichi from Fredericksburg, as did Bullard, 1928 (Okla. Geol. Surv. Bull. 47, pp. 13–15).

C. I. Alexander, 1929 (Univ. Tex. Bull. 2907) included Kiamichi in Fredericksburg but excluded it from Goodland.

J. S. Redfield, 1929 (Univ. Okla. Bull., vol. 9, pp. 76–77), included Kiamichi in Washita group, as did Bullard and Redfield, 1930 (Okla. Geol. Surv. Bull. 40–OO).

R. H. Cuyler, 1929 (A. A. P. G. Bull., vol. 13, pp. 1292–1299). Kiamichi fm., heretofore considered to belong to Washita group, is now considered, because of its characteristic Fredericksburg fauna, as a transitional fm. btw. the two groups.

J. M. Armstrong and G. Scott, 1930 (geol. map of Wise Co., Tex. dated March 1930), included Kiamichi in Washita group; but on June 1930 geol. map of Parker Co., Tex., they included Kiamichi in Fredericksburg group.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232), included Kiamichi in Fredericksburg group. *He stated (p. 323): There is some evidence of an uncon. at top of* Kiamichi over parts of Okla. and Kans. Also (p. 339): From Fort Worth to S. of Waco the Edwards is overlain, apparently uncon., by Kiamichi clay. South of Waco the Kiamichi is absent. Also (p. 344): The Kiamichi is very close in age to upper Edwards, differing largely in presence of *Gryphaea navia* and a few other zone fossils. [On pp. 325–326 he discussed fossils.]

S. A. Thompson, 1935 (A. A. P. G. Bull. vol. 19, No. 10, p. 1536), included Kiamichi in Fredericksburg group; proposed the new name *Gatesville fm.* to include Edwards and Comanche Peak lss. and Walnut clay, which he proposed be reduced to rank of members; and recommended abandonment of Goodland ls. He stated the Edwards, Comanche Peak, and Walnut are in part contemp. with one another, and that they contain essentially same fauna. Also that there is uncon. at top of Kiamichi. [This is a disputed point.]

W. C. Mendenhall, 1935 (p. 1537 of book last cited above), questioned advisability of new name *Gatesville fm.* and of abandoning Goodland ls., and stated that assignment of Kiamichi to Fredericksburg group is still considered a debatable question by some geologists.

The U. S. Geol. Survey at present divides Fredericksburg group into Edwards ls., Comanche Peak ls., and Walnut clay.

Named for Fredericksburg, Gillespie Co., Tex.

Fredericksburg gneiss.

Pre-Cambrian: Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). ***Fredericksburg gneiss.***—Largely a granite gneiss, foliated, banded, coarse grained; in general the light bands are wider than the dark. Embraced in area extending as far as 8 mi. SW. and 8 mi. NW. of Fredericksburg. Best exposed in quarries NW. of Fredericksburg.

A. I. Jonas, 1928 (Va. Geol. Surv prel. ed. of geol. map of Va.), mapped the gneiss around Fredericksburg as ***Baltimore (?) gneiss.***

Fredericksburg granite.

Pre-Cambrian: Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). ***Fredericksburg granite (quartz monzonite).***—Has been quarried to considerable extent near Fredericksburg. Best exposed along Rappahannock River in both Stafford and Spotsylvania Counties. It intruded the Fredericksburg granite gneiss [Baltimore (?) gneiss of 1928 Va. map], from which it cannot be separated.

†Fredericksburg sandstone.

A name loosely applied in some early repts (see W. B. Rogers, Phila. Acad. Nat. Sci. Proc., vol. 1, p. 142, 1842) to the ss. around Fredericksburg, Va., which is in part the Patuxent fm. (Lower Cret.). (See U. S. G. S. Patuxent folio, No. 204, 1917, p. 5.)

Fredericksburg freestone.

Trade term for ss. quarried from Potomac group in vicinity of Fredericksburg, Va. See under †*Rappahannock series.*

†Fredericktown dolomite.

Upper Cambrian: Southeastern Missouri.

C. R. Keyes, 1895 (Mo. Geol. Surv. Sheet Rept. No. 4 (vol. 9), pp. 18, 19, 48). *Fredericktown dol.*—Non-cherty mag. ls. 275 ft. thick; lower 75 ft. chiefly hard grayish ls. with some sandy material and shaly layers; upper 200 ft. buff dol. tolerably free from siliceous matter. Underlies Le Sueur dol. and overlies La Motte ss. in Mine La Motte and neighboring districts, Mo.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12). *Fredericktown ls.*=Bonne Terre ls. [Same statement by G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 67).]

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 254). *Fredericktown ls.,* 200 ft. thick, underlies Le Sueur dol. and overlies La Motte ss.

These rocks are now divided into Elvins group and Bonneterre dol.

Named for exposures at Fredericktown, Madison Co.

†Frederick Valley limestone.

See under *Frederick ls.*

Fredonia oolite member (of Ste. Genevieve limestone).

Mississippian: Western Kentucky and Tennessee, southeastern Missouri, and southern Illinois and Indiana.

E. O. Ulrich and W. S. T. Smith, 1905 (U. S. G. S. P. P. 36, pp. 24, 40). *Fredonia ls.*—White oolitic ls. interbedded with blue oolite, thin bands of subcrystalline and crinoidal lss., and seams of green clay sh. and fine-grained argill. ls. Thickness probably 150 ft. Basal memb. of Ste. Genevieve ls. Underlies Rosiclare ss. memb. of Ste. Genevieve and overlies, probably uncon., St. Louis ls.

The beds consisting chiefly of oolite and oolitic ls. the name has been changed to *Fredonia oolite memb.*

Named for Fredonia, Caldwell Co., Ky.

Freedom dolomite.

Pre-Cambrian (middle? Huronian): Central southern Wisconsin (Sauk County).

S. Weidman, 1904 (Wis. Geol. Nat. Hist. Surv. Bull. 13, p. 51). *Freedom fm.*—Upper part, dol. 500 ft. thick; lower part, iron ore, ferruginous slates, ferruginous dol., and ferruginous chert, 450 to 500 ft. thick. Appears to grade into underlying Seeley sl. and to lie uncon. below [so-called] Potsdam ss. Does not outcrop. Found only by exploration SW. of North Freedom. Is known to cover 5 or 6 sq. mi. in secs. 2, 3, 9, 10, 11, 15, 16, 17, and 20 of town of Freedom. Assigned to pre-Camb.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 720), indicated Freedom dol. may be middle Huronian.

Freeman.

See *Lower Freeman sand.* (Archer Co., Tex.)

Freeport coal group. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia, and eastern Ohio.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–492). *Freeport group,* 100 to 250 ft. thick, underlies *Mahoning massive bed of ss.* and overlies *Freeport or contorted ss.* Includes Upper Freeport coal, Freeport ls., and Lower Freeport coal.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. xxiii). Lower Productive Coal Measures [Allegheny fm.] divided into (descending) *Freeport coal group*, Kittanning coal group, and Clarion coal group.

I. C. White, also J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q). *Freeport group* extends from top of Upper Freeport coal to top of Upper Kittanning coal.

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas No. 65, Punxsutawney quad., pl. 4, p. 28). *Freeport fm.* extends from top of Upper Freeport coal to top of Upper Kittanning coal.

Freeport coal group is treated by U. S. Geol. Survey as an economic memb. in upper part of Allegheny fm., extending from top of Upper Freeport coal down to top of Upper Kittanning coal.

†Freeport limestone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia, and eastern Ohio.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, p. 492). *Freeport ls.*, 4 to 7 ft. thick, in midst of Freeport group, being separated from overlying Upper Freeport coal by 1 to 10 ft. of fire clay and sh. and from underlying Lower Freeport coal by 30 to 40 ft. of sl. and slaty ss. [As thus defined the name appears to have been applied to *Upper Freeport ls.* of current nomenclature.]

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 1–9). *Freeport ls.* lies btw. Middle Freeport coal and Lower Freeport coal.

I. C. White, 1876 (Lyc. Nat. Hist. Annals, vol. 11, pp. 14–18, also 2d Pa. Geol. Surv. Rept. K), applied *Freeport ls.* to 2 to 4 ft. of ls. separated from overlying Upper Freeport coal by 3 to 15 ft. of fire clay and sh. and from underlying Lower Freeport coal by 45 to 82 ft. of beds, including one unnamed coal.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K), applied *Freeport ls.* to 0 to 4 ft. of ls. lying 5 to 15 ft. below Upper Freeport coal and 55 to 65 ft. above Lower Freeport coal.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. xxviii), applied *Freeport ls.* to a ls. btw. Upper and Middle Freeport coals, and applied *Middle Freeport ls.* to a ls. btw. Lower and Middle Freeport coals in Cambria Co., Pa., but with statement that so-called Middle Freeport coal would probably in future be called *Lower Freeport*, that so-called *Middle Freeport ls.* would be called *Lower Freeport ls.*, and that so-called Lower Freeport coal would be called *Kittanning coal.*

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. 316), changed *Freeport ls.* of previous repts to *Upper Freeport ls.*; *Middle Freeport ls.* to *Lower Freeport ls.*; *Middle Freeport coal* to *Lower Freeport coal*; and *Lower Freeport coal* to *Upper Kittanning coal.* These are names that have been in common use for many years.

Same as *Upper Freeport ls. memb.* of current nomenclature.

Freeport sandstone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477). *Freeport or contorted ss.*—Massive ss., 15 to 60 ft. thick, underlying Lower Freeport coal and separated from Kittanning coal by 75 ft. of sh. and ss. [As thus defined the name applies to †Lower Freeport ss. of later repts.]

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Freeport ss.* is same as *Lower Freeport ss.*

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Lower Freeport ss.* is same as *Freeport ss.* of earlier repts. It is present at Freeport [Armstrong Co.], Pa.

Freeport clay.

See *Upper Freeport clay* and *Lower Freeport clay.*

Freeport gravel.

Pleistocene: Northwestern Illinois.

O. H. Hershey, 1897 (Am. Geol., vol. 19, pp. 207–209). *Freeport gravel.*—Ancient river gravel occurring locally in Kansan drift 2 mi. E. of Freeport, Stephenson Co.

F. W. Sardeson also discussed this fm. in Am. Geol., vol. 20, 1897, pp. 400–401.

Freeport formation.

See under *Freeport coal group*, G. H. Ashley, 1926.

†Freezeout limestone.

Triassic (?): Central Wyoming (Freezeout Mountains).

F. B. Peck, 1904 (Wyo. Hist. and Geol. Soc. Proc. and Coll., vol. 8, pp. 28–41). The uppermost memb. of Triassic in Freezeout Mtns, Wyo., is bed of ls. 10± ft. thick, which for convenience we can term *Freezeout ls.* Overlies Triassic "Red Beds."

Same as Alcova ls. memb. of Chugwater fm., according to J. B. Reeside, Jr. This name appears to have been overlooked, as it is not listed in U. S. G. S. alphabetic list of geol. names in literature, and was only recently (1936) discovered by compiler of this lexicon.

Freezeout tongue (of Chugwater formation).

Permian: Southeastern Wyoming (Laramie Basin to Freezeout Hills).

H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1664, 1670). *Freezeout tongue of Chugwater fm.*—Red sh. lying btw. Forelle ls. below and Little Medicine tongue of Dinwoody fm. above, and extending from Laramie Basin to Freezeout Hills. Upper part of this tongue of Chugwater extends laterally into lower part of Dinwoody fm., and rest of this tongue extends laterally into upper part of Phosphoria fm. This tongue contains a few beds of ls., breccia, and gyp., which may be tongues of the Phosphoria, but most of which are probably local lenticular beds. Thickness 110± ft. The Freezeout tongue by definition is limited to localities where the Forelle can be definitely recognized. At present Forelle has not been certainly identified except in Laramie Basin and N. into Freezeout Hills.

Fremont limestone.

Upper and Middle Ordovician: Eastern and central Colorado.

C. D. Walcott, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 154–167). *Fremont ls.*—At Canyon City consists of (descending): (1) Impure variegated banded ls. with interbedded sss. and argill. beds, 15 to 30 ft.; (2) compact, hard light-gray ls. breaking into angular fragments and with a band of purple and gray calcareo-aren. sh. at base, 45 ft.; (3) dark reddish-brown ss. parting, 10 ft.; (4) hard, compact, light-colored ls., 45 ft.; (5) gray siliceous mag. ls., somewhat ferruginous in lower part, 170 ft. Total thickness at Canyon City 285–300± ft. Rests on Harding ss. and is overlain by Carbf. ls.

According to E. Kirk, the Fremont ls. contains a Richmond (Upper Ord.) fauna in all but lower 10 ft.

Named for exposures in Fremont Co.

Fremont erosion cycle.

Pliocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310–340). The oldest erosion cycle recognized in central western Wyo. Assigned to Plio. Named for fact that the principal remnants of Wind River Plateau can be overlooked from Fremont Peak.

French slate.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 622, 645, 649). *French sl.*—Largely dark brown to blackish gray phyllites, with thin beds of qtzitic rocks and some laminae rich in magnetite and hematite. Thickness 2,000 ft. Overlies Towner greenstone, with probable conformity. Named for French Creek, the south fork of which runs along outcrop of the fm. for several mi. Considered of early Algonkian age.

French Bar formation.

Oligocene (?): British Columbia.

J. D. MacKenzie, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, p. 76).

French Creek limestone member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, June 9, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 135–136). It is here proposed that *upper Meadville ls.* be known as *French Creek ls.*, from outcrops in ravines eroded by tributaries to French Creek, Crawford Co. Type section is ravine at "Glendale" Cemetery, in Meadville city. Thickness 1 to 2 ft. In early part of this rept this ls. was called *Conneaut ls.*, but Conneaut is withdrawn as name for the ls., at request of G. H. Chadwick, who desires to apply "Conneaut" to a different unit in same region. [Table opp. p. 61 shows this ls. as overlain by Custards sh. memb. (=upper Meadville sh. of early repts) and underlain by Harvest Home sh. memb., all included in his Meadville stage (Meadville monothem).]

French Creek shale. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

R. C. Moore, May 1, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14). *French Creek sh.* underlies Caneyville ls. and overlies Jim Creek ls.

G. E. Condra, late in 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 9–10). *French Creek sh.*, about 7 mi. S. of Humboldt [SE. Nebr.?], 16 ft. Divided into (descending): Gray sandy sh., 2 ft.; Lorton coal, 2 to 4 inches; dull-gray argill. laminated sh., 6+ ft.; dull-gray irregular impure ls., grading laterally into ss., 10 inches; ss. or sh., gray green, bedded locally with plant remains, 6 ft. Underlies Nebraska City ls. and overlies Jim Creek ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 240). *French Creek sh.* overlies Jim Creek and underlies Caneyville ls. It is bluish gray or yellowish brown, clayey to sandy; some light-brownish or tan ss. in upper part; Lorton coal near top. Av. thickness 30± ft. Is recognized across all of Kans. Type loc., French Creek, NE. part of Pottawatomie Co., Kans.

French Lick stone. (In Chester group.)

Mississippian: Southwestern Indiana (Orange County).

E. T. Cox, 1871 (Ind. Geol. Surv. 2d Ann. Rept., p. 81). Fine-grained reddish brown gritstone extensively quarried into grindstones and whetstones. Known on market as *French Lick stone.* Supposed to be same as Hindostan stone. [E. M. Kindle, 1896, has shown that French Lick stone is upper ss. of Chester group, while Hindostan stone is Penn. and a part of Mansfield ss.]

Named for French Lick Springs, Orange Co.

French Pond granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map, pp. 28, 36). *French Pond granite.*—Heterogeneous body of granite with 3 phases. Is late Dev. or late Carbf. Assigned to New Hampshire magma series. Occurs just W. of French Pond.

Frenchtown diorite.

Age (?): Northeastern Maryland.

G. P. Grimsley, 1894 (Cincinnati Soc. Nat. Hist., Jour., vol. 17). Gabbro diorite near Frenchtown, Cecil Co. Described under heading *Frenchtown diorite.*

Frenck shale.

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 94, 96). [See under *Dover ls.*, Moore 1932 entry. On p. 58 thickness is given as 21 ft.]

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised chart), transposed *Frenck sh.* and *Table Creek sh.* [restricted] by applying *Frenck* to sh. *overlying* Dover ls. and *Table Creek* to sh. underlying Dover ls. [Derivation of name not stated.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), called the sh. overlying Dover ls. the *Friedrich-Dry sh.* and the sh. underlying Dover ls. the *Table Creek sh.* and did not use *Frenck sh.* See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 238, 240). *Frenck sh.* (derived from erroneous spelling of French Creek on maps) was applied to beds btw. Dover ls. below and Jim Creek (Nebraska City) ls. above, and is abandoned. French Creek sh. comprises upper part of what was termed "Frenck sh." in 1932 Guide Book.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Fresh Pond moraine.

Name applied by J. B. Woodworth to the glacial ridge forming the highest land in Cambridge, Mass.

Friar's Hill series.

Age (?): West Indies.

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 498).

Friar's Hill gravels and marls.

Pleistocene: Antigua.

A. P. Brown, 1914 (Phila. Acad. Nat. Sci. Proc., vol. 65, p. 605).

†Frickham bed.

U. S. G. S. Bull. 191, p. 167. (Error for *Trickham bed.*)

Friedrich shale. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, May 1, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14). *Friedrich sh.* underlies Jim Creek ls. and overlies Grandhaven ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 238). *Friedrich sh.* is here proposed to include clayey and sandy beds that overlie Grandhaven ls. and underlie Jim Creek ls. The unweathered sh. is chiefly bluish gray, but it commonly weathers yellowish or brownish. Locally there is ss. in upper part, and in S. part of Greenwood Co. a thin coal bed near top. Av. thickness 15± ft. Type loc., Friedrich Creek, sec. 6, T. 22 S., R. 11 E., Greenwood Co., Kans.

Friendsville black shale. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 574). *Friendsville black sh.*—Marine fauna (Cambridge?). Underlies Albright ls. and overlies Thomas coal; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 60, pl. 7). Thomas ss. is found above Thomas coal at places in Upper Potomac Basin, replacing Friendsville sh. [On pp. 95, 98, 100 he says Friendsville sh. is same as Cambridge black sh.]

Probably named for occurrence at Friendsville, Garrett Co.

Friendsville formation.

Pennsylvanian: Indiana.

See 1935 entry under *St. Wendell ss.*

†Frijole limestone member (of Delaware Mountain formation).

Permian: Western Texas (Guadalupe and Delaware Mountains).

W. G. Blanchard, Jr., and M. J. Davis, 1929 (A. A. P. G. Bull., vol. 13, pp. 973, 987). Delaware Mtn fm. in Guadalupe Mtns is capped by a dark shaly ls. that will be designated in this paper as *Frijole ls.* This memb. is extremely persistent and is recognizable in well cuttings as far E. as western Winkler Co. Below Frijole ls., deep in underlying Delaware Mtn ss., other ls. members are present that lithologically are practically indistinguishable from Frijole ls. [Authors showed (p. 988) that typical Delaware Mtn fm. of Delaware Mtns included in its upper part the equiv. of Capitan ls., and that Frijole ls. was its top bed. This interpretation of position of Frijole ls. is also that of R. E. King, 1931 (Univ. Tex. Bull. 3042, pp. 11-13) and E. H. Sellards, 1933 (Tex. Univ. Bull. 3232, pp. 159-160, 181).]

Although the 1929 publication cited is first known appearance of *Frijole ls.* in print, the name had for 2 or 3 yrs previously been in common use among geologists working in the region.

Named for exposures at Frijole P. O., Culberson Co.

This name is now replaced by *Lamar ls. memb.*, it having been found that the ls. at Frijole P. O. is not top memb. of Delaware Mtn fm., but an older ls. See W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7).

Frijole shale.

Permian: Western Texas (Loving County).

J. E. Adams, 1936 (A. A. P. G. Bull., vol. 20, No. 6, p. 785). *"Frijole" sh.* is locally misapplied to the black sh. encountered in wells at top of Delaware Mtn section. Because of lack of suitable name *Frijole* is used in this incorrect sense throughout present paper. This sh. is upper thin dark clastic memb. of Delaware Mtn group. Cores show the fm. consists of 3 members: (1) The upper 23 ft. is hard, dense black silt or silty sh.; (2) the next 7 ft. is hard, fine-grained, thinly laminated ss.; (3) a 1-ft. bed of dense, hard black sh. The fm. is extensively shattered in some local areas and many cracks are filled with veins of coarsely crystalline white calcite.

Frio clay.

Tertiary (Oligocene?): Eastern Texas.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, p. 554). *Frio clays.*—Dark-colored (greenish gray, red, and blue), usually massive, gypseous clays, with laminated and bedded sandy clays, sand, and sand rock. Overlies Fayette sands (which rest on Yegua clays), and underlies Oakville (Mio.). Included in Eocene. Typically exposed btw. Weedy Creek and Oakville, on Atascosa and Frio Rivers, and on the Nueces S. of Tilden.

E. T. Dumble, 1903 (Am. Inst. Mg. Engrs. Trans., vol. 33, pp. 913–987). *Frio clays* overlie Fayette sands and underlie Oakville beds (Mio.). Top fm. of Lower Claiborne stage of Eocene.

E. T. Dumble, 1911 (Tex. Acad. Sci., vol. 11, pp. 50–51). *Frio* overlies Fayette and underlies Corrigan beds. Is top subdivision of Claiborne stage. [The †Corrigan beds are now called *Catahoula tuff*.]

E. T. Dumble, 1915 (Jour. Geol., vol. 23, pp. 481–498). *Frio clays* overlie Fayette and uncon. underlie Jackson [so called]. Not recognized E. of Colorado River in Tex. All fossils are characteristic of Lower Claiborne.

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 81, 86–87). The *Frio* is a fm. of yellow and dark clays which weather white and are accompanied by gyp. Contains few marine fossils. Total thickness 660± ft. Thins to NE. and is not found E. of the Colorado and perhaps not E. of San Antonio River. In LaSalle and McMullen Counties it consists of greenish and pinkish red, compact, jointed clay that has small lime nodules and concretions of siliceous ls. Lower part consists of fossiliferous brown marl. Along Rio Grande it consists of gray and green gypseous clays, with sands. The clays often weather white and contain leaf impressions and ferruginous and calc. concretions. Outcrops in Karnes, Live Oak, McMullen, Duval, Webb, Zapata, and Starr Counties. Belongs to lower Claiborne, but some geologists consider Fayette and Frio as Jackson. Frio overlies Fayette and underlies Corrigan or Catahoula and also underlies Oakville Miocene.

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869). Of the few marine fossils found by us in *Frio clays* there were none characteristic of beds later than Lower Claiborne, and it was accordingly referred to that group. There is a possibility, however, that further collections may show that it belongs to Upper rather than Middle Eocene.

A. C. Trowbridge, 1923 (U. S. G. S. P. P. 131D). *Frio clay,* 100 to 400 ft. thick, overlies Fayette ss. and underlies Oakville ss. The Frio and Fayette are both of Jackson age.

T. L. Bailey, 1923 (Univ. Tex. Bull. 2333). *Frio fm.* (*Jackson*) in Colorado Co. consists, in wells, of black noncalc. gray, green, and pink, often bentonitic clay, with some beds of tuff and lignite. Dark-colored beds contain marine fossils. Shows an apparent alternation btw. fresh and salt water conditions, and may be partly if not largely of river-delta origin. Thickness 648 ft. Overlies Fayette (Jackson) and uncon. underlies Corrigan fm. (=Catahoula ss.).

A. Deussen, 1924 (U. S. G. S. P. P. 126). *Frio clay,* 235 to 705 ft. thick, underlies Catahoula ss. and overlies Fayette ss. Assigned to post-Claiborne Eocene.

T. L. Bailey, March, 1924 (Sci., n. s., vol. 59, pp. 299–300), introduced *Gueydan fm.* for beds (of volcanic origin) uncon. overlying Frio fm. and uncon. underlying Oakville ss.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, No. 4, July-Aug., pp. 424–436). *Frio group.*—Gypseous clays, chiefly with sands and sandrock, which weather white, but when wet may be green, blue, red, or yellow; contain concretions of ls. with manganese dendrites. Thickness 600± ft. No fossils except a leaf impression, but Jackson age is indicated by fact that we have traced what we consider to be its continuation S. to Conchos River in Mexico, where it forms a good part of Pomeranes Mtns, and on eastward-facing slopes of these mtns it is overlain by Lower Olig. beds. Rests uncon. on Whitsett beds, also of Jackson age, and is overlain by Oakville ss.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645). The name *Frio fm.* is here used with a different significance from its usage by any previous writer, so far as known. It here designates those predominantly argill. strata which lie conformably or discon. beneath Gueydan fm. [Catahoula tuff] and conformably on Fayette fm. Thickness 0 to 250 ft. Type loc. of Frio described by Dumble in 1894 occurs in upper part of Gueydan fm. of present writer. The Frio of Dumble's 1903 map of Live Oak Co., includes most of Gueydan and practically none of Frio of present rept, while in McMullen Co. it includes the Frio and most of lower Gueydan but excludes the beds of his type loc. in Live Oak Co. The Frio as defined by Dumble in 1924 is practically same as Gueydan fm. The Frio of Trowbridge [as mapped] (U. S. G. S. P. P. 131D, pp. 97–98, 1923) includes Frio, Oakville, and Lagarto fms. along N. side of Rio Grande. The Frio clay of Deussen includes Gueydan and Frio of this rept. The Frio and Fayette compose Jackson group in this area.

The †Gueydan fm. has been proved to be same as the Catahoula, and is now called *Catahoula tuff*, since in Tex. it consists chiefly of tuff.

In 1931 the name "Yeager clay" was introduced by Julia Gardner and A. C. Trowbridge (A. A. P. G. Bull., vol. 15, No. 4, p. 470) for the nonvolcanic clays underlying Catahoula tuff and overlying Fayette ss. because of the many conflicting uses of *Frio clay*. Later, however, it was agreed btw. Tex. Geol. Survey and U. S. Geol. Survey to drop the name "Yeager" and to adopt in its stead the definition of Frio clay that restricts that name to the beds beneath Catahoula tuff (= †Corrigan fm. and including Fant tuff memb.) and above Fayette ss. or Jackson fm. This is definition of Frio clay at present approved by U. S. Geol. Survey and by Tex. Geol. Surv. according to Univ. Tex. Bull. 3232, 1933. But A. C. Ellisor (A. A. P. G. Bull., vol. 17, No. 11) includes Fant tuff in Frio clay.

Named for exposures at and near mouth of Frio River, Live Oak Co.

Frisbie limestone.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Wyandotte ls.* Derivation of name not stated.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 59). *Frisbie ls.*—Basal memb. of Wyandotte ls. Consists of 1 to 3 ft. of gray, even, blocky ls., in one layer. Named for Frisbie, Johnson Co., Kans.; exposed at middle of N. side of sec. 17, T. 12 S., R. 23 E. Is recognized farther into NW. Mo. and farther S. into Miami Co., Kans., than any other memb. of Wyandotte ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Frisco limestone.

Lower Devonian: Central southern Oklahoma (Arbuckle Mountains).

C. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470–473). Massive bedded coquina-like gray ls., 0 to 20 ft. thick, which rests on Bois d'Arc fm. Best exposed in bed and bank of Bois d'Arc Creek and in vicinity of Coal Creek 7 mi. S. of Frisco [Pontotoc Co.]. Is top fm. of Hunton group. Carries Oriskany fauna. Stratigraphically lower than Woodford chert.

In 1911 Reeds named top fm. of Hunton ls. of Taff the *Bois d'Arc ls.*

Frog Mountain sandstone.

Middle Devonian (Onondaga): Northern and central Alabama and northwestern Georgia.

C. W. Hayes, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 470). *Frog Mtn ss.*—May be Oriskany. Underlies Chattanooga black sh. and overlies Rockwood ss. in NE. Ala. and NW. Ga. Assigned to Dev.

C. W. Hayes, 1895 (U. S. G. S. 16th Ann. Rept., pt. 3, pls. 20 and 21 and p. 555). *Frog Mtn ss.*—Coarse friable ss. and sandy sh. containing Lower Dev. fossils. Uncon. underlies Chattanooga sh. and uncon. overlies Rockwood ss. in NE. Ala. and NW. Ga.

C. W. Hayes, 1902. (See under *Armuchee chert.*)

C. Butts, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 365–380). All Dev. sss. of Ala. have heretofore been called Frog Mtn ss., but the 300 ft. of Dev. ss. at Frog Mtn, the type loc., is all of Onondaga age. The name *Frog Mtn ss.* is therefore here restricted to the sss. in Ala. that are of Onondaga age, the new name *Clear Branch ss.* is introduced for the sss. in Ala. that are of Oriskany age, and the new name *Ragland ss.* is introduced for the sss. in Ala. that are of Hamilton age. The restricted Frog Mtn ss. is present in Frog Mtn and elsewhere in Cherokee Co. and N. part of Calhoun Co., and also at Leeds, Shelby Co., and probably farther S. to Shelby, Calera, and Centerville regions.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221, p. 10). Writer has not visited Frog Mtn [Cherokee Co.], the type loc., but E. O. Ulrich found that *Frog Mtn ss.* at that locality consists of 150± ft. of coarse red ss., with *Spirifer macrothyris* and *Amphigenia curta* (?) at top, underlain by 200 ft. of sandy, calc., mag.?, and cherty beds with rounded quartz grains scattered through mag. ls. and quartz grains increasing toward bottom; fossiliferous cherty-looking rock at bottom contains *Chonetes mucronatus*. These beds are all of Onondaga age, so far as evidence goes. The fm. is overlain by Floyd sh. and underlain by ls. of Beekmantown age, probably Newala ls. The Frog Mtn ss. extends NE. into Ga., and is present in upper part of Armuchee chert. (See under *Armuchee chert.*)

Frondosa limestone.

Ordovician: Southern New Mexico.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 7). *Frondosa lss.*—Main body of Mid Ordovicic series in Franklin Mtns, which carries a Galena-Trenton fauna. Thickness 100 ft. [Derivation of name not stated.]

Frontenac.

Name applied to a glacial lake, of Pleist. age, in Ontario Basin.

Frontenac formation.

Paleozoic (pre-Ordovician?): Southeastern Quebec (Mount Megantic area).

H. W. McGerrigle, 1935 (Quebec Bur. Mines, Rept. Minister Mines 1934–35, pt. D, pp. 71, 74–78). Pillow lavas, tuffs, tuffaceous sediments. Underlie large part of Mount Megantic area of Frontenac Co.

Frontier formation. (In Colorado group.)

Upper Cretaceous: Western Wyoming and southern Montana.

W. C. Knight, 1902 (Eng. and Min. Jour., vol. 73, p. 721, in a paper on Uinta Co., SW. Wyo.). *Frontier fm.*—A coal-bearing ss. fm., 2,000± ft. thick, in which there is a thick stratum of evenly bedded light-brown ss., above and below which are beds of clay and sh. Extends N. from Kemmerer an unknown distance and S. to Diamondville, Cumberland, Spring Valley, and old R. R. cut just E. of Hilliard. Well developed at town of Frontier. Underlies Hilliard fm. and overlies Cret. beds of Benton age.

W. C. Knight, 1903 (Geol. Soc. Am. Bull., vol. 13, pp. 542–544). *Frontier fm.* has in past been called *Fox Hills*, but I could not find in it a Fox Hills fauna such as is common to Fox Hills of eastern Wyo.; therefore have named the beds *Frontier fm.* Is characterized by *Ostrea soleniscus*. Underlies Hilliard fm.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56, on SW. Wyo). *Frontier fm.*—Alternating beds of yellow and gray ss. and yellow, gray, and black carbonaceous clays with numerous coal beds. Distinctive Benton fossils. Thickness 2,200 to 2,600 ft. In upper part of fm. is Oyster Ridge ss. memb. Underlies Hilliard fm. and overlies Aspen fm.

In Rock Springs uplift is overlain by Baxter sh. and underlain by Aspen sh. In Hanna Basin and elsewhere in Wyo. it underlies Carlile sh. and overlies Mowry sh.

Front Range granite group.

Pre-Cambrian: Colorado.

T. S. Lovering and others, 1935 (Geol. map of Colo.). *Front Range granite group.*—Comprises all granites and related rocks in Colo. that are older than Uinta Mtn group and younger than Needle Mtns group. Includes Curecanti, Vernal Mesa, Powderhorn, Twilight, Eolus, Tenmile, Whitehead, and Trimble granites of SW. Colo.; also Pikes Peak, Sherman, Silver Plume, Cripple Creek, and Mount Rosa granites of eastern Colo., and unnamed granites and related rocks in different parts of State. Named for development in Front Range.

†Frostburg formation.

Permian: Western Maryland.

P. T. Tyson, 1837 (Md. Acad. Sci. Trans., vol. 1, pp. 92–98). *Frostburg coal fm.*—Shales, slates, lss., sss., and coals, 1300± ft. thick. Rests uncon. on old red ss. Georges Creek, in its passage from Frostburg, cuts through beds of the series. Fossils; but no marine remains found.

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pl. 13, p. 188). *Frostburg fm.*—Lss., sss., and shales, the lss. in several bands and at different horizons; most important ls. bed forms base of fm. Thickness of fm. 0 to 250 ft. Present in patches. Mapped. Overlies, apparently conformably, Elkgarden fm. and underlies Newark fm. Probably Perm. Named for Frostburg, Allegany Co.

Same as Dunkard group.

Frozenhead grit. (In Anderson sandstone.)

Pennsylvanian: Northern Tennessee (Morgan County).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 324, 328). *Frozenhead grit* (p. 324); *Frozenhead ss.* (p. 328). [Shown in section of Anderson fm., as lying about 25 ft. above Pilot Knob ss. (basal memb. of Anderson).] Top lies about 300 ft. below top of Frozenhead Mtn.

Fruitland formation.

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

C. M. Bauer, 1916 (U. S. G. S. P. P. 98P). *Fruitland fm.*—Brackish and fresh-water beds conformably overlying Pictured Cliffs ss. Consists of ss., sh., and coal, ranging from sandy sh. and shaly or clayey ss. in all conceivable proportions, to rocks that can definitely be called ss. or sh. Lateral and vertical variation of beds very rapid. Large concretions of iron carbonate occur at several horizons. The fm. is more sandy than overlying Kirtland sh., into which it grades through ss. lenses that are apparently of fluviatile origin. Thickness 194 to 292 ft. Comprises basal part of so-called Laramie of Holmes' 1877 rept. Named for small settlement on San Juan River, in San Juan Co., N. Mex., which is an outcrop of the fm.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). Fruitland fm. is 438 ft. thick on Florida River; 430 ft. thick in Red Mesa quad., SW. of Durango, Colo.; on La Plata River near Colo.-N. Mex. line it is 530 ft. thick. It seems most logical, in light of present knowledge, to consider both Fruitland and overlying Kirtland sh. as of late Montana age, possibly=latest part of Pierre sh. and part of Fox Hills ss. of region E. of Rocky Mtns.

Fry sand.

A subsurface sand, of Penn. age, in Fry, Byler, George, Smith-Ellis, and Thrifty fields, Brown Co., north-central Tex. Lies at 1,350± ft. depth.

†Fucoides caudagalli beds.

Lower Devonian: Southeastern New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 377). *Fucoides caudagalli beds.*—An argill. mass, in places somewhat sandy, of a black or dark-green color, which becomes lighter and by long weathering blanches. Is extraordinary for the peculiar fossil which it contains. Underlies Schoharie layers [Schoharie grit] and overlies Oriskany ss.

A paleontologic name. Replaced by *Esopus grit.*

Fulda sandstone.

Permian: Central northern Texas.

E. C. Case, 1907 (Am. Mus. Nat. Hist. Bull. 23, pp. 660–662). *Fulda ss.*—Ss., few inches to 20 ft. thick, varying from bright blue to all shades of brown, yellow, buff, and brilliant red; in places very massive. Included in Clear Fork div. Is older than Wichita cgl. and younger than Wichita div.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). *Fulda ss.* belongs in Clyde fm., of Wichita group.

Named for prominent development near little station of Fulda, Baylor Co.

Fullerton formation.

Pleistocene (Aftonian): Southern, central, and northern Nebraska.

A. L. Lugn and G. E. Condra, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 190). *Fullerton fm.* (Aftonian), of silt and clay, 8 to 60 ft. thick, rests conformably on Holdrege fm.

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 326, 343–345). *Fullerton fm.*—Largely fluvial inwash-outwash deposits of dark calc. silt and clay with some sand. Of Aftonian age. Thickness 0 to 65 ft. Covers 15,000± sq. mi. Extends continuously under Platte River Valley and plains to N. and S., but exposed only in N. part of State and at Fullerton, Nance Co. Occurs also in southern central Nebr. Rests conformably on Holdrege fm. and is overlain uncon. by Grand Island fm.

Fullington shale.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 379). *Fullington shales.*—Zone of *Gryphaea roemeri,* constituting lower and major part of Kiowa shales. Divided into Blue Cut shales, or zone of typical and abundant *G. roemeri,* above, and Black Hill sh. or Wafer sh. below. Underlies Tucumcari shales and overlies Champion shell bed.

Named for Fullington ranch, at Belvidere, Kiowa Co.

Fulmer Valley sand.

Name applied to a subsurface sand, of probable Dev. age, in SW. N. Y. See N. Y. State Mus. Bull. 239, 240, map opp. p. 16, 1922.

Fulton shale. (In Eden group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

A. F. Foerste, 1905 (Sci., n. s., vol. 22, p. 150). *Fulton layer.*—Geographic name for *Triarthrus becki* horizon, consisting of 4 or 5 ft. of clay at base of the Eden at Cincinnati.

Basal fm. of Eden group. Regarded by E. O. Ulrich as of latest Utica age and by R. Ruedemann as of earliest Lorraine age. Is overlain by Latonia sh.

Named for Fulton, formerly a suburb of Cincinnati, but now forming part of First Ward.

Fulton shale member (of Monongahela formation).

Pennsylvanian: West Virginia, western Pennsylvania, and eastern Ohio.

G. P. Grimsley, 1907 (W. Va. Geol. Surv. Rept. Ohio, Brooke, and Hancock Counties, p. 92). *Fulton green sh.*—On fresh exposures is bright-green, finely laminated sh., but weathers bluish green. Thickness 0 to 5 ft. Underlies Uniontown ls. and overlies Benwood ls. Exposed at Fulton, Ohio Co., W. Va.

The Ohio and W. Va. Geol. Surveys in 1931 applied *Arnoldsburg ls.* to lower part of Uniontown ls. of previous usage, and restricted *Uniontown* to younger beds.

Fulton loam.

Pleistocene: Western Kentucky.

F. J. Fohs, 1907 (Ky. Geol. Surv. Bull. 9, p. 67). *Fulton loam.*—Brown loam, 0 to 15 ft. thick, composing upper part of Columbia fm. Overlies Port Hudson clays (lower part of Columbia fm.) and underlies Recent alluvium.

Probably named for Fulton or for Fulton Co.

Funeral conglomerate.

Tertiary: Southwestern Nevada and southeastern California.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 78). *Funeral cgls.*—Term suggested for main gravel beds superposing the borate sediments in Death Valley region, where the deposits are finely developed on flanks of Funeral Range, [NE. of Death Valley in SE. Calif.]. Compose lower fm. of Virgen [Virgin] series in Nev. Plio. perhaps.

Funston limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 23). *Funston ls.* is new name for middle part of Speiser sh. as defined by Condra in 1927. In Nebr. it consists of (descending): (1) Gray ls., 1 ft. or more; (2) greenish argill. sh., 2 ft. or more; (3) gray ls., 1 ft. or more; (4) massive aren. ls. that weathers yellowish, 1⅓ to 2 ft. In southern Kans. the basal zone is 2 or more ft. thick and becomes dominant part of the memb. at type loc., in bluffs of Kansas River Valley S. of Funston, Kans. Named for Camp Funston, Riley Co., Kans. Underlies Speiser sh. restricted and overlies Blue Rapids sh.

G. E. Condra, 1935. (See under *Bigelow ls.*)

Furnace limestone.

Upper Cambrian (?), Ordovician (?), and Mississippian (?): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 352–365, and map). *Furnace ls.*—White to nearly black coarsely crystalline ls., 4,500 ft. or more thick. Grades downward into Arrastre qtzite and grades upward into Saragossa qtzite. Is intruded by granites. No fossils found. Probably Upper Camb. and Ord.

A. O. Woodford and T. F. Harriss, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, p. 270). Fossils collected close to top of Furnace ls. are pronounced by G. H. Girty to be probably Carbf., and more probably Miss. than Penn. or Perm. Thus a Miss. (?) age is suggested for at least a part of Furnace fm.

Named for Furnace Canyon, San Bernardino Co., which is cut in the fm.

Furnacean series.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 78). *Furnacean series* is locally used to designate the chief borate-bearing beds of Death Valley dist., fully outcropping in Furnace Canyon, E. of Death Valley, Inyo Co., SE. Calif. In Nev. divided into Millett clays above and Redhill ss. below. Older than Piutean series and younger than Amargosan series. Of Miocene age.

Furnaceville iron ore.

Silurian: Central and western New York.

J. M. Clarke, 1906 (N. Y. State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12). [See under *Irondequoit ls.*]

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114, p. 20). *Furnaceville ore.*—Included in Clinton fm. of Rochester and Ontario Beach quads. Underlies Wolcott ls. and overlies Sodus sh.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). The *Furnaceville ore bed* lies *in* and not *below* Wolcott ls. [J. M. Clarke, 1910 (N. Y. State Mus. Bull. 140) treated Furnaceville as distinct fm., but E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22, pl. 28, 1911) apparently included it in Wolcott ls., since he showed Wolcott resting on Sodus sh.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 48). *Furnaceville iron ore* occurs at Rochester and extends E. into Wayne Co., where it is typically developed in vicinity of Furnaceville, and where it directly overlies Sodus sh., but at Rochester a thin band of ls. intervenes btw. Sodus sh. and the ore.

G. H. Chadwick 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). Sodus sh. restricted to upper part of Sodus sh. as previously defined and used, the underlying beds down to top of Thorold ss. being named (descending): Sterling Station ore, Reynales ls., *Furnaceville ore,* Bear Creek sh., and Maplewood sh. The iron ore underlying true Wolcott ls. is here named *Verona iron ore.* The true *Furnaceville ore* is a much older bed. Hartnagel miscorrelated Wolcott ls. with the much older Reynales ls. The iron ore overlying Wolcott ls. is here named *Wolcott Furnace ore.*

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 191), included *Furnaceville sh.* in Reynales ls. On p. 347 he included *Furnaceville ore* in Reynales ls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 324, 325), included *Furnaceville ore* in Reynales ls., of which it is said to be basal 4 ft.

Furnaceville shale.

Silurian: Central and western New York and western Ontario.

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, p. 47), used *Furnaceville (Sodus) sh. memb.* for part of Clinton fm. in Ontario; and G. S. Hume, 1932 (Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 24), used *Furnaceville sh.* in Ontario.

See also 1923 entry under *Furnaceville iron ore.*

Fuson shale. (In Inyan Kara group.)

Lower Cretaceous: Western South Dakota, southeastern Montana (in wells), eastern Wyoming, and northwestern Nebraska.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 530). *Fuson fm.*—Very fine-grained sss. and massive shales and clay; of white, gray, buff, purple, and maroon colors. Thickness 30–100 ft. Underlies Dakota ss. as here restricted and overlies Minnewaste ls. Included in Dakota ss. of previous repts. Striking exposures in Fuson Canyon [on E. side of Black Hills, S. Dak.], for which it is named.

W. W. Rubey (1930) made this top fm. of *Inyan Kara group,* q. v.

Fusselman limestone.

Silurian (Niagaran): Western Texas and southern New Mexico.

G. B. Richardson, 1908 (Am. Jour. Sci., 4th, vol. 25, pp. 476, 479–480). *Fusselman ls.*—Massive, whitish, mag. ls. approx. 1,000 ft. thick. Overlies Montoya ls., apparently conformably. Underlies Hueco ls., also apparently conformably. Contains fossils of upper Niagaran age. Outcrops in El Paso quad., in Franklin and Hueco Mtns.

Named for exposures in Fusselman Canyon, Franklin Mtns, N. of El Paso, Tex.

Gabbs formation.

Upper Triassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Muller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Gabbs fm.*—Purple to black sh. and dark-brown to black ls., 420 ft. thick. Conformably underlies Sunrise fm. (Lower Jurassic) and conformably overlies Luning fm. (Upper Triassic). Fossils from middle, base, and top. Assigned to Upper Triassic. Named for Gabbs Valley Range, where, in New York Canyon area, it is best exposed.

Gabilan limestone.

Pre-Jurassic (?): Western California (San Francisco Bay region).

G. F. Becker, 1888 (U. S. G. S. Mon. 13, pp. 128, 181). *Gavilan ls.*—In Gavilan Range [spelled *Gabilan* by U. S. Geographic Board], some 60 mi. S. of Bay of San Francisco, the lowest sed. fm. encountered is in part ls., which at points is very crystalline. Associated with it are rocks of Archean gneiss type. It is possible it is a memb. of Knoxville series much more metamorphosed than usual, but it appears more probable it is a remnant of some older fm. which has perhaps undergone repeated metamorphism.

Is now known to be of pre-Franciscan age, and in San Francisco region occurs as inclusions in quartz diorite that has been called "Montara granite," of late Jurassic (?) age. (See also under *Sur series.*)

†Gabouri limestone.

Mississippian: Central eastern Missouri.

I. N. Nicollet, 1843 (Rept intended to illustrate a map of the Hydrog. Basin of Upper Mississippi River; 26th Cong., 2d sess., S. Ex. Doc. 237, p. 33), used once, casually, "Gabouri ls." for what he a few sentences farther along called "oolitic ls. of the Gabouri" exposed at Ste. Genevieve, Mo. According to C. [R.] Keyes (Pan-Am. Geol., vol. 44, pp. 149–150, 1925) the Gabouri ls. of Nicollet is Spergen ls., and he would revive Nicollet's name. The only known uses of "Gabouri" in literature are Nicollet's casual use and Keyes' proposed revival of the term.

Gabriola formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 100).

Gaffney marble.

Cambrian (probably Lower): Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1921 (Limestones and marls of N. C., by G. F. Loughlin et al.: N. C. Geol. and Econ. Surv. Bull. 28, pp. 28, 72–75). *Gaffney marble.*—A rather variable fm. ranging from very fine to medium fine-grained marble, and from bluish gray to white in color. Most of it has a schistose or banded structure, made more evident by presence of impurities, such as mica and hornblende. In some places the marble is highly magnesian. Thickness 30 to 300 ft. Overlies Blacksburg schist. Is of Camb. age, probably Lower Camb.

Named for exposures at Gaffney, Cherokee Co., S. C.

Gage shale. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 45). *Gage sh.*—Top memb. of Doyle fm. Consists of shales, of alternating gray, greenish gray, and chocolate red colors. Thickness increases from 28 ft. in Nebr. to 50 ft. in southern Kans. Overlies Towanda ls. memb. and underlies Stovall ls. memb. of Winfield fm. Named for Gage Co., Nebr. Type loc. btw. 1 and 2 mi. S. of W. side of Wymore, Nebr.

Gagné Brook series.

Ordovician (?): Quebec.

F. R. Burton, 1931 (Quebec Bur. Mines Ann. Rept. 1930, pt. D, p. 109).

†Gainesville.

Lower Cretaceous (Comanche series): Northeastern Texas and southwestern Arkansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 384–385). If it be needful to sometimes use a collective name for the Washita and Denison divisions of Comanche series, the name *Gainesville,* from the north Tex. town of that name, which practically marks bdy btw. Washita and Denison, is appropriate. [His Washita div. included Denton, Fort Worth, and Duck Creek. His Denison div. included Grayson, Choctaw, Pawpaw, and North Denison.]

Practically synonymous with Washita group.

Gainesville sand.

A subsurface sand, of Middle Dev. age, in western Ky.

Gakona formation.

Eocene (upper): Southeastern Alaska (central Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 52, map). *Gakona fm.*—Fresh-water deposits. Upper part soft, fissile or massive gray or buff shales, with interbedded gravel, sand, and lignite beds. Lower part coarse, thoroughly indurated cgl., at least 500 ft. thick; appears to be basal memb. Thickness of fm. 2,000+ ft. Contains Eo. plants. Occurs E. of Gakona Glacier.

Galatia sandstone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Saline County).

G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 256–258). *Galatia ss.*—A cuesta-forming ss., about 75 ft. thick, lying about 500 ft. above base of McLeansboro fm. Lies strat. higher than Brushy Creek ss. and also about 100 ft. higher than an unexposed ls. that is correlated with Shoal Creek ls. Crops out about ½ mi. N. of Galatia, Saline Co.

Gale sand.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54). *Gale sands.*—Stiff and clayey sands derived from Osceola till; partly stratified and partly washed and redistributed. Steilacoom gravels differ from Gale sands in their prevailing coarseness. Named for creek in Tacoma quad., which flows across part of area covered by Gale sands.

Galena dolomite.

Middle Ordovician (Trenton): Northern Illinois, Iowa, and southern Minnesota and Wisconsin.

J. Hall, 1851 (Rept. on geol. of Lake Superior land district, by J. W. Foster and J. D. Whitney, pt. 2, pp. 146–148). In going westward [from Escanaba River] I had not an opportunity of observing the overlying deposits of Trenton ls. until I arrived in Wis. Here, in numerous localities, as well as in Ill. and Iowa, the deposit above that which is marked by an abundance of fossils characteristic of the Trenton, is a grey, or drab-colored ls., very friable, forming part of "cliff ls." of Ohio and Ind. repts, and is called by Dr. Owen, in his rept on Lead region, the "upper mag. ls." From its position and lithologieal characters it appears that this ls., which is principal lead-bearing rock in these States, is a continuation of that noticed on the Escanaba, lying above the fossiliferous beds of Trenton ls.; but that it has increased in thickness, as traced westwardly, and becomes an important memb. of the series; and hence we have designated it in the classification of the rocks as *"Galena ls."* In neighborhood of Galena, Dubuque, Mineral Point, and other places there are numerous localities where a direct succession in the beds may be traced. It is very evident that this ls. diminishes in thickness eastwardly from these points, and becomes a very subordinate memb. of the series, losing, at same time, its metalliferous character. This lead-bearing rock, as before observed, rests upon fossiliferous strata of Trenton age. The galena sometimes penetrates the Trenton series, in films or sheets, but does not form veins, as in the gray heavy-bedded ls. above. From all the evidence, therefore, the lead-bearing or Galena ls. must be regarded as a distinct memb. of lower Sil. system, which is not recognized to E. Believed to underlie Hudson River group, but relations not positively determined. [In strat. columns on pp. 2 and 5, by J. W. Foster and J. D. Whitney, *Galena ls.* is placed beneath so-called Hudson River group and above Trenton ls.]

J. Hall, 1858 (Iowa Geol. Surv. Rept. 1855–57, vol. 1, pt. 1, pp. 42, 56, 57, 58, 60). *Galena ls.*—This rock, which succeeds Trenton ls. proper, or, as shown in preceding sections, alternates with that rock at junction of the two, is a most important and interesting fm. in Iowa. It is a gray or drab-colored, often yellowish, porous, and subcrystalline rock, usually friable but sometimes compact and possessing a considerable degree of tenacity. It varies in different parts of its extent; the porous and friable character being that prevailing in central part of its greatest development, while other characters supervene toward its northern and northwestern margin. This rock has been designated by Dr. Owen "Upper Mag. ls;" but this term, as originally applied, included also Niagara ls., causing the two to be confounded for a long time; and in order to avoid the difficulty arising therefrom the name *Galena ls.* has been proposed. The great interest of this rock arises from its being the chief depository of the lead ore found in Iowa, Ill., and Wis. [On p. 290, by J. D. Whitney, is statement that city of Galena [Ill.] is surrounded by bluffs of Galena ls. On p. 350, also by Whitney, is statement that Galena ls. is most fully and characteristically developed on Miss. River in neighborhood of Galena and Dubuque.] Thickness [pp. 42, 56, 57, 58] 30 to 250 ft. [The so-called Trenton ls. of Hall is Platteville ls. of modern nomenclature, and is of Black River age.]

The Galena dol. continued for many years to be classified as post-Trenton, although J. Hall in 1862 (Wis. Geol. Surv. Rept. 1, pp. 32–33) assigned it to Trenton group. In 1873 (Minn. Geol. Nat. Hist. Surv. 1st Ann Rept.) N. H. Winchell stated that lower beds of Galena are interstratified with underlying Trenton ls., but he and others continued to treat Galena as post-Trenton. In 1879 (Geol. and Nat. Hist. Surv. Minn., vol. 3, pt. 2, Final Rept., p. lxxxix) N. H. Winchell and E O. Ulrich assigned the

Galena to the Trenton and the underlying so-called Trenton shales and lss. to the Black River. In 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 332–368) C. W. Hall and F. W. Sardeson also definitely assigned the Galena to the Trenton, and divided it and the underlying beds (also called Trenton) into several faunal zones. In 1895 (Am. Geol., vol. 15, pp. 33–39) N. H. Winchell stated: "It may therefore be considered that Galena ls. is only a phase of the Trenton intensified in its type region and fading out in all directions." In 1905 H. F. Bain (U. S. G. S. Bull. 246, pp. 18–19) introduced *Platteville ls.* for the beds underlying the massive-bedded Galena dol. in NW. Ill. and SW. Wis., which he stated are pre-Trenton. In 1906 the upper beds of Platteville ls. of Bain were removed from the Platteville by S. Calvin, who named them *Decorah sh.* and included them in his *Platteville stage.*

Since 1906 *Galena dol.* has been generally accepted as of Trenton age, as overlying Decorah sh., and as underlying Maquoketa sh. in upper Miss. Valley region. However, A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, p. 61, etc.), use *Trenton (Galena) group* to include (descending) Dubuque, Stewartville, Prosser, and Decorah exclusive of Spechts Ferry memb. of Kay, which they include in underlying Platteville ls. On p. 286 Kay also used this classification, but on p. 288 he stated that in northern Iowa and Minn. "it is *more convenient* [italics are Kay's] to consider the Spechts Ferry as a lowest memb. of Decorah fm."

Named for excellent exposures in bluffs of Mississippi River in neighborhood of Galena, Joe Daviess Co., Ill.

See also under *Decorah sh.* and *Platteville ls.*

†Galena series.

Middle Ordovician: Upper Mississippi Valley region.

F. W. Sardeson, 1896 (Am. Geol., vol. 18, pp. 356–368). ***Galena series*** is here used to designate the fms. that have been called *Trenton group* in Iowa, Ill., Wis., and Minn. [Included (descending) Galena dol., Decorah sh., and Platteville ls. of current nomenclature. The Galena and upper part of the Decorah are of Trenton age, but the Platteville is now generally considered to be of Black River age.]

A. C. Trowbridge et al., 1935 (Conf. Rept. Kans. Geol. Soc.), employed *Trenton (Galena) group* to include Galena ls. and Decorah sh. of previous repts, but this was not adopted by Iowa, Ill., Minn., and Wis. State Surveys, which adhered to Galena dol. for the beds overlying Decorah sh.

Galena King limestone.

Miners' local name for the principal ore-bearing ls. in Galena mine, Stockton dist., central northern Utah. Occurs in lower part of Oquirrh fm. (Penn.). Lies 550± ft. below Paisley ls. and about 113 ft. above Rambler fm., both local miners' terms. (See U. S. G. S. P. P 173, 1932.)

Galesburg shale. (In Kansas City group.)

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 36). ***Galesburg shales.***—Fossiliferous, sandy shales, 75 to 100 ft. thick, underlying Dennis ls. and overlying Hertha ls. [Later work proved this lower ls. not to be the Hertha but the younger Bethany Falls ls.]

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). ***Galesburg sh. memb. of Kansas City fm.*** (5 to 10 ft. thick in NW. Mo.) underlies Winterset ("Dennis") ls. memb. (25 to 40 ft. thick) and overlies Bethany Falls ls. memb. [This definition of Galesburg sh. was followed for many years. In Kans. the Kansas City deposits are treated as a *group* by U. S. Geol. Survey and Galesburg sh. as a fm. In SE. Kans. the Galesburg is treated as a memb. of Coffeyville fm.]

In 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 91, 97) R. C. Moore (1) revived *Dennis ls.;* (2) divided it into (descending) Winterset ls. memb. ("same as Winterset as previously recognized in Kansas and Mo."), Stark sh. memb., and Canville ls. memb.; and (3) stated: So-called Galesburg sh. of Kansas City is mainly Stark sh. Moore also assembled Bethany Falls ls. and underlying beds into a fm. which he named *Swope ls.* (q. v.), and assembled Dennis, Galesburg, and his Swope ls. into his Bronson group.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21), stated that Stark sh. and Canville ls. are present at both Dennis and at Galesburg, and that they are included in Galesburg sh. of Kansas City area, but he includes them in the Dennis, as explained under *Dennis ls.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 92+). In Linn Co., where Canville ls. disappears, Stark sh. rests on Galesburg sh., and lower 1 to 3 ft. of Stark sh. being there black fissile sh., it is easy to separate Stark and Galesburg shales. (Upper part of Stark is 2 to 5 ft. thick.) Where Canville ls. is missing in southern Kans. the absence of black sh. at horizon of Stark memb. makes it impossible to recognize Stark sh., and upper bdy of Galesburg sh. is here extended up to base of Winterset ls.

These changed definitions have not been considered by U. S. Geol. Survey for use in its publications. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Named for Galesburg, Neosho Co., Kans., which, according to R. C. Moore (1936), is built largely on Winterset ls.

Galesville member.

Upper Cambrian: Southern Minnesota and Wisconsin, Iowa.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 45, 79). It is proposed that *Dresbach fm.* be defined to include the sss. and shales that lie btw. the Red Clastic series and the Franconia in southern Minn. and northern Iowa, btw. the pre-Camb. and the Franconia in southern and central Wis., and btw. the Keweenawan and the Franconia along the Saint Croix, and that this fm. be subdivided into 3 members, the lower 2 of which are called Mount Simon and Eau Claire respectively, and that the new name *Galesville memb.* be applied to the uppermost memb. [now known as *Dresbach ss.*], which is exposed from top to bottom on the bluff of Beaver Creek at the mill dam at Galesville, Wis., where it is 86 ft. thick.

The foregoing classification was also used by Trowbridge et al in Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, passim; also by Twenhofel, Raasch, and Thwaites in Geol. Soc. Am. Bull., vol. 46, 1935, No. 11, pp. 1687–1744.

The U. S. Geol. Survey at present uses ***Dresbach ss.*** for the rocks underlying Franconia ss. and overlying Eau Claire ss.

Galice formation.

Upper Jurassic: Southwestern Oregon.

J. S. Diller, 1907 (Am. Jour. Sci., 4th, vol. 23, pp. 401–421). *Galice fm.*—Mainly dark to black slates, some ss. and cgl. Jurassic fauna. Well exposed at Galice, Oreg., on Rogue River, also on Galice Creek. [Table placed Galice fm. below Dothan fm., but p. 421 stated Galice overlies Dothan.]

J. S. Diller, 1914 (U. S. G. S. Bull. 546, pp. 17–18). Jurassic sed. rocks of Galice-Kerby-Waldo region consist of 2 fms.—Galice fm. on SE. and Dothan fm. on NW., separated by an irregular belt of igneous rocks, mainly greenstone and serpentine. Relative position indicates Dothan fm. is younger than Galice. The Cret. is markedly uncon. on Jurassic.

J. S. Diller and G. F. Kay, 1924 (U. S. G. S. Riddle folio, No. 218). Thickness of *Galice fm.* in this quad. 100 to 2,000 ft. Part of these rocks connect with type Galice. May include some unfossiliferous rocks older than Galice. Is thought =Mariposa fm. of Calif. Relations of Dothan fm. to Galice fm. not established, but believed to be uncon. Relations of Galice fm. to May Creek fm. (Dev.?) are a thrust fault.

Galisteo sandstone.

Tertiary (?): Central northern New Mexico.

F. V. Hayden, 1869 (U. S. Geol. and Geog. Surv. Terr. 3d Ann. Rept., pp. 40, 67, 90). *Gallisteo sand group.*—Variegated sands and sss., of varied texture, from a fine aggregate of quartz particles to a rather coarse puddingstone. In some beds are irregular layers of dull dusty brown concretionary aren. ls. Colors vary from light reddish to deep brick red, dull purplish, very deep yellow, white, brown, drab, etc. Only fossils enormous silicified trunks of trees. Named for fact that they are, so far as known, confined to valley of Gallisteo Creek, although they pass under the Santa Fe marls, and northern limit is concealed from view. Overlies Placer Mtn group. Are doubtless middle Tert.

Galisteo is commonly accepted spelling of this name.

Galiuro rhyolite.

Tertiary: Southeastern Arizona (Galiuro Mountains).

W. P. Blake, 1902 (Eng. and Min. Jour., vol. 73, p. 546). The Galiuro Range consists of ancient rhyolites which I name the "Galiuro rhyolite."

N. H. Darton, 1924 (geol. map of Ariz.), mapped the rocks of Galiuro Mtns as of Tert. age.

Galiuro limestone.

Pennsylvanian: Southeastern Arizona (Gila Basin).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 508, 517–521). *Galiuro ls.*—Name here applied to Penn. part of Ransome's Tornado ls., which is discarded, the Miss. rocks included under that name being Escabrosa ls. In certain ways the Galiuro ls. is different from Naco ls., the Penn. of extreme SE. Ariz. The beds composing it are individualized lithologically, as compared with the monotonous lead-gray ls. beds of the Naco. At type section (in Galiuro Mtns, at junction of Gila and San Pedro Rivers, 45± mi. NE. of Tuscon and 6 mi. E. of Winkelman, S. of Deer Creek coal field and Ash Creek, and at foot of Saddle Mtn) the Penn. beds are light-gray, white, and light-brown ls. beds rich in nodules and bands of chert, all very fossiliferous. In this part of mtns the fm. is 950 ft. thick. Uncon. overlain by Cret. cgls. and qtzites. Basal 40 ft. of Galiuro fm. consists of alternating aren. and argill. shales with layers of ls. at top, which may be conveniently called "Fusulinella beds." Next above are lss. that might be called "Marginifera beds." The overlying strata are white, yellow, brown, and pink ls., often silicified, and with frequent inclusions of cherty nodules. Upper part of Galiuro ls. consists of thinner-bedded pink and brown hard, compact lss., often more or less silicified and containing well-preserved bryozoan reefs, and may be called "Orthotichia beds." [Discusses fossils, and gives many details.]

Gallatin limestone.

Upper Cambrian: Southern Montana and northwestern Wyoming.

A. C. Peale, 1893 (U. S. G. S. Bull. 110), and 1896 (U. S. G. S. Three Forks folio, No. 24). *Gallatin fm.*—Mainly calc., 835 ft. thick. In vicinity of Three Forks, Mont., divided into (descending): (1) Pebbly lss. (light colored, laminated, yellowish brown at base, dove-colored at top with dark-blue layers), 145 ft.; (2) *Dry Creek shales* (brownish yellow, red, and pink, with shaly calc. sss.), 30 ft.; (3) *Mottled lss.*, 260 ft. (massive-bedded, the lower 20 to 25 ft. being laminated, light-gray or brownish); (4) *Obolella shales*, 280 ft. (more calc. than aren.; soft shaly beds with few thin ls. bands, dark greenish in lower part, lighter in upper part); (5) *Trilobite lss.*, 120+ ft. (thin-bedded dark-gray central part massive). Conformably overlain by Jefferson ls. and rests on Flathead shales. [In Bull. 110 mapped on both sides of Gallatin River near Gallatin, Mont. In Three Forks and Livingston folios is mapped in parts of Gallatin Range, SE. part of Three Forks quad. and W. part of Livingston quad. The Gallatin Range extends into NW. corner of Yel. Park.]

W. H. Weed, 1896 (U. S. G. S. Yellowstone Park folio, No. 30). *Gallatin ls.*—Named for typical occurrence in Gallatin Range [the S. extension of which is in NW. corner of Yel. Park], where it forms upper part of Camb. series and is 110 ft. thick. It is essentially a series of lss., more massively bedded than those of underlying Flathead fm., and forms first prominent ls. bluff that rises above the Archean areas. Lowest bed is massive mottled black and gray ls. 50+ to 100 ft. thick. Above this mottled ls. the rocks are more thinly bedded and carry Upper Camb. fossils. Is overlain by Jefferson ls. [Since base of Gallatin ls. is here drawn at base of †Mottled ls., this definition of Gallatin is a restriction of Peale's

1893 definition. In 1918 the beds btw. base of †Mottled ls. and top of Flathead qtzite were named *Gros Ventre fm.* The Gallatin ls. as now generally accepted is overlain by Jefferson ls. and underlain by Gros Ventre fm. and is considered to be wholly of Upper Camb. age.]

Gallatinian series.

A term applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to part of Belt series of Mont.

Gallego sandstone member (of Miguel formation).

Upper Cretaceous: Southwestern New Mexico (Alamosa Creek Valley, Socorro County).

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A). Massive yellow ss. containing *Halymenites*. Thickness 93 ft. Occurs near middle of Miguel fm., about 983 ft. below Bell Mtn ss. memb. Named for Gallego Creek, Socorro Co.

Gallegos sandstone.

Pennsylvanian (?): Central northern New Mexico (Sandia Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 3, 7). *Gallegos sss.*—Thick ss. beds in middle of Maderan lss. in Sandia Range. Thickness 100 ft. [Derivation of name not stated.]

Gallinas shale.

Name introduced by C. [R.] Keyes (Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 7) for 200 ft. of shales forming "basal memb. of Coloradan series, well developed on Gallinas Creek, near Las Vegas."

Gallitzin limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania (Armstrong County).

J. P. Lesley, 1880 (2d Pa. Geol. Surv. Rept. H_5, p. 312), applied *Gallitzin ls.* to a concretionary ls. described by W. G. Platt in body of this rept as separated from overlying Gallitzin coal by 2 ft. of shales and from *underlying* Johnstown iron ore (which rests on Lower Mahoning ss.) by 10 ft. of shales.

J. D. Sisler, 1925 (Pa. Geol. Surv., 4th ser., Bull. M_7, p. 268), gives following downward succession of beds in lower part of Conemaugh fm. of Somerset Co., Pa.: Elk Lick ls., Berlin coal, Berlin ls., Platt coal, Price coal, Coleman coal, Coleman ls., Philson (Rose) coal, Philson ls., *Johnstown iron ore,* Brush Creek (Gallitzin) coal, Mahoning ss.

Gallup sandstone member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup-Zuñi Basin).

J. D. Sears, 1925 (U. S. G. S. Bull. 767). *Gallup ss. memb.*—Three thick persistent cliff and ridge-forming sss. traceable throughout Gallup-Zuñi Basin. Upper and in places lower sss. are pink on E. side of basin; all 3 are generally light-gray on W. side of basin, but in places the upper ss. is pink or red. The upper ss. contains lenses of very coarse grains, in many places an arkose. Between the sss. are sh. The lower sh. contains several thin coal beds. The upper sh. contains at most places from 1 to 3 commercial coal beds. Thickness of memb. 180 to 250 ft. Underlies Dilco coal memb. Is basal memb. of Mesaverde fm. in this basin. Overlies (conformably) Mancos sh. Named for town of Gallup, part of which is built on uppermost ss. bed.

†Galt limestone.

See under *Guelph dol.*

Galt moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Galt sand.

A subsurface sand, 25± ft. thick, in upper (Trinity) part of Comanche Cret. of Talco field, Titus and Franklin Counties, Tex., lying lower than Carr sand. Named for Galt well No. 1 of Humble Oil & Refining Co.

Galton series.

Name applied by R. A. Daly (Canada Dept. Int., Rept. Chief Ast. 1910, vol. 2, p. 97, pl. opp. p. 178, 1913) to rocks in Gallatin Range (Montana-British Columbia) which he correlated with pre-Camb. rocks classified by U. S. Geol. Survey as Belt series, but which he classified as Lower, Middle, and Upper Camb. Includes Roosville fm. at top and Altyn ls. at base.

Galum limestone member (of McLeansboro formation).

Pennsylvanian: Southwestern Illinois (Perry County).

A. H. Bell, C. Ball, and L. McCabe, 1931 (Ill. Geol. Surv. Press Bull. No. 19). *Galum ls. memb.*—Earthy yellow nodular ls.; fossils rare or absent. Thickness 3 ft. Top lies 6 to 19± ft. below Cutler ls. memb. and base lies 35± ft. above Herrin (No. 6) coal in vicinity of Pinckneyville and Jamestown, Perry Co. Well exposed along Galum Creek, near Pinckneyville.

Galway formation.

Upper Cambrian: Eastern New York.

J. M. Clarke, 1910 (N. Y. State Mus. Bull. 140, pp. 11–12 and map). *Galway fm.*—A series of distinctly transitional beds underlying Little Falls dol. and overlying Potsdam ss. in Broadalbin quad., Fulton and Saratoga Counties. Best developed at Galway, Saratoga Co.

W. J. Miller, 1911 (N. Y. State Mus. Bull. 153, pp. 8–38 and map), described and mapped the rocks btw. Little Falls dol. and Potsdam ss. in Broadalbin quad. as *Theresa fm.*, a name that has priority over Galway fm.

Only record of Galway fm. is Clarke's 1910 publication.

Gamache series.

An abbreviated form of *Gamachian series.*

Gamachian series.

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 700). *Gamachian series*, of Cincinnatic system, follows Richmondian series and has no known representative elsewhere in North America [than Mingan and Anticosti Islands, Gulf of St. Lawrence]. These strata are seen to best advantage at Gamache (or Ellis) Bay, where the characteristic fossils of the series occur in abundance. On Anticosti it embraces all of Ellis Bay stage, but eventually it may possibly be shown that upper portion of Charleton stage should be included in this series. In other words, this Gamachian series is intended to include all American deposits later in age than the youngest Richmondian of Ind. and Ohio and older than Anticosti series, which in United States is thought to have its basal equiv. in typical Medina and Edgewood stages. [Schuchert's *typical Medina* is upper Medina or Albion ss.]

E. O. Ulrich, 1913 (12th Int. Geol. Cong., Canada, p. 15). The Gamachian series of Schuchert "corresponds to lower part of upper Medina [Sil.] and name is superfluous."

W. H. Twenhofel, 1914 (Canada Geol. Surv. Mus. Bull. 3, p. 8). *Gamachian series* (*Ellis Bay fm.*) assigned to Ord.; is younger than any div. assigned to Richmond, and older than any North American fm. referred to Sil. [Its large fauna listed.]

The 1915 edition of Pirsson and Schuchert's Textbook of geol., pt. 2, p. 629 (table), showed *Gamache* as overlying Richmond and underlying Oswegan, and as forming topmost Ord. In index *Gamache series* was used. The 1924 edition of this Textbook also included *Gamache* in Ord. and placed it above the Richmond.

A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, p. 27). The Upper or Gamachian div. of the Richmond has little in common with Richmond faunas elsewhere, except in the case of those species which were already present during Vaurial time and which continued their existence into the overlying Gamachian or Ellis Bay div.

The foregoing are only records of this name.

Gammon ferruginous member (of Pierre shale).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Gammon ferruginous memb.*—Basal memb. of Pierre sh. in NE. Wyo. and SE. Mont. Consists of 800 to 1,000 ft. of light-gray mudstone and sh. with abundant concretions and thin beds of siderite. Fossils scarce, but consist of marine species. Commonly forms bare buttes. Includes Groat ss. bed, 150 ft. thick, near top and Pedro bentonite bed at base. Rests on Beaver Creek chalky memb. of Niobrara fm. There is a possible uncon. at or near base of Gammon memb. Named for exposures along Gammon Creek, in T. 57 N., Rs. 67 and 68 W., Cook Co., Wyo.

Ganado series.

Tertiary or Pleistocene: Northeastern Arizona. See 1932 entry under *Bidahochi fm.*

Gander Run shale member. (In Hamilton group.)

Middle Devonian: Central Pennsylvania (Bedford County).

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, June 1935, p. 361). [See this citation under *Mahantango fm.* Not defined.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, Aug. 31, pp. 1279, 1282). Near Chaneysville, Bedford Co., Pa., Mahantango fm. is divided into 3 intergrading members (descending): Frame sh. memb., 343 ft.; Chaneysville ss. memb., 182 ft.; and *Gander Run sh. memb.*, 850 ft. The Gander Run memb. consists of brown-weathering, dark-gray sandy sh. with some shaly ss. Rarely well exposed and nearly barren. Named for stream occupying the valley underlain by these strata 6 to 8 mi. N. of Chaneysville. Not recognized in Blair Co.

Ganges formation.

Cretaceous: British Columbia.

C. H. Clapp, 1917 (Canada Geol. Surv. Mem. 96, p. 229).

Gannett group.

Cretaceous(?): Southeastern Idaho and southwestern Wyoming.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98G, pp. 76, 82, 83). *Gannett group.*—Includes 5 distinct subdivisions (descending): Tygee ss., 100 ft.; Draney ls., 200 ft.; Bechler cgl., 1,775 ft.; Peterson ls., 205 ft.; and Ephraim cgl., 1,025 ft. Total thickness over 3,300 ft. Rests with apparent conformity on Stump ss. (Jurassic) and is uncon. overlain by Wayan fm. Fossils not distinctive but probably Cret. Named for Gannett Hills, in Bannock Co., Idaho, and Lincoln Co., Wyo., in E. part of Wayan quad., where all of its fms. are well exposed.

Gannett erosion cycle.

Name applied by G. R. Mansfield (Jour. Geol., vol. 32, 1924, p. 485) to a Pleist. erosion cycle in SE. Idaho.

Gansevoort.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Gansevoort* introduced for middle Canajoharie or zone of *Glossograptus quadrimucronatus cornutus* in Mohawk Valley.

†Gant bed.

Silurian (Niagaran): West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 576, 582–583). *Gant bed.*—Fossiliferous lss. underlying Hardin ss. and forming upper part of Brownsport bed in vicinity of Martin's mill, on Indian Creek, Wayne Co. Includes at base the 5 to 10 ft. of coarse sandy fossiliferous ls. here named *Gant ls.* This is overlain by 9 ft. of bluish better-bedded ls., partly fine-grained and partly crinoidal, succeeded by 14 ft. of much weathered and poorly exposed lss.

Nongeographic name. Replaced by Bob crystalline ls. memb. of Brownsport fm., of which it composes middle and upper parts.

Named for A. B. Gant homestead, about 1 mi. NE. of Martin's mill, Wayne Co. (Mr. Gant no longer lives here.)

†Gant limestone.

Silurian (Niagaran): West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 576, 582-583). [See explanation under †*Gant bed.*]

Gantz sand.

A subsurface sand, of late Dev. or Miss. age, 15 to 60 ft. thick, lying 1,916 ft. below Pittsburgh coal in eastern Greene Co., Pa. Named for Gantz farm, Franklin Twp., Washington Co., Pa. Considered to be part of 100-foot sand.

†Gap latite.

Miocene: Southwestern Colorado (Platoro-Summitville region).

Field name used by E. S. Larsen for rocks he named *Fisher quartz latite.* This field name crept into print in Colo. Geol. Surv. Bull. 13, 1917, simultaneously with the adopted name.

Gap sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage and Washington Counties).

M. I. Goldman, 1920 (U. S. G. S. Bull. 686W, pp. 330, 333). *Gap ss.*—Named for occurrence at top of Gap Ridge, in SW. cor. of T. 29 N., R. 13 E., in NW. cor. of Washington Co. The gap, locally known as "Osage Gap," through which pass a high road and the branch of Atchison, Topeka & Santa Fe Ry btw. Pawhuska, Okla., and Caney, Kans., cuts through this ridge. In its exposure at the gap the ss. is 10 ft. or less thick, but thickens to N., where it forms surface of most of Ramsey anticline. It is=part of Revard ss. of neighboring Twps. Is very lenticular. Not recognized to W. across valley of Coon Creek, in sec. 32, T. 29 N., R. 12 E., and can be seen to pinch out within ½ mi. to S. of the gap. Lies short distance [15± ft. in later repts] below Possum ss.

Gaptank formation.

Pennsylvanian: Western Texas (southeast of Glass Mountains).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex., Bur. Econ. Geol. and Tech. Bull. 44, p. 47). *Gaptank fm.*—Named by Udden. Consists of (descending): (1) Mainly several masses of ls. separated by shaly and sandy material; (2) shales interbedded with lss.; (3) cgls. alternating with lss., sss., and shales. Thickness 1,500± ft. Is of upper Penn. age, and probably=Cisco fm. Occurs at Gaptank, 24 mi. NE. of Marathon, and extends short distance to SE. and 15 mi. to SW. [This definition included beds named *Wolfcamp fm.* in 1917.]

J. A. Udden, 1917 (Univ. Tex. Bull. 1753, pp. 38-41, pl. 3). *Gaptank fm.* [restricted] underlies Wolfcamp fm., where latter is present, and uncon. underlies Hess fm. where Wolfcamp is absent. Böse and C. L. Baker rept uncon. at base. Overlies Haymond fm. *Uddenites* zone included in Wolfcamp fm.

E. Böse, 1917 (Univ. Tex. Bull. 1762, pp. 15-16, 21-22). *Gaptank fm.* as originally defined included Wolfcamp fm. As now restricted consists of mostly shales, lss., and ss. of uppermost Penn. age. Underlies Wolfcamp fm. and overlies Haymond fm. *Uddenites* zone included in Wolfcamp fm.

I. A. Keyte, W. G. Blanchard, Jr., and H. L. Baldwin, Jr., 1927 (Jour. Pal., vol. 1, pp. 175-178, pl. 31), placed *Uddenites* zone in Gaptank fm., 400 ft. below base of Wolfcamp fm.

C. Schuchert, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 383-400). Writer believes *Uddenites* zone belongs to Wolfcamp fm., but Keyte, Blanchard, and Baldwin believe it belongs to Gaptank fm. It is here included in Wolfcamp. There is an uncon. at its base.

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). *Uddenites* zone is basal part of Wolfcamp, and there is uncon. at its base.

I. A. Keyte, 1929 (A. A. P. G. Bull., vol. 13, pp. 903-906). *Uddenites* zone belongs in Gaptank fm., and there is an erosinal uncon. btw. it and overlying Wolfcamp fm., and the faunas are different.

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 925). *Uddenites memb.* of Wolfcamp fm. is uncon. on underlying rocks.

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 43-57). *Uddenites memb.* included in base of Wolfcamp fm. (basal Perm.). R. E. King and writer are convinced of Perm. age of this memb., which is uncon. on older beds. Present investigation has shown that Wolfcamp fm. is present along almost the whole of Glass Mtns escarpment. Near type loc. it consists in large part of green or blue clay shales, with rather abundant thin fossiliferous ls. beds; but to SW., where the fm. encroaches upon the strongly folded rocks, it becomes coarsely clastic, with several hundred ft. of basal cgl. followed by sandy shales with sparse fossils. Thickness at type loc. 700 ft. For convenience of reference and mapping Wolfcamp fm. is here divided into 3 members (descending): (1) Upper memb., comprising about three-fourths of total thickness, is largely blue and green clay shales with thin layers of ls., and contains unmistakable Perm. fossils, including *Schwagerina,* which first appears at base of this memb.; (2) the Gray ls. memb., a rather thick-bedded, scarp-forming ls. about 50 ft. thick, containing few fossils; (3) *Uddenites memb.,* consisting of sh. with a few thin ls. beds, and varying in thickness up to 300 ft. The *Uddenites memb.* is exposed ¾ mi. NE. of summit of Leonard Mtn, but is absent W. of Leonard Mtn, where basal beds of Wolfcamp fm. are cgls., ranging from 10 ft. thick W. of Iron Mtn to 450 ft. near Lenox. The Gaptank fm. is 1,800 ft. thick in vicinity of Gap Tank. Its basal bed is the *Chaetetes* ls., 50 ft. thick, characterized by large masses of *Chaetetes milleporaceous.* [Gives detailed sections and fossil lists of Gaptank and Wolfcamp fms.] Cgls. first appear in Gaptank fm. several hundred ft. above its base. They are 15 to 50 ft. thick and 5 in number in one area. In upper 788 ft. of Gaptank fm. are 5 lss., 40 to 75 ft. thick, separated by sss. and shales. The 5th ls. is top bed of fm.

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pl. 103), treated *Uddenites-bearing sh. memb.* as top bed of Gaptank fm., and assigned it to Penn. This is present definition of U. S. Geol. Survey. (See also *Wolfcamp fm.*)

Named for a tank, sometimes locally called "Gap Tank," located in a gap locally called Stockton Gap and Marathon Gap.

Garber sandstone.

Permian: Central northern Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Garber ss.*—A series of red clay shales, and red sandy shales, and red sss. overlying Wellington fm. and underlying Hennessey sh. in north-central Okla. Divided into Lucien sh. memb. below and Hayward ss. memb. above. Included in Enid group. Thickness 600 ft. Named for exposures at Garber, Garfield Co.

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 252–256). *Garber fm. redefined.*—Aurin, Officer, and Gould give 600 ft. as thickness of Garber. They indicate considerable more thickness and greater breadth of outcrop for Garber of this area (Logan and Lincoln Counties, Okla.) than writer has found, but their thicknesses and contacts were only approximates. Writer finds thickness 260 to 300± ft., instead of 600 ft. as given by them. The base is not far from where writer has mapped it, but top in northern Logan Co. is about 6 mi. W. of where writer shows contact. Since most geologists familiar with area are agreed on top of Garber at Oklahoma City, and since no one can find a horizon for top of Garber as shown by Aurin, Officer, and Gould W. of Guthrie, Hayward, and Garber, it is proposed top of Garber be taken as that recognized at Oklahoma City, which is shown correctly by A. Travis on his map of Oklahoma Co. (Okla. Geol. Surv. Bull. 40, vol. 2, map 37). This is best break from predominant sand deposition to predominant sh. deposition, and a much more mappable top contact than that indefinitely defined by Aurin, Officer, and Gould. The Garber of S. part of Logan Co. is probably 90 percent ss., but at N. line of Co. it is about half ss. and half sh.

J. C. Ross, 1933 (A. A. P. G. Bull., vol. 17, No. 3, p. 255). Referring to Patterson's paper, serious objection can be made to what amounts to redefinition of fms. established by Aurin, Officer, and Gould in 1926, which is foundation on which later work must be based, or at least until their divisions are superseded. Their paper was defective in that type areas of the new fms. were not definitely set out, and no means were provided for identifying the contacts and working them both ways, but it was published before the present mass of detail was accumulated. In Logan Co. area their divisions are readily made out, at least in a thin zone, and it is not certain they should be changed. Patterson's divisions are more prominent beds, and for Logan Co. area more convenient. Agreement, however, would have to be reached concerning a much greater area, from Garvin to Noble, to upset the boundaries established by the nomenclators.

Garber sand.

A subsurface sand in SW. Okla., correlated with a part of Garber ss. (Perm.). The name has also been applied to a subsurface sand in central northern Okla. correlated with basal part of Pawhuska fm. (Penn.). In Garber pool, Garfield Co., the latter sand lies at 2,000 ft. depth, the Crews sand at 1,800 ft., and the Hoover at 2,400 ft.

†Garber limestone.

Miners' local name for an ore-bearing ls. in Deseret ls. (upper Mississippian), Ophir dist., central northern Utah. Is worked in Garber tunnel. (See U. S. G. S. P. P. 173, 1932.)

Gardeau shale member (of Portage formation).

Upper Devonian: Western and west-central New York.

J. Hall, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 390–392, 452–455). *Gardeau flagstones or Lower Fucoidal group.*—Thick mass (100 to 250 ft.) of sh. and flagstones, or thin strata of fine-grained ss. at intervals of a few ft. and often a few inches. Throughout greater part of group the lower surfaces of the sss. are covered with fucoides and one side is covered with a glazing of sh. Along Genesee River this group commences a short distance above Mount Morris and continues to lower falls at Portage. Most extensively exposed along Gardeau Reservation [Livingston and Wyoming Counties], hence name. Underlies Portage or Upper Fucoidal group [Nunda ss.] and overlies Cashaqua sh., the intervening Ithaca group being absent in these counties (Steuben, Allegany, Cattaraugus, Livingston, and Genesee) and in Genesee Valley.

D. D. Luther, 1902 (N. Y. State Mus. Bull. 52). Hall's Gardeau divided into (descending): (1) *Gardeau flags,* 428 ft.; (2) ss. correlated with Grimes ss., 25 ft.; (3) flags and shales [later named Hatch sh.], 209 ft.; (4) second black band [later named Rhinestreet sh.], 52 ft.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 78), included Dunkirk sh. of Erie Co. in the Gardeau as restricted by Luther (see 1912 quotation under *Portland sh.*), stating that it occurs next above horizon of Grimes ss., and apparently within basal Gardeau.

F. Houghton, 1914 (Buffalo Soc. Nat. Sci. Bull., vol. 11). The Dunkirk sh. is distinct enough to warrant our excluding it from the Gardeau. [He excluded it in his classification, but stated that it merged with the Gardeau.]

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), applied *Gardeau sh.* to beds btw. Nunda and Grimes sss. in Cattaraugus and Allegany Counties, but placed Dunkirk sh. at a much higher strat. horizon, where it is still placed.

In 1930 the U. S. Geol. Survey adopted, for use in its publications, *Gardeau sh. memb. of Portage fm.* for the beds underlying Nunda ss. (†Portage ss. of some authors) and overlying Grimes ss. This is definition of N. Y. State Survey, 1931. (See W. Goldring, N. Y. State Mus. Hdb. 10, p. 369.)

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96, 98, 193), proposed to restrict Gardeau to lower part of the Gardeau of previous repts and named the upper part *Letchworth sh.*

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included Gardeau and underlying Grimes in Chemung group.

†Garden limestone.

An abbreviated form of *Garden City ls.* (Lower Ord. of Utah) employed by C. [R.] Keyes.

Garden City limestone.

Lower Ordovician (Beekmantown): Northeastern Utah and southeastern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 407, 408). *Garden City ls.*—Thick- and thin-bedded gray ls., 1,000 ft. thick. Conformably underlies Swan Peak qtzite and overlies St. Charles ls. with evidence of erosional uncon. Contains Beekmantown fauna.

Named for exposures in Garden City Canyon, Rich Co., NE. Utah.

Garden Creek phyllite.

Cambrian (?): Southern central Idaho (Bayhorse quadrangle).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Garden Creek phyllite.*—Intensely sheared and metamorphosed argill. rocks at least several hundred ft. thick. Base not exposed. Underlies Bayhorse dol. with uncon. (?). Named for creek on which Challis is located.

C. P. Ross, Oct. 31, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 941, etc.). *Garden Creek phyllite.*—Exclusively soft, easily weathered dark-gray, nearly black phyllite, locally slightly calc., with abundant sericite on cleavage surfaces. Bedding is represented by thin crenulated bands, visible only on close inspection. Several hundred ft. thick. Base nowhere exposed. Recognized only along inner gorges of Garden and Bayhorse Creeks, in N. part of Bayhorse quad. Provisionally referred to Camb. No fossils.

Garden Gulch member (of Green River formation).

Eocene: Northeastern Utah (Uinta Basin) and northwestern Colorado (Garfield and Rio Blanco Counties).

W. H. Bradley, 1931 (U. S. G. S. P. P. 168). *Garden Gulch memb. of Green River fm.*—Light-gray beds. Characteristic feature paper sh. with discrete laminae less than 1 mm. thick, which constitutes 20 to 40 percent of memb. and occurs in unbroken units 20 to 70 ft. thick, intercalated with thicker units of flaky sh. and thickly laminated marlstone, some of which is shaly. Contains only a few beds of fine-grained ss. and siltstone. Total thickness 200± ft. in Hells Hole Canyon, near Watson, Utah, and 700± ft. in Parachute Creek Canyon, N. of Grand Valley, Garfield Co., Colo. Overlies Douglas Creek memb. and underlies Parachute Creek memb. Named for thick exposures in bluffs near mouth of Garden Gulch, a short tributary of Parachute Creek, in secs. 7, 8, T. 6 S., R. 96 W., Garfield Co., Colo.

†Gardiner interval.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard, Gardiners Island, etc.).

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). [See 1906 item under †*Gayhead interval.*]

Gardiner clay.

See *Gardiners clay.*

Gardiners clay.

Pleistocene: Southeastern New York (Long, Gardiners, and Fishers Islands) and islands of southern New England (Block, Nantucket, Marthas Vineyard, No Mans Land, and probably Cape Cod).

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367–390). *Gardiner clay* (interglacial), 30 to 150 ft. thick. Conformably overlies Jameco gravel (glacial) and conformably underlies Jacob sand (interglacial) on Fishers Island. Correlated with early part of Yarmouth stage of Mississippi Valley.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467–469). *Gardiner clay.*—In some places occurs as a single bed; in other places is split into a series of clays interbedded with sands. Color varies from red through gray and brown to black. Small shell fauna. Present on Long Island, Fishers Island, Block Island, Marthas Vineyard, Cape Cod, and Mass. coast to Boston.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Gardiners clay,* named for Gardiners Island, at E. end of Long Island, on which several clay beds with included sands are well exposed at a number of places. Time of deposition is called *Gardiners stage.* Outcrops at many places on Long Island, and is found on Robins, Plum, Fishers and Gardiners islands.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Gardiners clay* occurs on Block and Nantucket Islands, Marthas Vineyard, No Mans Land, and is doubtfully identified on Cape Cod.

Gardiners stage.

The time covered by deposition of *Gardiners clay.*

Gardner dolomite.

Mississippian (lower): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Gardner dol.*—Is recognized as a distinct fm. because it contains a great variety of recognizable fossils, most of which were found on spur W. of Gardner Canyon. Fm. consists chiefly of fine-grained gray to dark bluish-gray dol.; small chert nodules in some beds; a few beds of black dense carbonaceous ls. interstratified. Top is mapped at base of lowest exposed black cherty beds of Pine Canyon ls. At or near top is 100 ft. of black highly carbonaceous and pyritic shaly ls. Thickness 435 to 700 ft. Overlies Victoria qtzite. Fossils are of Madison age, G. H. Girty says.

Garfield sandstone. (Of Chester group.)

Mississippian: Western central Kentucky.

A. F. Foerste, 1910 (Ky. Geol. Surv. Rept. Prog. 1908 and 1909, pp. 79, 84). *Garfield ss.*—Chiefly ss., but locally replaced to considerable extent by clay. Thickness 127 ft. Underlies Stephensport bed and overlies Clover Creek ls. in Meade and Breckinridge Counties.

According to C. Butts, 1917 (Ky. Geol. Surv., Miss. series in west Ky., p. 87), this is Cypress ss.

Named for Garfield, Breckinridge Co.

Garfield formation.

Pennsylvanian: Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 66). *Garfield fm.*—In descending order: (1) Dominantly qtzite with subordinate sh. beds; (2) dominantly sh. with some qtzite; (3) chiefly ls. with interstratified black sh., 200 ft.; (4) black sh. with thin strata of qtzite and impure ls., 700 ft.; (5) qtzite and cgl. 30 ft. Total thickness 2,600 to 2,800 ft. Overlies Ouray ls. (Miss.-Dev.), with apparent conformity. Uncon. underlies Kangaroo fm. Named for Garfield, Chaffee Co. Fossils [listed].

Garfield formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, and maps). *Garfield fm.*—Banded (black and red) fine-grained hard, cherty ferruginous qtzite, in many places highly pyritiferous. Graphitic schists usually overlie the qtzite, and are also pyritiferous. The fm. is locally known as "Iron Dike," because of iron content and long dikelike outcrops. Thickness 60 ft. Believed to be of Keewatin age. Older than Pluma fm. and younger than Northwestern fm.

Derivation of name not stated, but occurs in Lead dist., Lawrence Co.

Garfield sand.

Drillers' term; western Pa.; see under *Cherry Grove sand.*

Garibaldi volcanic formation.

Pleistocene: British Columbia.

E. M. J. Burwash, 1918 (The geol. of Vancouver and vicinity, p. 77).

†Garland conglomerate. (In Pottsville formation.)

Pennsylvanian: Northwestern Pennsylvania.

J. F. Carll, 1875 (2d Pa. Geol. Surv. Rept. I, pp. 38, 45–46). *Garland cgl.*—The cgl. capping the hills at Garland, Warren Co. [On p. 38 is called *Olean cgl. (Garland).*]

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_3, pp. 12–57). *Garland cgl.* is used in these pages as a convenient local geographical name for lowest memb. of Carbf. Cgl. series in NW. part of State. It is apparently identical with Olean cgl. of McKean Co. At Garland quarries, about 1 mi. NW. of Garland, it is 40 ft. thick, massive, coarse grained, obliquely bedded, yellow and white in some parts, iron stained in others, with pebbly horizontal layers and pockets, especially in lower portion. Basal deposit of Pottsville cgl.

Replaced by Olean cgl. memb. of Pottsville fm., better-established name.

Garland sand.

Drillers' term for a sand of Upper Dev. (Chemung) age in NW. Pa.

Garley Canyon sandstone member (of Mancos shale).

Upper Cretaceous: Central eastern Utah (Book Cliffs and Wasatch Plateau).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, p. 438). *Garley Canyon ss. memb. of Mancos sh.,* 0 to 140 ft. thick, lies considerable distance below Emery ss. memb. of Mancos and considerable distance above Ferron ss. memb. in Wasatch Plateau. [Named for prominent exposures in walls of Garley Canyon, Carbon Co. Later repts give distance below Emery ss. as 400 to 500 ft., and distance above Ferron ss. as 2,300 to 2,400 ft.]

Garner formation. (In Strawn group.)

Pennsylvanian (Allegheny): North-central Texas (Brazos River region).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 108). *Garner fm.* has been proposed by G. Scott and J. M. Armstrong (ms. of geol. rept. on Parker Co.) to include lower part of Mineral Wells fm. of Plummer and Moore. Consists of a coal seam, shales, ss., and cgls.; some thin lss. are present, one near middle of Mingus memb. Thickness of fm. 400 to 500 ft. The Thurber coal with some associated thin lss. and shales marks the beginning of the fm. Next overlying this memb. is Mingus memb., consisting of 250 or 300 ft. of sandy sh. The overlying Brazos ss. and cgl. (top memb. of Garner fm.) is 25 or 30 ft. thick. [On p. 106 Sellards listed, beneath the Thurber coal, the following members in Garner fm. (descending): Goen ls., Plummer, 1929; Santo ls., Plummer, 1929; and Barton Creek ls., Plummer, 1929, preoccupied and discarded.] Type loc., Garner, Parker Co.

F. B. Plummer and J. H. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15–30). *Garner fm.* was named by Scott and Armstrong (unpublished ms.) to include all strata in Brazos River section from base of Thurber coal up to top of Brazos River ss. (25 to 75 ft. thick). The beds (145 to 210 ft. thick) btw. Thurber coal and Brazos River ss. comprise the Mingus sh. memb. The fm. is a shallow-water partly marine, partly fluviatile, and partly lacustrine deposit. It is uncon. on Millsap Lake fm.

Garnet Range formation.

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deiss, 1921 (Geol. Soc. Am. Bull., vol. 42, p. 681, figs. 2, 3). *Garnet Range fm.*—Chiefly qtzites of different colors and types, but including some argillite and ss. Thickness 7,600 ft. Conformably underlies Sheep Mtn. fm. and overlies McNamara fm., all included in Missoula group. [Detailed section given.] Type loc. on N. side of Blackfoot Canyon from Johnson Gulch 2 mi. E. of Bonner eastward to 1 mi. from mouth of West Twin Creek. Blackfoot Canyon forms NW. bdy of Garnet Range, the W. part of which is composed largely of rocks of Garnet Range fm.

†Garnett limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 110, 120–121). Hard compact lss., separated into two parts by 8 to 10 ft. of sh. Here called *Burlington or Garnett ls.,* ultimate choice of name being left to future. Overlies Le Roy shales. Separated from higher Strawn ls. by 75 to 100 ft. of sh.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. Mines, vol. 13). "Garnett ls." of Kans. includes (descending) Stanton ls., Vilas sh., and Plattsburg ls.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 70). Moore's restricted *Lansing group,* to include only Stanton ls., Vilas sh., and Plattsburg ls., corresponds to Garnett ls. of early Kans. Surv. The revival of *Garnett* might not be desirable, however, inasmuch as the term has been used for several different units and has never had wide acceptance.

Named for Garnett, Anderson Co.

Garnuan series.

A term introduced by C. [R.] Keyes for a part of the pre-Camb. rocks of N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 7. Derivation of name not stated.)

Garrard sandstone. (In Eden group.)

Upper Ordovician: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 2). *Garrard ss.*—Calc. ss. and sh. or mudstone. 70 to 130 ft. thick, grading imperceptibly into Richmond fm. above and into Winchester ls. below.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 8–23). *Garrard substage* (top div. of Eden stage of central Ky.) consists of 65 ft. of fine-grained ss. with concretionary layers in middle. To N. ss. is wanting at this horizon. Lower part of Eden stage consists of 200 ft. of blue sh. and thin lss., overlying Winchester substage [restricted to lower 40 ft. of Campbell's Winchester]. The lower beds of Eden age were named *Million sh.* by J. M. Nickles in 1905. This sh. underlies Garrard ss.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7). *Garrard ss.* of Richmond folio [as mapped?] includes Mount Hope bed and Paint Lick bed.

G. C. Matson, 1909 (U. S. G. S. W. S. P. 233). *Garrard ss. memb. of Eden sh.*—Upper part of Eden sh. in S. part of Blue Grass region, Ky. Consists of shaly sss., in some places concretionary, having max. thickness of 150± ft. Thins gradually to N. Lower part of Eden consists of blue sh. with sandy layers and locally beds of ls.

Named for Garrard Co.

Garrett conglomerate.

Lower Cretaceous (Comanche series): Northeastern New Mexico.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 2, 7). *Garrett cgl.*, 50 ft. thick, basal memb. of Early Cretacic section in NE. N. Mex. and SW. Kans. [Derivation of name not stated. Keyes has also applieu the name in Colo. He describes it as older than Kiowa sh.]

Garrett Mill sandstone member (of Warsaw formation).

Mississippian: Southeastern Kentucky and northern central Tennessee (Overton County).

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, pp. 89, 107, 122). *Garrett Mill ss. memb.*—Generally flaggy ss., 5 to 10 ft. thick. Is persistent throughout northern Overton Co. and thence as far N. as Pulaski Co., where it is represented by a few inches of sandy ls. at top of the Warsaw in bluff of Cumberland River just N. of Burnside. It is the only ss. in a considerable thickness of ls., and extends over several counties (Overton Co., Tenn., to Pulaski Co., Ky.). Is top memb. of Warsaw fm. Lies stratigraphically higher than Somerset sh. memb. of Warsaw. [Page 122 shows a few ft. of sh. btw. St. Louis ls. and Garrett Mill ss.] Named for exposures at Garrett Mill, on Eagle Creek, 3 mi. N.-NE. of Livingston, Overton Co., Tenn. The mill stands on the ss.

Garrison shale. (In Council Grove group.)

Permian: Eastern Kansas, northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 712). Florena shales below (2 to 13 ft. thick) and Neosho memb. above (130 ft. thick), with aggregate thickness of 140 to 145 ft., are now united to form *Garrison fm.*, so named on account of good exposures from Garrison S. in Big Blue Valley.

This name was continued in use for many years. In 1936 (Kans. Geol. Surv. Bull. 22, pp. 50, 251) R. C. Moore discarded the name, treating the numerous named subdivisions into which it had in recent years been differentiated as fms. within Council Grove group. The U. S. Geol. Surv. has not yet had occasion to reconsider retaining the name for its publications.

Named for exposures at Garrison, Pottawatomie Co., Kans.

Gartland oil sand.

Drillers' term; western Pa.; see under *Cherry Grove sand.*

Garvin beds.

Permian: Central southern Oklahoma (Garvin County).

A. R. Denison, 1923 (A. A. P. G. Bull., vol. 7, No. 6, pp. 627–644). *Garvin beds.*—Upper part of subsurface Perm. in Robberson field, Garvin Co. Consists of 1,200 ft. of "red beds," gumbo, and gravel with one or two ls. beds, one of which, occurring from 950 to 1,000 ft. depth, is recorded as present in most of early wells drilled for which accurate logs were made. Carries a few water sands near surface. Overlies Mauldin beds and underlies Perm. shales and sss.

Gary moraine (also **morainic system**).

Pleistocene (Wisconsin stage): South Dakota, North Dakota, Minnesota, Iowa.

T. C. Chamberlin, 1883 (U. S. G. S. 3d Ann. Rept., p. 393). Next later than Altamont moraine. Named for development in vicinity of Gary, Deuel Co., S. Dak.

See also F. Leverett's moraine map in U. S. G. S. P. P. 161, 1932. Is of late Wisconsin age.

Gasconade dolomite.

Lower Ordovician (Beekmantown): Eastern and central Missouri.

F. L. Nason, 1892 (Mo. Geol. Surv. vol. 2, pp. vii, 12, 93, 114–115, pl. III). *Gasconade ls.*—Great series of ls. beds interstratified with thin beds of ss. that underlie Roubidoux ss. in Ozark uplift and compose lower fm. of Ozark series. Includes 3d and 4th Mag. lss. and separating sss. of earlier repts.

A. Winslow, 1894 (Mo. Geol. Surv. vols. 6 and 7), and 1895 (Am. Geol., vol. 15, pp. 81–89), stated that Gasconade ls. underlies Roubidoux or Saccharoidal [?] ss. and includes Jefferson City ls., Moreau ss., Osage ls., Cole Camp ss., and Proctor ls.

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser.). *Gasconade ls.*—Whitish or grayish cherty and noncherty dol. with beds of chert and occasional sss. Thickness 250 ft. Is=Third Mag. ls. of Swallow. Underlies St. Elizabeth fm. [Roubidoux] and overlies Gunter ss. [This definition was followed by S. H. Ball, 1904; C. F. Marbut, 1904; E. R. Buckley and H. A. Buehler, 1904; E. M. Shepard, 1904; E. R. Buckley, 1905; H. A. Buehler, 1907; and C. [R.] Keyes, 1914.]

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bulls. 260, 267). *Gasconade ls.*—Chert-bearing dolomitic lss. and sss., 450 to 650 ft. thick. Underlies Roubidoux fm. and overlies Elvins fm. Is=3d and 4th Mag. lss. and 3d ss., also=Lesueur ls. Includes Osage ls., Gasconade ls., Cole Camp ss., Gunter ss. and Proctor ls. [This definition was followed by G. H. Scherer, 1905.]

E. R. Buckley, 1908 (Am. Min. Cong. Rept. Proc. 10th Ann. sess., p. 286). *Gasconade* of Mo. underlies Roubidoux and uncon. overlies Proctor. [This definition of Gasconade (which includes Gunter ss. memb. at base) was followed by C. F. Marbut, 1908; E. R. Buckley, 1909; R. S. Bassler, 1911; E. O. Ulrich, 1911; G. W. Crane, 1912; H. A. Buehler, 1917; C. L. Dake, 1918; E. B. Branson, 1918; M. E. Wilson, 1922; H. A. Buehler, 1922; and E. B. Branson, 1923; and it was for many years the accepted definition of U. S. Geol. Survey.]

H. S. McQueen, 1930 (Insoluble residues as a guide in stratigraphic studies, Mo. Bur. Geol. and Mines, separate). *Gasconade fm. restricted.*—Dol., light colored, finely crystalline with characteristic hard blue chert. Thickness 140 to 200 ft. Chert is dominant constituent; much of it is vitreous and quartzose, but lacks the even glassy texture of the Eminence and to some extent the chert of the Van Buren, and it is also darker than any similar material in Van Buren or Eminence. Uncon. underlies Roubidoux fm. and uncon. overlies Van Buren fm. [See further explanation under *Van Buren fm.* This is definition of Gasconade dol. that has been adopted by Mo. Geol. Survey and is now followed by U. S. Geol. Survey.]

Named for exposures on Gasconade River, central Mo.

Gascons formation. (In Chaleur series.)

Silurian (Niagaran): Quebec (Gaspé Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44 p. 48).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). Fauna of Gascons fm., of middle Sil. Chaleur series, is transitional btw. Clinton and Lockport.

Gaspe series.

Devonian and Mississippian: Quebec.

W. E. Logan, 1863 (Canada Geol. Surv. Repts 1843–63, pp. 406–453, 880–886). *Gaspe series.*—Is Middle and Upper Sil., Dev., and Lower Carbf. Includes Gaspe ls., Gaspe ss., and Bonaventure fm.

Subsequent writers assigned Gaspe ls. and Gaspe ss. to Dev. and Bonaventure fm. to late Miss.

Gaspe sandstone.

Devonian: Quebec.

W. E. Logan, 1863 (Canada Geol. Surv. Repts. 1843–63, pp. 394–404). *Gaspe sss.,* Dev., Canada. Included in Gaspe series.

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 174–175). *Gaspe sss.* are late Dev.

C. H. Kindle (1936) stated fossils of lower memb. of Gaspe ss. are probably Middle Dev. (See under *Malbaic cgl.*)

Gaspe limestone.

Devonian: Quebec.

W. E. Logan, 1863 (Canada Geol. Surv. Repts 1843–63, pp. 390–394). *Gaspe lss.*—Middle and Upper Sil., Canada.

J. M. Clarke, 1908 (N. Y. State Mus. Mem. 9, p. 26). *Gaspe lss.* of Quebec are Dev.

F. J. Alcock, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. D, p. 81), and 1926 (Canada Geol. Surv. Summ. Rept. 1924, pt. C, p. 139). *Gaspe ls.* of Quebec is Dev.

W. A. Parks, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 787). *Gaspe ls. series* embraces Grand Greve, Cape Bon Ami, and St. Alban.

Gasper formation.
Gasper oolite. } (Of Chester group.)

Mississippian: Kentucky, southwestern Virginia, Tennessee, and northern Alabama.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian fms. of western Ky., pt. 1, pp. 64–84). *Gasper oolite.*—Thick-bedded ls. and oolite, and in parts of Breckinridge Co. (also in Meade, Hardin, Grayson and perhaps Hart Co.) it includes, near middle, the Sample ss. memb., which has a max. thickness of 40 ft. Total thickness of fm. 100+ ft. Replaces Ulrich's "Tribune ls." Is not known W. of E. part of Crittenden Co., Ky. Rests uncon. on Fredonia oolite memb. of Ste. Genevieve ls., the intervening Rosiclare and Ohara members of the Ste. Genevieve and the Bethel ss. being absent. Is older than Cypress ss. The Ridenhower sh. is = in part at least Gasper oolite and possibly is represented in only upper part of Gasper fm. Named for exposures in bluffs along Gasper River in Warren Co., Ky.

C. Butts, 1926 (Geol. Surv. Ala., Spec. Rept. No. 14), defined *Gasper fm.* of that region as underlying Cypress ss. and overlying Bethel ss.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430, 439–441). Uncertainty regarding the beds which Butts himself intends to include within typical Gasper has made it impossible for writers to recognize "Gasper" as a valid fm. name. Therefore *Girkin* is proposed as a designation for beds of Renault and Paint Creek age in that part of West. Ky. where the Bethel (Sample) ss. is not developed. [See under *Girkin fm.*]

Gaspereau formation.

Carboniferous: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 210).

Gasport limestone member (of Lockport dolomite).

Silurian: Western New York and Ontario.

E. M. Kindle, 1913 (U. S. G. S. Niagara Falls folio, No. 190). *Gasport ls. memb.*—Light-gray to white coarse-grained semicrystalline crinoidal ls., generally nonmagnesian. Thickness 6 to 20 ft. In literature has been called Lower Niagara ls., Lockport Encrinal marble, and Crinoidal ls. Overlain by dark-gray to chocolate-colored saccharoidal dol.; underlain by drab mag. ls. [later named De Cew ls.]. Named for exposures at Gasport, Niagara Co., N. Y.

Gasport shaly channel.

Silurian: Western New York.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 265, pp. 5–14). *Gasport shaly channel.*—Is intercalated in Lockport ls., but faunule differs entirely from that of surrounding Lockport ls. The channel rock itself, for most part, consists of calc. and argill. sh., sandy near top, and containing six thin layers of shaly ls. By its dark-brown color it contrasts strikingly with the light-buff Lockport ls. Passes laterally, with a jagged margin of interlocking layers, into coralline and crinoidal beds of Lockport ls. and therefore represents an original depression btw. the reefs. Probably represents the filling of a depression or lagoon.

Gassetts schist.

Upper Cambrian(?): Southeastern Vermont (Windsor County).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 210, 225). *Gassetts schist.*—Silvery white, highly garnetiferous, muscovite schist; scaly texture, or muscovite is arranged in parallel plates and is by far the most abundant constituent. Is a highly metamorphosed sediment, which in certain outcrops has been affected by intrusives bearing boron and fluorine. Is a new and the oldest memb. of Upper Camb. Missisquoi group. Underlies the typical sericite schists and qtzites of that group, of which it is the lower memb. Overlies Bethel and Cavendish schists. Outcrops at Gassetts [Ludlow quad.] in N. part of Chester [Twp], and at other places [mentioned] in Reading, Cavendish, Baltimore, and Chester Twps. Assigned to Upper Camb.

See also C. H. Richardson, 1931 (17th Rept. Vt. State Geol., pp. 198, 223). Also 18th Rept. Vt. State Geol., where Richardson and J. E. Maynard state type loc. is just N. of Gassetts railroad station.

Gastineau volcanic group.

Triassic (Upper): Southeastern Alaska (Juneau region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 92, 247, chart opp. p. 120). *Gastineau volcanic group.*—In descending order, sl., andesitic tuff, calc. sl. with Upper Triassic fossils, and andesitic lava with local lenses of sl. Thickness possibly 5,000 ft. Assigned to Upper Triassic. Overlies Perseverance sl. and underlies Thane volcanic group.

Named for Gastineau Peak, which is in midst of the group. Whether the whole group is Upper Triassic is now considered questionable.

Gates limestone.

Silurian: Western New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 335, 356, 358, 359, 360, 361, 364). *Gates ls.*—About 20 ft. of beds at Rochester, heretofore included in Rochester sh., which apparently are absent at Niagara, and which are really a ls., being quarried and sold as such. Are uncon. overlain by Decew (basal) memb. of Lockport dol., and are separated from Rochester sh. [restricted] below by a perfectly clean-cut line or clay seam. Carry few fossils except *Lingula lamellata.* Named for town [in Monroe Co.], in which the beds appear in the canal prism. Probably continues to thicken E. of Rochester under the drift and is very likely the rock forming the falls at Wolcott village. Present at Ontario, N. Y., and at Wallington and probably at Red Creek [both in Wayne Co.]; also doubtfully identified at South Granby and Brewerton, N. Y., and at Hamilton, Ont. Absent in Lakeport well [Madison Co.].

Gates formation.

Cretaceous: British Columbia.

F. H. McLearn, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 6).

Gatesburg formation.

Upper Cambrian: Central Pennsylvania (Blair to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 527, 534, 537; name proposed by E. S. Moore). *Gatesburg fm.*—Thick-bedded steely-blue, coarsely crystalline dol., with many interbedded qtzite layers up to 10 ft. thick; contains considerable silicified oolite, also, near middle, Ore Hill ls. memb., and at base Stacy dol. memb. Underlies Mines dol. and overlies Warrior ls. Named for Gatesburg Ridge, Center Co.

Gatesville formation. (In Fredericksburg group.)

Lower Cretaceous (Comanche): North-central Texas.

S. A. Thompson, 1935 (A. A. P. G. Bull., vol. 19, No. 10, pp. 1508, 1530, 1531–1533, 1536). Edwards ls., Comanche Peak ls., and Walnut clay of Fredericksburg group are in part contemp. with one another and contain essentially same fauna. They are here treated as members of *Gatesville fm.*, new name for lower part of Fredericksburg group, the Kiamichi clay being upper fm. of that group. [It is still a debated question whether Kiamichi should be included in Fredericksburg group.] Type loc. *is near State Training School for Boys N. of Gatesville,* Coryell Co.

W. C. Mendenhall, 1935 (p. 1537 of book cited above) questioned usefulness of this name.

Gateway formation.

Pre-Cambrian: Southern British Columbia and northwestern Montana (Galton Range).

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines, Mem. 38, maps 2, 3, 4). *Gateway fm.*—Chiefly thin-bedded siliceous metargillite; some dol. at base. [Younger than Purcell lava and Siyeh fm.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 107, 136, 178). *Gateway fm.*—Chiefly metargillite and qtzite. Upper memb. (1,850 ft.) consists of thin-bedded highly siliceous metargillite interstratified with subordinate more or less sericitic metasandstone; carries abundant salt crystal casts, and is almost certainly contemp. with lower part of Kintla fm. Lower memb. (125 ft.) consists of dol., ss., ls., qtzite, metargillite, and at once suggests possible identity or origin with Sheppard fm. The fm. is well exposed on heights E. of Gateway, Mont., and overlooking Tobacco Plains. Rests conformably on Purcell lava, and grades into overlying Phillips fm.

Gato formation.

Pliocene: Dominican Republic.

C. J. Maury, 1931 (Sci., n. s., vol. 73, p. 42).

Gatun formation.

Miocene (middle): Panama.

E. Howe, 1907 (Isthmian Canal Comm. Rept., pp. 108–138).

Gautreau formation.

Mississippian: New Brunswick (Stony Creek oil and gas field).

G. W. H. Norman, 1932 (Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 170).

Gauvin andesite.

Age (?): New Brunswick.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 72).

Gavilan.

See *Gabilan ls.*

Gaviota formation.

Eocene and Oligocene (?): Southern California (Santa Barbara County).

W. L. Effinger, 1935 (Pan-Am. Geol., vol. 64, No. 1, p. 75). *Gaviota fm.* is proposed for that assemblage of marine strata falling within "*Turritella variata* zone" of Woodring in Santa Ynez Range, Santa Barbara Co. Type area is W. of Gaviota Pass, and type loc. is designated as Cañada de Santa Anita, where the fm. consists of 1585 ft. of sss. and siltstones overlying Tejon fm. (Eo.) and underlying Sespe fm. Lower part of fm. is believed to be Eo.; upper part may include some Olig.

H. G. Schenck and R. M. Kleinpell, 1935 (p. 76 of book cited above). Microfossils and strat. relations suggest *Gaviota fm.* is late Eo.

See also under *Refugian stage.*

†Gay Head clays.

Trade name applied to part of Cret. deposits of Marthas Vineyard, Mass.

†Gayhead interval.

Pleistocene: Southeastern Massachusetts (Gay Head, Marthas Vineyard, etc.).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 975–988). *Gay Head interval of erosion and folding* separates Sankaty beds (interglacial) from succeeding Tisbury [Manhasset] beds (glacial).

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). There is nothing on Long Island which can clearly be referred to *Gayhead interval* except by inference.

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). As the name Gay Head belongs more properly to the folding than to the erosion interval which followed, the name *Gardiner interval* is suggested for the latter, from Gardiner Island, where the truncated folds can be well observed.

Gaysport member. (In Conemaugh formation.)

Pennsylvanian: Southeastern Ohio (Muskingum County).

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 258). *Gaysport memb.*—Siliceous ls. or calc. ss. Marine fossils. Thickness 0 to 2½ ft. Lies 20 ft. 4 in. below horizon of Duquesne coal and 16 ft. 3 in. above Ames ls. Occurs locally in Muskingum Co. Best developed in vicinity of Gaysport, Bluerock Twp., Muskingum Co.

Gazley Creek sands and clays.

Eocene: Southern central Texas (Bastrop County).

W. A. Price and K. V. W. Palmer, 1928 (Jour. Pal., vol. 2, p. 22), loosely applied this name to gray ss. containing a Cook Mtn fauna and to overlying sands and clays on S. bank of Colorado River at mouth of Gazley Creek, in W. edge of Smithville, Bastrop Co.

†Gebo formation.

Upper Cretaceous: Northwestern Wyoming (Park County).

D. F. Hewett, 1914 (U. S. G. S. Bull. 541, pp. 91, 100). *Gebo fm.*—Massive ss., buff near base and white near top, separated by thin beds of sh.; near base 1 or more coal beds. A few plants and invertebrates of Montana types. Thickness 1,120 ft. along Shoshone River and to S. Underlies Meeteetse fm. and overlies Colorado sh. Named for Gebo, near Thermopolis, near which extensive mining operations have been conducted on a coal bed near base of fm.

Later work proved this fm. is same as Mesaverde fm. of Colo., and it was therefore discarded and mapped as Mesaverde on 1924 geol. map of Wyo.

Gemini limestone.

Ordovician: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Gemini ls.*—Forty-five or more relatively thin alternating horizons of blue, gray, light-gray, and white ls., of varying texture and hardness, but all generally distinctly bedded. Thickness 902 ft. Underlies Chief Consolidated ls. and overlies 920 ft. of white lime sh. [later named Opohonga ls. The fm. was evidently named for Gemini mine.]

The Chief Consolidated and Gemini lss. of Crane compose Bluebell dol.

Genesee group.

Upper Devonian: New York, Pennsylvania, Maryland, northern West Virginia, and across western Virginia.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 168–169). *Genesee sl.*—A black argill., fissile mass., appropriately a mudrock. Is the *Black sh. and sl.* and *Upper Black sl.* of repts. Thickness 100 ft. Underlies Portage or Nunda group (which includes Cashaqua sh., Gardeau and Portage groups, and Sherburne flagstone and sh.), and overlies Tully ls.

In succeeding years the names *Genesee beds*, *Genesee sh.*, and *Genesee group* were applied to the beds btw. Portage group and Tully ls., but bdy btw.

the Portage and Genesee was by some placed at top of a so-called "Lower Black Band" and by others at base of or 10 to 15 ft. below base of this "Band." In 1903 (N. Y. State Mus. Hdb. 19, p. 23) J. M. Clarke introduced *Middlesex black shales* for the "Lower Black Band" and *Rhinestreet black sh.* for the "Upper Black Band," both of which, "for paleontologic reasons," he included in Portage group. In 1904 (N. Y. State Mus. Bull. 63) J. M. Clarke and D. D. Luther applied *Genesee beds* to strata btw. Middlesex sh. and Tully ls., which they divided into Standish flags and shales (top), 15 ft.; West River sh.; Genundewa or Styliola ls.; and *Genesee sh.*, the latter defined as densely black bituminous sh. 95 ft. thick, resting on Tully ls. They stated: It was clearly this excessively black mass of sh. that it was intended [by Hall] to distinguish by the name *Genesee*, and it is here proposed to restrict *Genesee* to this lower memb. only. [In several places in text (pp. 23 and 25) they casually alluded to restricted Genesee sh. as *Gorham shales*, probably from their occurrence at or near town of Gorham. These casual references to *Gorham* were evidently not intended as a geol. name, and they constitute the only known record of *Gorham*.]

The broad use of Genesee was applied in many repts during succeeding years, but the repts of Clarke and Luther continued to restrict the name to the beds btw. Genundewa and Tully lss., although they subsequently stated (N. Y. State Mus. Bull. 81, 1905, and N. Y. State Mus. Bull. 128, 1909) that Genesee sl. as originally defined and as used by Hall included their restricted Genesee sh., the Genundewa ls., and the West River sh., but that [1905 citation] it has seemed best to retain that name [*Genesee sl.*] in application to lower part of the series as exhibited on Genesee River, for the lower beds are highly bituminous and regularly slaty, and it was to indicate this bituminous character that the rock series was specially and separately designated. C. A. Hartnagel's Hdb. 19 (1912) applied *Genesee* in both the broad and the restricted sense. In 1920 (Geol. Soc. Am. Bull., vol. 31, p. 118) G. H. Chadwick proposed to replace the restricted Genesee sh. with *Geneseo black sh.* The Middlesex sh. appears to have been consistently included in Portage group until K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, pp. 201–202), included it in the Genesee, in which he also included Tully ls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), adopted the restricted definition of Genesee (i. e. the basal memb., or Geneseo sh. of Chadwick) and included the overlying Genundewa ls., West River sh., and Standish sh. in Portage group; but Cooper (1935) used *Geneseo*, as defined by Chadwick, i. e., for the sh. above Tully ls. and below Genundewa ls.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included all of above beds in *Genesee group*, and discussed fauna on pp. 310+.

The U. S. Geol. Survey in March 1936, at request of W. H. Bradley (who had in preparation a rept (Bull. 899–A) on structure and gas possibilities in Steuben and adjacent counties in south-central N. Y.), adopted *Genesee group* to include the following *fms.* (descending): Standish ss., West River sh., and Geneseo sh. (redefined to include Genundewa ls. lentil at top).

Named for abundant exposures along Genesee River and Valley, N. Y., especially in gorge of Genesee River below Portage.

Genesee Valley limestone and shales.

Triassic: Northern California (Sierra Nevada).

J. P. Smith, 1910 (Jour. Geol., vol. 18, chart opp. p. 220). *Genessee Valley limestone and shales.*—Triassic. Older than Sailor Canyon shales [restriction ? of Sailor Canyon fm.], and overlies Paleozoic.

J. S. Diller (U. S. G. S. Bull. 353, 1908) mapped the Triassic rocks of Genesee Valley region as *Swearinger sl.* and *Hosselkus ls.* Name probably derived from occurrence in Genesee Valley, E. of Genesee, Plumas Co.

Geneseo shale. (In Genesee group.)

Upper Devonian: New York.

G. H. Chadwick, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 118). *Geneseo black sh.*—The name "Genesee" is in duplicate use for the group (including the West River) and for the part beneath Genundewa ls., which is under water at Hall's type loc. To avoid confusion the variant *Geneseo* may be given to the latter, which is 84 ft. thick in the fall on Fall Brook, Geneseo, N. Y.

See also *Gorham sh.*

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 310). *Geneseo black sh.* goes out of section just before plunging under Lake Erie.

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 824). Chadwick's name *Geneseo* is adopted for the black sh. overlying Tully ls. and underlying Genundewa ls., because use of *Genesee* in two senses is confusing. The Geneseo is 75 ft. thick in vicinity of type section of the Tully, 100 ft. at Cayuga Lake, 85 ft. in Genesee Valley, 2 ft. on Cazenovia Creek, Erie Co., and on shore of Lake Erie consists of remnants a few inches thick. In Unadilla Valley writers could not find it.

The U. S. Geol. Survey in March 1936, at request of W. H. Bradley (who has in preparation a rept on structure and gas possibilities in Steuben and adjacent counties in south-central N. Y.), adopted *Geneseo sh.* for basal fm. of *Genesee group*, and redefined *Geneseo* by including in it, at top, *Genundewa ls. lentil.* The Genundewa was included in Geneseo sh. "because of its small thickness and the similarity of its fauna to that of the Geneseo, and because at some places it consists of several layers of ls. separated by black sh."

Geneva limestone.

Middle Devonian: Central and southeastern Indiana (Shelby to Jennings Counties).

J. Collett, 1882 (Ind. Dept. Geol. and Nat. Hist. 11th Ann. Rept., pp. 63, 81, 82). *Geneva ls.*—Buff mag. ls. (Corniferous), 38 ft. thick, at top of Dev. in Shelby Co. Overlain by glacial drift and underlain by 0 to 14 ft. of stratified Dev. rubble ls. (Corniferous?) or by Sil. strata.

E. M. Kindle, 1901 (Ind. Dept. Geol. and Nat. Res. 25th Ann. Rept.). *Geneva ls.*—Soft dark-buff to brownish fine-grained mag. ls., 3 to 30 ft. thick. Lies btw. Niagara and Jeffersonville lss. Is=Shelby bed of Foerste, which should be abandoned. Believe Geneva ls. replaces Sellersburg and Jeffersonville to N.

J. F. Newsom, 1903 (Ind. Dept. Geol. and Nat. Res. 26th Ann. Rept.). *Geneva ls.*, 2 to 30 ft. thick, to N. apparently replaces Jeffersonville and Sellersburg beds.

T. C. Hopkins, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept.). Jeffersonville ls. includes *Geneva ls.*, Shelby beds, and Hartsville beds.

E. M. Kindle, 1913 (Jour. Geol., vol. 21, p. 313). Fauna of Geneva ls. indicates it is of either Schoharie or Onondaga age, probably Schoharie.

W. N. Logan, 1920 (Ind. Dept. Cons., Div. Geol. Pub. 8, btw. pp. 50 and 57), called the ls. beneath Silver Creek ls. *Geneva (Jeffersonville) ls.*

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 466). *Geneva ls.* of Collett may represent a facies of some part of the Jeffersonville. What actual relationships of Geneva and Jeffersonville-Sellersburg fms. are has not been satisfactorily determined. The Geneva may be a lithologic facies of one or both of these fms., or, more likely, a distinct fm. older than the Jeffersonville. Ulrich apparently correlates it with Schoharie, though his reasons are not stated. It occurs in Jennings, Decatur, Bartholomew, and Shelby Counties.

Named for Geneva, Shelby Co.

†Geneva quartzite.

Lower Ordovician: Northeastern Utah (northern Wasatch Mountains).

E. Blackwelder, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 519, 526–527, 542). The Ogden qtzite as originally defined has no existence. In Ogden Canyon 2 thick beds of qtzite appear to be separated by several hundred ft. of sh. and ls. Geologists of 40th Par. Surv. considered the lower of these to be Camb. The upper fm. was named "Ogden qtzite," and its age was thought to be approx. Dev. This classification stood unchallenged for more than a generation. A few years ago F. B. Weeks (unpublished rept, 1908), found Ord. fossils in a qtzite and sh. fm, N. of Brigham. This qtzite was separated from the Camb. qtzite by a thick series of sh. and ls., and on this account Weeks considered it to be="Ogden qtzite." But the "Ogden qtzite" in Ogden Canyon is now believed to be merely a slab of Camb. qtzite repeated by an overthrust. An early Paleozoic qtzite formerly correlated with "Ogden qtzite" is widely distributed in Wasatch Mtns, and is now bereft of its name, since the typical "Ogden qtzite" must be ruled out. As it is clearly exposed and well marked by fossils E. and N. of Geneva, it will be called the *"qtzite at Geneva."* Seems to be best exposed in N. part of Wasatch Range. It is a cream-colored calc. qtzite interbedded with green sh. near top and bottom and altogether not over 400 ft. thick. It is doubtless in this qtzite Weeks found Ord. fossils. The same fauna was found by writer at 2 points near Geneva in 1909. [In footnote on p. 519 he calls this fm. *Geneva fm.*]

The name *Geneva* being preoccupied, G. B. Richardson in 1913 named the Ord. qtzite *Swan Peak qtzite*, the name by which it is now known.

†Geneva sands.

Pleistocene: Southeastern Alabama and Georgia.

See description under †*Ozark sands.*

Probably named for Geneva or Geneva Co., SE. Ala.

†Genevieve group.

Mississippian: Missouri.

H. S. Williams, 1891 (U. S. G. S. Bull. 80, p. 169). *Genevieve group.*—Geographic name proposed for Archimedes group of B. F. Shumard. Includes Chester, St. Louis [broad and abandoned usage], and most of Warsaw, the faunas of which are more closely allied than they are to faunas of the Keokuk and Burlington.

Includes Chester and Meramec groups of present terminology.

Named for exposures in Ste. Genevieve Co.

Genevieve limestone.

An abbreviated form of *Ste. Genevieve ls.*, employed by C. [R.] Keyes.

Gennet Creek formation. (In Chester group.)

Mississippian: Southwestern Indiana.

M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. No. 133, p. 78), listed (but did not define) *Gennet Creek fm.*, 10 to 35 ft. thick, as underlying Mount Pleasant ss. and overlying Bristow ss. In previous repts the Mount Pleasant had been defined as resting on Bristow ss.

Genoa moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin and northeastern Illinois. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Genoa Junction, Walworth Co., Wis.

Genshaw formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Genshaw fm.*—Four persistent thin gray ls. beds, alternating with gray calc. shales, all containing a large sp. of *Atrypa* and *Gypidula romingeri.* Measured thickness, 51 ft. Underlies Killians ls. and rests on clay shales of Ferron Point fm. Type loc., region around Genshaw School, sec. 13, T. 32 N., R. 8 E., Alpena Co.

Gent facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 178, etc., 1931) to a lithologic facies of his Carwood fm. in a part of southern Ind.

Gentile Valley group.

Pleistocene or late Tertiary: Southwestern Idaho (Gentile Valley).

A. C. Peale, 1879 (U. S. Geol. and Geog. Surv. Terr. 11th Ann. Rept., pp. 612, 642, and map). Near one of our substations in Gentile Valley a coarse cgl. outcrops, which was horizontal and seemed to be older than the soft deposits in center of valley. In Portneuf Canyon a similar cgl. was noted, also on E. side of Cache Valley. These beds I have provisionally designated *Gentile Valley group.*

According to G. R. Mansfield (personal communication) these beds may be Pleist. or may belong to Salt Lake fm. (Tert.).

Genundewa limestone lentil (of Geneseo shale).

Upper Devonian: Western and west-central New York.

J. M. Clarke, 1897 (N. Y. State Geol. 15th Ann. Rept.). [The ls. in midst of Genesee sh. had for many years been called *Styliola ls.* (from its characteristic fossil), and described as somewhat concretionary, sometimes inclined to be shaly, composed almost wholly of *Styliola fissurella,* having a thickness of 0 to 4 [8] ft. (thinning out to E.), and lying from 20 to 86 ft. above base of the Genesee. In 1897 rept cited above Clarke referred to it as *Genundewah or Styliola ls.* In 1903 (N. Y. State Mus. Hdb. 19, chart) Clarke used the following title: *Genesee sh. incl. Genundewa ls.,* while D. D. Luther (N. Y. State Mus. Bull. 69, p. 1001) referred to it as *Styliola or Genundewa ls.*]

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, pp. 199–214). The *Genundewa or Styliola ls.* of Genesee shales is a thin sheet sometimes interrupted, sometimes nodular, but virtually continuous from Lake Erie to Seneca Lake.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, p. 26). *Genundewa ls. or Styliola ls.*—Dark-gray soft shaly ls. in layers 2 to 10 inches thick, separated by dark or black sh. Where purest is composed almost wholly of shells of *Styliola (Styliolina) fissurella.* Divides the mass of Genesee deposits into nearly equal parts in Canandaigua and Naples quads. Typical outcrop on shore of Canandaigua Lake, at foot of Bare Hill or, as it should be termed, *Genundewa.* [On map accompanying this rept the hill is called "Bare Hill." It is in Yates Co.] Included in Genesee group, which is divided into (descending): Standish flags and shales, West River sh., Genundewa or Styliola ls., and Genesee sh. restricted [which Chadwick proposed (1920) be replaced by *Geneseo shale*].

J. M. Clarke and D. D. Luther, 1905 (N. Y. State Mus. Bull. 81, p. 5). *Genundewa ls.* named for Genundewa Point on Canandaigua Lake.

See further explanation under *Genesee sh.*

The U. S. Geol. Survey in March 1936, at request of W. H. Bradley (who has in preparation a rept on structure and gas possibilities in Steuben and adjacent counties in south-central N. Y.), adopted *Geneseo sh.* for basal fm. of *Genesee group,* and redefined Geneseo by including in it, at top, *Genundewa ls. lentil.* The Genundewa was included in Geneseo sh. "because of its small thickness and the similarity of its fauna to that of the Geneseo, and because at some places it consists of several layers of ls. separated by black sh."

George River limestone.

Age(?): Nova Scotia.

H. Fletcher, 1878 (Canada Geol. Surv. Rept. Prog. 1876–77, p. 426).

George River limestone series.

Age(?): Nova Scotia.

H. Fletcher, 1900 (Canada Geol. Surv., Descriptive note on Sydney coal field, p. 5).

George River series.

Pre-Cambrian: Nova Scotia.

G. A. Young, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 268).

Later repts, by other geologists, assigned these rocks to pre-Camb.

Georges Fork sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503-520). *Georges Fork ss. memb. of Atoka fm.*—Thin to massive-bedded ss.; medium-grained; commonly greenish brown on fresh surface, weathering to brown; surfaces of bedding planes often covered with fucoidal markings. Fossils. Thickness 35 ft. Base lies 80 to 120 ft. above Pope Chapel ss. memb. and top lies 60 ft. below Dirty Creek ss. memb., the intervals being occupied by sh. Named for exposure E. of Georges Fork, in secs. 24 and 25, T. 12 N., R. 19 E.

Georgetown limestone. (In Washita group.)

Lower Cretaceous (Comanche series): Central and southern Texas.

T. W. Vaughan, 1900 (U. S. G. S. Uvalde folio, No. 64). *Georgetown ls.*—Name proposed by R. T. Hill for impure, yellowish, argill. ls., 40 or more ft. thick, characterized by *Kingena wacoensis*. Underlies Del Rio clay and overlies Edwards ls. Is equal in part to ls. formerly called Fort Worth ls. Exposures very small.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7). Upper 10 ft. of *Georgetown ls.* correlates with Main Street ls. The rest of Georgetown has lithologic aspect of Fort Worth ls. but is paleontologic equiv. of Kiamitia clay, Duck Creek fm., Fort Worth ls., and lower Denison beds. Thickness of Georgetown at Austin 49.9 ft. Underlies Del Rio clay and overlies Edwards ls.

J. A. Udden and C. L. Baker, 1916 (Univ. Tex. Bull. 44). Del Rio clay=Grayson marls and Main Street ls.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120, pl. 18). Del Rio clay=Grayson marl and probably Main Street ls.

W. S. Adkins, 1920 (Univ. Tex. Bull. 1856). *Georgetown ls.* includes equivalents of lower part of Main Street ls., Pawpaw fm., Weno fm., Denton fm., Fort Worth fm., and Duck Creek marl, but not of Kiamitia fm., which disappears at Brazos-Colorado uplift.

W. M. Winton and G. Scott, 1922 (Univ. Tex. Bull. 2229, pp. 12–15). Kiamitia is not represented in central Tex. despite statements of earlier writers.

W. S. Adkins, 1923 (Univ. Tex. Bull. 2340). *Georgetown fm.* of McLennan Co. is composed of 7 well differentiated and partially mappable members, which are strat. and paleontologic equivalents of the fms. of same names in north-central Tex. and southern Okla., and their relations with these fms. have been accurately traced, viz., Mainstreet, Pawpaw, Weno, Denton, Fort Worth (30± ft.), Duck Creek (30± ft.), and Kiamitia (5 to 9 ft.). Underlies Del Rio fm. and overlies Edwards ls.

H. P. Bybee and F. M. Bullard, 1927 (Univ. Tex. Bull. 2710, p. 21), correlated *Georgetown ls.* with Pawpaw, Weno, Denton, Fort Worth, Duck Creek, and Kiamichi.

R. H. Cuyler, 1929 (A. A. P. G. Bull., vol. 13, pp. 1292–1299), correlated uppermost part of Georgetown ls. with Main Street ls.

Basal fm. of Washita group in Tex. W. of Brazos River.

Named for Georgetown, Williamson Co.

Georgia slate.

Lower Ordovician (Beekmantown): Northwestern Vermont (Franklin County).

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1, pp. 357–386). *Georgia group or Georgia sl.*—Consists of clay sl.; roofing sl.; clay sl. approximating to micaceous ss.; various kinds of ls.; brecciated ls.; and cgl. composed of pebbles of ls. Includes what Prof. [E.] Emmons has called black sl., in part, Taconic sl., and roofing sl. Age in doubt. Thickness 2,000 ft. Overlain by Talcose cgl.; is younger than the Quartz Rock, which has been mistaken for Potsdam ss., and the Red Sandrock series. The Georgia sl. is fully exposed in town of Georgia [Milton quad.], Franklin Co., where its most interesting fossils have been found.

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 122–126). *Georgia sl.*—Almost entirely sl., soft, and as a rule dark gray or bluish gray; much of it is banded. At base are several specialized and very important beds, chief of which is Swanton cgl. [later renamed *Corliss cgl.*], which has been separated as a distinct fm.; being separated from Georgia sl. by a great uncon., and, with Georgia sl., overlapping onto Highgate sl., Milton dol., Colchester fm., and Mallett dol. Possibly there are other and higher cgls., but all now known are explainable as basal beds. The sl.

lies in synclines and its upper part has been removed by faulting or erosion; original thickness therefore unknown, but is likely to be over 2,000 ft. in Georgia. Lies in a belt 34 mi. long, whose S. end is in Colchester and N. end in Highgate. North of main belt several narrow strips of fm. extend to Canada, and several prongs of the sl. project from main fm. in vicinity of St. Albans. In town of Ga., for which the fm. is named, the belt is widest—about 3 mi. Narrows to N. and S. In earlier repts Georgia has been used in both narrower and broader senses. In 1861 Hitchcock, in his original use of *Georgia sl.*, included only the slates of Georgia and their supposed equivalents elsewhere. This usage was followed in the main by other geologists. The underlying lss. and sss. were treated as another fm.—the "Red Sandrock." In present paper the Georgia sl. is somewhat restricted from Hitchcock's original limits by cutting off about 300 ft. of beds (Highgate sl.) from base of fm., because they are Upper Camb., while bulk of Georgia sl. is post-"Saratogan," and because there are 2 great unconformities btw. the 2 parts. The Swanton cgl. was also included in original definition of Georgia sl.

A. Keith. 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 379), assigned Georgia sl. to Lower Ord., based on Beekmantown fossils found in it, and applied new name *Corliss cgl.* to the cgl. previously called *Swanton cgl.* C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 359, 379–380) also assigned the Georgia to Lower Ord., based on fossils identified as Beekmantown by G. A. Cooper.

†Georgia beds.

Original form of †Georgian series.

†Georgia group.

See under *Georgia sl.*

†Georgian epoch (or series).

Discarded name for Lower Cambrian (Waucoban epoch or series). See U. S. G. S. Bull. 769, pp. 94–96, 100.

Gering formation.

Miocene: Western Nebraska.

N. H. Darton, 1898 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 735, 747–755). *Gering fm.*—Coarse sands, soft sss., and cgl.; the sands laminated, massive, cross-bedded, and of light-gray color. Often comprises two or more members, more or less distinctly separated by unconformities. Greatest development is SW. of Gering, Nebr., where it is 200 ft. thick. It is possible upper memb. of Gering fm. is basal portion of overlying Arikaree fm. Rests uncon. on White River group.

These deposits are now considered to be local sediments in stream channels, and are covered by the broader term *Arikaree fm.*, of which they form basal part.

Gerlane formation.

Quaternary: South-central Kansas.

G. L. Knight, 1934 (Geol. Soc. Am. Proc. 1933, p. 91). *Gerlane fm.*—A Quat. continental deposit of south-central Kans., with type loc. near Gerlane, Barber Co. Is of alluvial origin; derived from Perm. and Tert. fms. in the area. Occurs both as valley filling and as surface wash, the former type best developed in larger valleys, giving them smooth broad floors. Where partly removed by erosion the Gerlane forms terraces along valley sides. The surface-wash phase covers much of intervalley areas of lower slopes. Thickness 100+ ft. in drills near Sharon, in what is believed to have been valley of Medicine Lodge River before it changed its course.

Germantown sands.

Subsurface sands (First Germantown and Second Germantown) in Pottsville fm. (Penn.) of SE. Ohio.

Germer tuffaceous member (of Challis volcanics).

Tertiary (late Oligocene or early Miocene): Southern central Idaho (Custer County).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Germer tuffaceous memb. of Challis volcanics.*—Tuff, tuffaceous ss., cgl., and rhyolite flows. Thickness 0 to 2,000+ ft. Type, Germer Basin, Bayhorse quad. Overlain by Yankee Fork rhyolite memb. of Challis volcanics and underlain by basal andesitic beds (0 to 2,000+ ft. thick) of Challis volcanics.

More fully described by C. P. Ross in rept on Casto quad., U. S. G. S. Bull. 854, 1934.

Named for Germer Basin, on S. side of Salmon River, nearly opposite mouth of Bayhorse Creek.

Gerome andesite.

Tertiary: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 98, map). *Gerome andesite.*—Lava flows, tuffs, breccias, and intercalated beds of sh. and ss. containing impure carbonaceous seams of varying thickness. Lava flows predominate, but tuffs, breccias, and sediments compose possibly 20 percent of whole. Thickness at least 700 ft. Uncon. overlies Stevens series and granite intrusives. Lies in N.-S. depression carved in older fms. Confined to SW. corner of Co. Appears to be a northern extension of larger areas farther S. in Columbia lava plateaus. Large exposures near town of Gerome. Included in Tert.

Gerona marble.

Late Jurassic (?): Cuba.

C. W. Hayes, 1901 (Rept. geol. reconn. Cuba, p. 114). [Age not given, but J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 536), assigned it to pre-Jurassic. C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 524), assigned Gerona marble of Isle of Pines to late Jurassic.]

†Geronimo series.

Pennsylvanian (?): Southwestern Oklahoma (Wichita Mountains).

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 140–141). *Geronimo series.*—Consists of ss., cgl., shales, and lss. underlying Perm. red beds in Wichita Mtns, Okla. Later than Trenton. Named for famous Apache chief, who lives as a prisoner of war at Fort Sill.

Gerster formation.

Permian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Gerster fm.*—Largely thin-bedded sandy and shaly lss., brownish gray on fresh surfaces but weathering yellowish brown or pink. Beds usually 2 in. to 1 ft. thick. Locally thin beds of ss. occur, and in most exposures moderately thick beds of cherty ls. are present. Overlies Oquirrh fm. with sharp contact. Thickness 600 ft. Contains Perm. fossils. Named for exposures in Gerster Gulch, in NW. corner of Gold Hill quad.

See also U. S. G. S. P. P. 177, 1934.

Gerty sand.

Quaternary? (Pleistocene?): Central and central southern Oklahoma.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 439). *Guertie sand.*—Gravel, sand, and silt. 30 or more ft. thick, resembling recent river or lake sand plains, probably deposited in a deserted river channel, and extending over part of McAlester coal field. [Mapped (pl. 64) as *Peaceable sand* (probably from Peaceable Creek, Hughes Co.), but Guertie adopted in text as more appropriate name. Assigned to Quat. (?).]

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 109), gave thickness as 0 to 50 ft.

Named for Guertie, Hughes Co. The spelling of name of this town was in December 1924 changed by U. S. Geographic Board to *Gerty*.

Gething member.

Cretaceous: British Columbia.

F. H. McLearn, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 4).

Gettysburg shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania.

A. I. Jonas, 1926 (Topog. and Geol. Atlas of Pa. No. 178, New Holland sheet, p. 17). *Gettysburg sh.* is second and middle memb. of the Triassic. Is composed of soft, red, shaly sss. with hard gray pebbly ss. beds, and contains beds of thick red ss. with scattered pebbles of different sizes. It is here made up of less sh. and more ss. than in type area, and is overlain by an undet. thickness of coarse cgl. interbedded with red ss., which forms upper memb. of Triassic. Thickness of Gettysburg sh. is about 1,000 ft. [On accompanying map it is mapped as "soft red sh. and ss."] It rests on "basal memb. of Triassic" (called *lower arkosic ss. and cgl. memb.*), which consists of 1,000 ft. of quartz cgl. underlain by about 500 ft. of arkosic red ss.

G. W. Stose, 1929 (U. S. G. S. Fairfield-Gettysburg folio, No. 225). *Gettysburg sh.* is *redefined* so as to include all Triassic sediments of this part of SE. Pa. that overlie New Oxford fm. (lower fm. of Newark group). These Gettysburg sediments, which compose upper fm. of Newark group in this region, aggregate approx. 16,000 ft., and consist in general of red shales and soft red sss., with minor amounts of white ss., green and yellow sh., black carbonaceous sh., and dark impure ls. Much of fm. has been metamorphosed, by intrusive diabase, to dark purple or black argillite or to white porcelanite. Near middle is Heidlersburg memb. and at top the Arendtsville fangl. memb. (consisting of quartzose cgl.) and a contemp. ls. cgl.

Named for exposures at Gettysburg.

Gettysburg granite.

A local trade term for Upper Triassic diabase quarried extensively in vicinity of Gettysburg, Pa.

†Geuda salt measures. (In Sumner group.)

Permian: Eastern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 1–48). *Geuda salt measures.*—Chiefly clay shales, of many colors and kinds, and beds of ls., gyp., and salt. Thickness 300 to 400 ft. Divided into (descending): (1) Sh. and shaly ls.; (2) *Greeley gyp.;* (3) shales, 100 ft.; (4) Hope gyp. Basal fm. of Sumner div. Underlies Wellington shales and overlies Marion concretionary ls. (top bed of Chase lss.). Prosser's term *Marion fm.* included Geuda salt measures and lower part of Wellington, and is preoccupied. Named for town of Geuda Springs, [Sumner Co.], Kans.

Cragin later abandoned this name for *Marion fm.* The latter name has been used to include the salt beds and also to exclude them. In 1927 Kans. Geol. Survey and U. S. Geol.. Survey abandoned Marion fm. and redefined Wellington fm. so as to extend down to top of Herington ls. The salt beds are therefore now included in the Wellington.

Ghost River formation.

Devonian (?): Alberta (Front Range).

C. D. Walcott, 1921 (Smithsonian Misc. Coll. vol. 72, No. 6, p. 5). *Ghost River fm.,* Rocky Mtns, Canada. [Walcott gave a full description of this fm. in Smithsonian Misc. Coll., vol. 67, No. 8, pp. 463–464, 1923. No fossils found. Rests on Middle Camb. and is overlain by Dev. In 1927 (Canada Geol. Surv. Mem. 153, p. 13) P. S. Warren assigned the fm. to Dev., as did Walcott in 1928, and Warren in 1929.]

Giants Range granite.

Pre-Cambrian (pre-Huronian and post-Knife Lake): Northeastern Minnesota (Vermilion and Mesabi districts).

J. E. Spurr, 1894 (Minn. Geol. Nat. Hist. Surv. 22d Ann. Rept., pp. 119–124). *Giant's Range granite.*—Hornblende-biotite variety. Intrusive and post-Keewatin.

C. K. Leith, 1903 (U. S. G. S. Mon. 43, pp. 24, 186–188, etc.). The intrusive *Giants Range granite* forms core of Giants Range, and is lower Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 135–136). *Giants Range granite* extends for 20 mi. or more along Vermilion Range in contact with various fms. It includes a series of granites ranging in color from light gray to very dark gray, flesh, pink, and red. Varies from very dense fine-grained granites through medium-to coarse-grained ones. Is of lower or middle Huronian age.

Forms all of Giants Range except extreme E. end, which is formed by the Keweenawan Embarrass granite. Giants Range is southern extremity of Mesabi Range.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned Giants Range granite to Algoman, which they correlated as pre-Huronian and post-Knife Lake series.

Gibson coal member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup-Zuni Basin).

J. D. Sears, 1925 (U. S. G. S. Bull. 767). *Gibson coal memb.*—Light-gray to white lenticular ss., light-gray clay sh., and valuable coal beds throughout Gallup-Zuni Basin. Thickness 150 to 175 ft. Underlies Allison barren memb. and overlies Bartlett barren memb.; all belonging to Mesaverde fm. Named for village of Gibson, McKinley Co., for many years the center of mining operations in the coals of this memb.

Gibson sand.

A subsurface sand in Hardinsburg ss., of Chester (Miss.) age, in SW. Ind.

Gibson erosion cycle.

A name applied by G. R. Mansfield (U. S. G. S. Bull. 713, 1920, p. 16) to a Pleist. erosion cycle in SE. Idaho. Named for fact that little settlement of Gibson stands on the terrace developed during the interval. Later (Jour. Geol., vol. 32, p. 485, 1924) Mansfield called this *Blackfoot cycle*.

Gila conglomerate.

Pleistocene and Pliocene: Arizona and southwestern New Mexico.

G. K. Gilbert, 1875 (U. S. Geog. and Geol. Surv. 100th Mer., vol. 3, pp. 540-541). *Gila cgl.*—A system of valley beds, of which a cgl. is the characteristic memb., which are exhibited in section along the gorges of the upper Gila and its tributaries, the Bonita, Prieto, Gilita, and San Francisco creeks and rivers. The boulders of the cgl. are of local origin; the cement is calc.; interbedded by layers of slightly coherent sand, and of trass, and sheets of basalt, the latter in some cliffs predominating over the cgl. Thickness 1,000 to 1,500± ft.

Gilan series.

A term employed by C. R. Keyes instead of Gila cgl.

Gilbert shale.

Pennsylvanian (?): Northeastern Arkansas (White County).

D. D. Owen, 1858 (First rept. geol. reconn. northern counties of Ark., pp. 68–69). *Gilbert shales.*—Shaly strata, 60 ft. thick, dark or nearly black in lower part and reddish yellow and ferruginous toward top. Includes numerous segregations of carbonate of iron and carbonate of lime. Exposed 3 mi. NW. of Searcy, White Co., at "bald point," in vicinity of Widow Gilbert's farm. Belong to coal measures. Overlie heavy sss. supposed to be ss. which forms "Bee rock" and belongs to millstone grit fm.

According to later repts (see U. S. G. S. W. S. P. 399, 1916, by L. W. Stephenson and A. F. Crider) Carbf. rocks are encountered only in wells in White Co.

Gilbert limestone. (In McMillan formation.)

Upper Ordovician: Central Kentucky.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17, pp. 18, 23). *Gilbert memb.*—Chiefly dove-colored lss. [thickness not stated], in McMillan fm. in central Ky. Overlies Tate memb. of McMillan fm., and stratigraphically corresponds nearly to Corryville memb. to N.

Probably named for Gilbert, Lincoln Co.

Gilbert sandstones. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 217–219). *Upper Gilbert ss.*—Grayish white, massive, medium-grained, micaceous, 40 to 50 ft. thick; lies 1 to 10 ft. below Lower War Eagle coal and 30 to 50 ft. above Glenalum Tunnel coal. *Lower Gilbert ss.*—Massive, grayish white, very hard and aren., 50 to 80 ft. thick; underlies Glenalum Tunnel coal. Named for Gilbert, Mingo Co.

Gilbert shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 168). *Gilbert sh.*—Roof sh. of Gilbert coal in western part of Wyoming Co. Generally dark gray to black. Frequently carries marine fossils. Thickness 2 to 40 ft. Underlies Gilbert A coal.

Gilbert Peak erosion surface.

Tertiary (Oligocene or Miocene): Northeastern Utah and southeastern Wyoming (Uinta Mountains).

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). Gilbert Peak erosion surface is older than Bishop cgl. Named for large remnant of the surface that slopes westward and northward from W. base of Gilbert Peak, Utah.

Gilberts morainic system.

Gilberts moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. (See M. M. Leighton, 16th Int. Geol. Cong. Guidebook 26, 1932, p. 49.)

Gilboa formation.

Upper Devonian: Eastern New York (Schoharie Valley).

G. A. Cooper, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 1–12). *Gilboa beds.*—In Schoharie Valley, in hills N. of Gilboa and S. along shores of Gilboa Reservoir, *Spirifer mesastrialis* and other Ithaca fossils are common in the sss. This div. (250± ft. thick) is=Tully (Laurens) and Sherburne ss., and is Ithaca facies of Sherburne, Geneseo, and Tully. Nearly complete section is exposed in W. face of Reed Hill, which is taken as the type.

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 803, 818–821, 829). At time Cooper defined *Gilboa beds* he believed all beds btw. top of Hamilton and *"Spirifer" mesastrialis* zone at Jefferson, Ruth, and elsewhere, 250 ft. thick, represented Tully, Geneseo, and Sherburne fms. in Schoharie Valley, where they could not be separated. But Cooper was in error in supposing *"Sp." mesastrialis* was at base of Ithaca. It seems best, therefore, to expand *Gilboa fm.* to include all rocks (325 ft. thick) in Schoharie Valley btw. top of Hamilton and base of red beds of Sherburne age. As thus defined the Gilboa includes Tully and Unadilla fms. which are not here separable because of disappearance of Tully fossil ***Hypothyridina.*** At place originally designated as type loc. the upper part of fm. is absent, but is well exposed along Highway 30, about 2½ mi. NE. of Grand Gorge. Top of Hamilton in Schoharie Valley is drawn at top of zone containing peculiar plicated terebratuloids, here named ***Rhipidothyris.*** Best section of the Gilboa is at Intake Building and along road from this bldg. which connects with road to Hardenburg Falls and Grand Gorge, where base of Gilboa exposed is 10 to 20 ft. above top of Hamilton. Although Gilboa fauna is almost wholly composed of Ithaca species, the fm. is actually of pre-Ithaca age. East of Schoharie Valley it is represented by Onteora beds of Chadwick. [On p. 820 is section along highway 30 2½ mi. NE. of Grand Gorge showing *Gilboa fm.* overlain by 183 ft. of ***Onteora*** *beds.* On p. 829 they say:] *Gilboa fm.* as redefined is certainly=Tully and may include some or all of Geneseo. [See further explanation under ***Unadilla*** *fm.*]

Gilboy sandstone member (of Monongahela formation).

Pennsylvanian: Southwestern Pennsylvania, northern West Virginia, and eastern Ohio.

I. C. White, 1891 and 1903. See under †*Browntown ss.*

Gilchrist shale. (In Pottsville formation.)

Pennsylvanian: Northwestern Illinois (Mercer County).

H. R. Wanless, 1929 (Ill. Geol. Surv. Bull. 57, pp. 49, 73, 83, 88, 122, 142). *Gilchrist sh.*—Blue-gray to greenish sh., micaceous in some beds; plant impressions irregularly distributed. Thickness 20 to 100+ ft. Complete thickness is penetrated by coal-test boring near Gilchrist, sec. 17, T. 14 N., R. 2 W., Greene Twp, whence name. Well exposed in pits of Hydraulic Press Brick Co. at Shale City and of NW. Clay Mfg. Co. at Griffin. Lies 6–13± ft. below top of Pottsville, or base of Colchester coal, in Alexis quad.

Gilcrease sand.

A subsurface unit 160 to 250 ft. thick, of limes, sands, and sandy limes, the top of which is encountered at a depth of 2,850 to 2,950 ft. in Papoose oil field, Okfuskee and Hughes Counties, central Okla. Has been correlated with Hartshorne ss., also with Atoka fm. Is productive in Gilcrease pool.

Giles *formation*.

Lower Devonian and Silurian: Southwestern Virginia and southeastern West Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 177, pl. 4) and 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 2). *Giles fm.*—In ascending order: Blue calc. sh. and blue ls., 30 to 40 ft.; very coarse ferruginous ss., 15 to 20 ft.; cherty ls., 30 to 40 ft.; yellow or green fossiliferous ss. of undet. thickness but probably less than 100 ft. Total thickness of fm. 30 to 200 ft. Of Lower Helderberg and Oriskany age. Overlies Rockwood fm. and underlies Romney sh. [As mapped this fm. has included beds of Sil. (Cayuga) age (see Va. chart II), but F. M. Swartz (U. S. G. S. P. P. 158, 1929) restricted name to beds of post-Cayuga age.

Named for Giles County, Va.

Gilford gabbro.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series*. Crops out ¼ mi. E. of Gilford station.

†Gillespie formation. (In Trinity group.)

Lower Cretaceous (Comanche series): Central Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 221). *Gillespie fm.*—Cross-bedded vermilion-red sands, 120 ft. thick. In Gillespie Co. rests on Paleozoic and grades up into upper beds of Glen Rose fm. Might possibly be correlated with basal sands of Travis Peak fm., but are more probably strat. equiv. of lower part of Glen Rose fm. where it rests on Travis Peak.

Apparently named for Gillespie Co.

Gillette moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County). See N. Y. State Mus. Bull. 187, 1916.

Gilliam thin-bedded member (of Capitan limestone).

Permian: Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 52). *Gilliam fm.*—Gray, light-colored, reddish ls. and dol., nearly massive, or at least bedding planes are very dim. In middle the ls. shows thick lenticular beds. In lower part it is decidedly thin-bedded. At base we find thicker layers of reddish dol. alternating with thinly laminated layers of same rock and with thin strata of yellowish marly ss. Thickness 2,600 ft. in Gilliam Canyon, Glass Mtns. Is top fm. of Perm. of Marathon region.

J. A. Udden, 1917 (Univ. of Tex. Bull. 1753, pp. 52–53). *Gilliam fm.*—Yellow dolomitic ls., in places pinkish and even brownish in color; stratification planes sharply marked and straight, and especially in lower part the rock is quite thin-bedded. To SW. of White Elephant tank there is in this fm. a brown ss. 20 ft. thick. This ss. was also observed in Gilliam Canyon and seems to be persistent. Thickness 743 ft. Grades into overlying Tessey fm. (1,400 ft. thick), which is topmost Perm. fm., and typically exposed 2± mi. N. of mouth of Gilliam Canyon. [This appears to be a redefinition of Gilliam fm.]

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). *Gilliam fm.* was named for a canyon that was supposed to be spelled *Gilliam*, but Hess Canyon and Altuda topog. sheets spell the canyon *Gilliland*, and that is spelling adopted by U. S. Geographic Board. The com. on geologic names of U. S. Geol. Survey, however, regards it as inadvisable to change the spelling of the fm., which is well established as *Gilliam fm.*

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 73–84). *Gilliam memb. of Capitan fm.* [See 1931 entry under *Tessey dol.*]

P. B. King, 1933 (Historical geol. of R. C. Moore, p. 325). *Gilliam thin-bedded ls. memb. of Glass Mtns fm.* [See 1933 entry under *Tessey dol.*]

The present approved name of U. S. Geol. Survey is *Gilliam thin-bedded memb. of Capitan ls.* See P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–798).

Gillies intrusive.

Jurassic (?): British Columbia.

C. O. Swanson, 1925 (Canada Geol. Survey Summ. Rept. 1924, pt. A, p. 110).

Gilman quartzite.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Gilmanton monzodiorite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series.* Named for Gilmanton Twp.

Gilmore sandstone member (of Greene formation).

Permian: Southwestern Pennsylvania (Greene and Washington Counties), northern West Virginia, and eastern Ohio.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K, pp. 38–39). *Gilmore ss.*—Coarse massive ss., greatly cross-bedded and of uneven texture. Thickness 25 to 40 ft. Lies beneath Windy Gap coal, in upper part of Greene County group [Greene fm.]. Occurs on crests of higher hills in Springhill, *Gilmore,* Aleppo, and Jackson Twps, Greene Co., Pa.

I. C. White, 1891 (U. S. G. S. Bull 65, p. 22). *Gilmore ss.*, massive ss., 40 ft. thick. Belongs in upper part of Dunkard Creek series [Dunkard group].

Gilmore limestone. (In Greene formation.)

Permian: Northern West Virginia.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties, p. 173). *Gilmore ls.*, 6 inches thick, underlies Gilmore coal and is separated from underlying Taylor ss. by 100 to 150 ft. of red sandy beds, sss., and sometimes a ls. [Probably named for association with Gilmore coal.]

Gilmore City limestone.

Mississippian: Central northern Iowa (Pocahontas and Humboldt Counties).

F. M. Van Tuyl, 1925 (Iowa Geol. Surv., vol. 30, pp. 113–114). [Author does not state that he is naming the beds described, but he uses *Gilmore City ls.* in three places, and it is in index to volume. As described, the beds in Gilmore Portland Cement Co.'s quarry, 1½ mi. NW. of Gilmore City, Pocahontas Co., consist of about 41 ft. of ls. of Kinderhook age, which is said to be probably older than Humboldt oolite, to resemble lithologically Alden ls., to rest on brownish dolomitic ls. assigned to Kinderhook group, and to be possibly=Iowa Falls dol., but "correlation is uncertain."]

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 349, 416–417). Alden ls. of Hardin Co. and *Gilmore City ls.* of Humboldt and Pocahontas Counties suggest Spergen both lithologically and faunally. The large crinoid fauna in base of Gilmore City ls. carries large number of Kinderhook genera. Alden ls., which is correlated with Gilmore City ls., lies uncon. on upper surface of Iowa Falls memb. of Hampton fm. This relation seems to suggest they should not be considered of Kinderhook age. [p. 349.] Alden ls. is correlated with oolitic ls. exposed near Humboldt and Gilmore City. Exact age of fauna of Gilmore City ls. is doubtful, but it is considered younger than the Kinderhook because of the fauna and the marked uncon. which separates it from upper beds of the Kinderhook. Fauna as a whole resembles certain parts of fauna of Madison ls. of the West. Type section of Gilmore City beds consists of (descending): (1) Thin-bedded white oolitic ls., numerous joints filled with green sh. (*Cyathophyllum* zone), 14 ft.; (2) very massive hard grayish-white crystalline cross-bedded oolitic ls., fossiliferous throughout but more so near the base (*Streptorhynchus* zone), 18 ft.; (3) massive greenish ls. interbedded with green sh. (*Rhodocrinus* zone), 8 ft.; (4) soft blue shaly ls. (*Camarotoechia* zone), 3 ft. [In his 1933 paper he called this *Rhynchopora* zone]; (5) brecciated ls., 2 ft. [pp. 416–417. In his 1933 paper cited below, No. 5 of type section of Gilmore City fm. is described as 15 ft. of ls., gray, lithographic, banded, carrying a brown ls. memb. in base and a brown shaly ls. memb. in top; no fossils.]

L. R. Laudon, 1933 (Univ. Iowa Studies, n. s., No. 256, vol. 15, No. 2). *Gilmore City fm.* consists almost entirely of gray, white, or blue cross-bedded ss. Thickness 210 ft. Is uncon. overlain by St. Louis ls. and uncon. underlain by Iowa Falls memb. of Hampton fm. Writer believes the fm. represents an eastward invasion of some portion of Madison sea of the West. [Listed fauna and described and discussed it.] At first glance one is impressed with similarity of this fauna with that of Spergen fm. A close examination, however, will reveal that it is not the Spergen fauna and that it is far older. It has its closest affinities with the molluscan fauna of the Wassonville memb. of Hampton fm. (Kinderhook). [Writer treated the Gilmore City as top fm. of Kinderhook.]

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245). *Alden ls.* of northern central Iowa is uncon. overlain by St. Louis ls., uncon. underlain by Hampton fm., and is=Salem [Spergen] ls.

L. R. Laudon, 1935 (p. 247 of rept last cited). Moore revives old term Alden and correlates the fm. with Spergen. A careful study of Gilmore City fauna shows more of Spergen species are present. The abundant crinoid fauna is typically late Kinderhook and very closely related to fauna at LeGrand.

Gilmore Gulch formation.

Tertiary (?), probably pre-upper Miocene: Central Nevada (northern Nye County).

H. G. Ferguson, 1933 (Nev. Univ. Bull., vol. 27, No. 3, p. 21). *Gilmore Gulch fm.*—Consists of ss., dark sh., and siliceous tuff. Thickness 500+ ft.; base not exposed. Assigned to Tert. (?), probably pre-upper Mio. Named for exposures in Gilmore Gulch, Tybo dist. Overlies Lone Mtn dol. (middle Sil.).

Gimlet limestone.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a ls. locally lying higher in McLeansboro fm. (Penn.) of central western Ill. than Lonsdale ls. Derivation of name not stated.

Gimlet cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a middle portion of McLeansboro fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated.

Girard shale member (of Chemung formation).

Upper Devonian: Northwestern Pennsylvania (Erie and Crawford Counties).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 118–119, 251). *Girard sh.*—A succession of very argill. ashen-gray and bluish shales with now and then a thin sandy stratum. Thickness 225 ft. No fossils except fucoids. I regard them as a transition series from the Portage to the Chemung, since they rest on undoubted Portage rocks, and typical Chemung fossils occur in the overlying rocks. The distinction btw. Girard and Portage beds is one of mineral constitution, and is founded on relative proportion of ss. layers and sh. layers. Well exposed along Elk Creek above Girard, Erie Co.

W. A. VerWiebe, 1917 (Am. Jour. Sci., 4th, vol. 44, p. 41). It appears to writer, after careful study of its stratigraphy and lithology, that true relation of *Girard sh.* is with the Chemung of N. Y.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), showed *Girard sh.* as overlain by Chadakoin and as resting uncon. on Northeast sh. In 1924 (N. Y. State Mus. Bull. 251, p. 157) he seemed to include Cuba ss. in Girard. In 1925 (Geol. Soc. Am. Bull., vol. 36, p. 464) he showed *Girard sh.* as resting on Cuba ss., which, in turn, rested on Northeast sh. In 1933 (Pan-Am. Geol., vol. 60, No. 3, pp. 195–196) he showed *Girard* as underlying Chadakoin and overlying Northeast, and stated that it is wholly younger than Chemung.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61), divided his *Girard stage* into *Girard sh.* (above) and Cuba ss. (below), and showed it as underlying his Chadakoin stage.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71), reported that it now seems likely Cuba ss. goes below, instead of above, Northeast sh. (See under *Northeast sh.*)

Girard moraine.

Pleistocene (Wisconsin stage): Northwestern Pennsylvania. Upper moraine of Lake Escarpment morainic system. Named for Girard, Pa. (See U. S. G. S. Mon. 41.)

Girard stage.

See Caster 1934 entry under *Girard sh. memb.*

Girardeau limestone.

Silurian (early): Southeastern Missouri and southwestern Illinois.

G. C. Swallow, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pt. 1, p. 109). *Cape Girardeau ls.*—As described by B. F. Shumard [on a later page of this vol.] is a fossiliferous compact bluish-gray brittle ls. 40 to 50 ft. thick, with smooth fracture, in layers 2 to 6 in. thick, with thin argill. partings. Lowermost fm. of Upper Sil. Underlain by Hudson River group, the upper 40 ft. of which consists of blue-gray and brown argillo-mag. ls., the lower part more argill., with several thin beds of bluish gray crystalline ls.

In 1866 (Ill. Geol. Surv. vol. 1, p. 139) A. H. Worthen introduced *Thebes ss.* for a ss. in southern Ill. which he stated was separated from the younger *Cape Girardeau ls.* by brown sandy sh. In many subsequent early Ill. and Mo. repts this brown sandy sh. was included with the ss. under name *Thebes ss. and sh.* and, later, *Thebes fm.* In 1909, however (Am. Jour. Sci., 4th, vol. 28, p. 515), Savage named the sh. *Orchard Creek sh.* and restricted *Thebes* to the ss. The name of this ls. was many years ago shortened to *Girardeau ls.* (See C. R. Keyes, 1894, Mo. Geol. Surv., vol. 4, pp. 30, 40.) The Orchard Creek sh. is now classified as early Sil. and the Thebes ss. as Upper Ord. (Richmond).

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., pp. 109–111). *Girardeau ls.* underlies Bainbridge ls. and overlies Thebes fm. in eastern Mo.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 351–376). *Girardeau ls.* is not known farther N. than a few mi. above Cape Girardeau, Mo. Is post-Richmond.

Named for outcrops 1½ to 2 mi. above Cape Girardeau, Cape Girardeau Co., Mo.

Gird.

Name introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) for 750 ft. of shales in Kootenai fm. of Mont. Derivation of name unknown.

Girkin formation. (In Chester group.)

Mississippian: Western Kentucky.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430, 440, 441). Unfortunately Butts has never described the section exposed along Gasper River from which his name *Gasper* is derived, and although upper limit of this fm. is fixed at base of Cypress ss., the position of its lower bdy is uncertain. *Gasper* as a fm. name has never been adequately defined, nor has its type loc. been clearly indicated. Uncertainty regarding the beds which Butts himself intends to include within the typical Gasper has made it impossible for writers to recognize "Gasper" as valid fm. name. Along most of S. margin of West Ky. coal basin and along part of its E. border, the Bethel (or Sample) ss. is absent, and Renault and Paint Creek lss. come together to form a single formational unit. A name by which it might be known would be convenient. Gasper would be a suitable name for this unit, but unfortunately the confusion, uncertainty, and miscorrelation that have surrounded it for 15 years have permanently impaired its usefulness; and it seems advisable to select a new name rather than attempt to define the Gasper within these limits, at *this late date. Therefore Girkin is now proposed as a designation for beds of Renault and Paint Creek age in that part of west Ky. where the Bethel (or Sample) ss. is not developed. It will include everything from Ste. Genevieve ls. (with Platycrinus penicillus) below to Cypress ss. above. This part of the section is well developed in the hills that nearly surround village of Girkin in Warren Co., Ky., and an excellent section may be seen in bluff of Barren River at Greencastle, 8 mi. to W.*

Gizzard formation. (In Lee group.)

Pennsylvanian: Central Tennessee.

J. M. Safford, 1869 (Geol. of Tenn., pp. 369–370). *Lower Coal Measures (Gizzard Portion).—Alternating shales, sss., and coals, 228 ft. thick, overlying Mountain ls. and separated from overlying Upper Coal Measures by 70 ft. of cgl. [Sewanee cgl.].*

Basal fm. of Lee group in central Tenn. Uncon. overlies Pennington sh. (Miss.). Underlies Sewanee cgl.

Named for Little Fiery Gizzard Creek, Marion Co.

†Glacial epoch.

†Glacial period.

Terms applied in early repts (and still used in popular articles) to *Pleistocene epoch.*

Glacian.

Pre-Cambrian: General.

See under *Pelodian.*

Glacier division.

Pre-Cambrian: British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 170).

Glacier Peak volcanics.

A term that has been applied in a formational sense to the volcanic rocks of Glacier Peak, Snohomish Co., Wash. (See H. C. Culver, State of Wash. Dept. Cons. and Develop., Div. Geol. Bull. 32, 1936, p. 21.)

Glacier Point glacial stage.

Pleistocene: Eastern California (Yosemite region).

F. E. Matthes, 1929 (Sci., n. s., vol. 70, pp. 75–76). *Glacier Point glacial stage.*—Oldest of the 3 stages of Pleist. glaciation recognized in Yosemite region of Sierra Nevada. Appears to be recorded only by erratic boulders occurring singly or in rows or groups, but without accompanying fine material, at levels 100 to 200 ft. above highest lateral moraines of the second or El Portal stage. These erratic boulders occur at a level 700± ft. above Glacier Point, extending in a row from E. base of Sentinel Dome to N. end of Illilouette Ridge. Others are scattered on broad divide E. of Mount Starr King. This stage may correspond to Kansan or even Nebraskan stage. [See also F. E. Matthes, U. S. G. S. P. P. 160, 1930.]

†Glade limestone.

Lower Ordovician: Central and western Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 258–267). *Glade ls.*—Light-blue or dove-colored thin-bedded or flaggy ls.; fossiliferous. Thickness 118 to 120 ft. Preeminently the bed of the great "Cedar Glades" of Central Basin. Underlies Carter's Creek ls. and overlies Ridley ls. Included in Trenton or Lebanon [Stones River] group.

Nongeographic term. Replaced by Lebanon ls. Of Chazy age.

Named for fact areas in which it appears on surface abound in bare or nearly bare rocky places called glades.

†Glade sandstone.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). [See 1933 entry under *Knapp fm.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 61), replaced this name with *Cobham cgl. memb.*

Glade sand.

Drillers' term for a sand, of Upper Dev. (Chemung) age, 10 to 50 ft. thick, in western Pa.

Gladeville sandstone. (In Pottsville group.)

Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 33). *Gladeville ss.*—Heavy, coarse, white ss., 100 ft. thick, massive in upper portion, becoming thin-bedded toward bottom, but carries no sh. Underlies Wise fm. and overlies Norton fm. in Bigstone Gap coal field of Va. and Ky.

Named for Gladeville (now called Wise), Wise Co., Va.

Gladwin moraine.

Pleistocene (Wisconsin stage): Northern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Gladwin, Gladwin Co.

Glady Fork sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 321). *Glady Fork ss.*—Greenish-brown coarse massive ss., 25 to 40 ft. thick. Plant fossils at base. Underlies Lower Mud sh. and overlies Pipestem sh., all members of Bluestone group [fm.]. Type loc. in end of ridge btw. Brush Creek and Glady Fork, just SE. of Princeton, Mercer Co.

Glamorgan gabbro.

Pre-Cambrian: Ontario.

F. D. Adams and A. E. Barlow, 1910 (Canada Geol. Surv. Mem. 6, p. 152).

Glance conglomerate.

Lower Cretaceous (Comanche series): Southeastern Arizona (Bisbee region).

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, pp. 56, 57+). *Glance cgl.*—Distinctly bedded red-brown cgl., 50 to 75 ft. thick, composing basal fm. of Bisbee group (of Comanche age) in Bisbee quad. Rests uncon. on pre-Camb. Pinal schist. Overlain conformably by Morita fm. Named for Glance, on El Paso & SW. R. R., near Glance mine, Bisbee quad.

Glassboro gravel.

Pleistocene: Southeastern Pennsylvania and adjacent parts of New Jersey.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 296–309). *Glassboro gravel.*—Called "Fossiliferous gravel" in earlier papers, because many of its pebbles are fossiliferous. Occurs at lower elevations than Bryn Mawr gravel. Abundant in N. J. and SE. Pa. It is the yellow gravel which caps the watershed btw. the Atlantic and the Delaware at a height of nearly 200 ft. Is older than Philadelphia red gravel.

R. D. Salisbury and G. N. Knapp, 1917 (N. J. Geol. Surv., vol. 8, pp. 11, 62), used *Glassboro phase of Bridgeton fm.* See 1917 entry under *Bridgeton fm.*

Is a part of Bridgeton fm., according to U. S. G. S. Phila. folio (No. 162), 1909.

Probably named for occurrence at Glassboro, Gloucester Co., N. J.

Glass Buttes series.

Miocene: Central southern Oregon (Lake County, northeast corner).

A. Waters, 1927 (Jour. Geol., vol. 35, pp. 442–452). *Glass Buttes series.*—A closely related series of rocks of acidic composition that form main portion of Glass Buttes Range. Includes augite andesite, quartz andesite, hypersthene dacite, augite dacite, hypersthene augite dacite, perlite, obsidian, and vitrophyre. Most striking feature is pronounced banding of all the larger flows. Seven lava flows belonging to this series, each at least 50 ft. thick, occur on one fault scarp, while 2 other flows are exposed on downthrown block of same fault. This brings total known thickness up to over 400 ft., and it probably is not much thicker. Has been referred to Mio. Rests conformably on a series of olivine and augite basalts, which have also been referred to Mio. Overlain by very recent flows of olivine and augite basalt.

†Glass Mountain formation. (In Cimarron group.)

Permian: Northwestern Oklahoma and southern Kansas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 353, 355). *Glass Mtn fm.*—Includes all beds, 160 ft. thick, above Salt Plain measures and below Cave Creek fm., the equiv. Cedar Hills sss. and Flower-pot shales of Kans. section not being satisfactorily identified in Okla. Included in Salt Fork div.

Named for Glass (also spelled Gloss) Mtns, Major Co., Okla.

†Glass Mountains formation.

Permian: Western Texas (Glass Mountains).

P. B. King, 1933 (Historical geol., by R. C. Moore, p. 325). *Glass Mtns fm.*—Underlies Bissett cgl. and overlies Word fm. Divided, in E. part of Glass Mtns, into (descending) Tessey massive ls. memb., Gilliam thin-bedded ls. memb., and Vidrio massive ls. memb. In W. part of Glass Mtns includes, in lower part, Altuda siliceous sh. memb. Is=Capitan ls. [See 1931 and 1933 entries under *Tessey dol.*]

This name being preoccupied, and the rocks being the southern extension of Captain ls. (an older and well-established name), the U. S. Geol. Survey designates these rocks in Glass Mtns the *Capitan ls.* (See P. B. King, Geol. Soc. Am. Bull., vol. 45, 1934, pp. 697–798.)

Glastonbury granite gneiss.

Late Carboniferous or post-Carboniferous: Central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 115, and map). *Glastonbury granite gneiss.*—Larger part is dark, well foliated, almost schistose gneiss, of fine grain, which on cleavage shows alternating patches of black biotite and white feldspar. A narrow eastern belt is more granitic and in places reaches the massiveness of true granite. The more schistose variety forms the hills SE. of Glastonbury and occurs in bed of Roaring Brook in South Glastonbury. Believed to be of igneous origin.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the continuation of this fm. in Mass. as Monson granodiorite, of late Carbf. or post-Carbf. age. Monson has priority.

†Glauconitic group.

Descriptive term applied by L. Harper (Prel. rept. geol. and agric. Miss., 1857, p. 72) to Cret. rocks in Miss.

†Glauconitic division.

Descriptive term applied by R. T. Hill (Am. Jour. Sci., 3d, vol. 38, 1889, pp. 468–473) to Navarro group of Tex.

Glenarm series.

The provincial series of pre-Camb. metamorphosed sed. rocks present in northern Va., Md., SE. Pa., western N. J., and possibly SE. N. Y. Formerly assigned to "Algonkian system," but that term has now been discarded. In 1929 (Md. Geol. Surv. Baltimore Co. Rept., p. 104) and later repts E. B. Knopf and A. I. Jonas assigned this series to *late pre-Camb.* (For definition see U. S. G. S. Bull. 769, p. 112.)

B. L. Miller, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 5, pp. 715–756), discussed age and problems involved in rocks designated as *Glenarm series*, and concludes that much more work is needed on the problems, concerning which there has been and still is considerable diversity of opinion.

J. H. Mackin, 1935 (Jour. Geol., vol. 43, pp. 356–380). *Glenarm series* of SE. Pa. may be wholly or in part Paleozoic.

Glenburnie member (of Chaumont formation).

Middle Ordovician (Black River): Ontario (Frontenac County).

G. M. Kay, 1929 (Jour. Geol., vol. 37, No. 7, pp. 664–671; and A. A. P. G. Bull., vol. 13, No. 9, p. 1214). *Glenburnie memb. of Chaumont fm.*—Includes 2 ft. of very argill. and very fossiliferous ls. intercalated with thin beds of sh., lying above Leray ls. memb. of Chaumont fm. and below Watertown memb. of Chaumont fm. at type section in small quarry W. of road in lot 22, conc. V, 1 mi. SW. of hamlet of Glenburnie, Kingston Twp, Frontenac Co., Ont. Fossils listed. Not present in N. Y., where it is represented by uncon. btw. Watertown and Leray lss.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), apparently does not mention this name, as it is not listed in index or tables.

Glencairn shale member (of Purgatoire formation).

Lower Cretaceous (Comanche): Eastern Colorado (Colorado Springs region).

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). *Glencairn sh. memb. of Purgatoire fm.*—Dark sh. with a little intercalated ss. Thickness 10 to 145 ft. Top memb. of Purgatoire fm. Overlies Lytle ss. memb. T. W. Stanton says fossils are Comanche and belong to Washita horizon. Named for a tract of land a few mi. N. of Lytle.

Glen Canyon group.

Jurassic (?): Southern and eastern Utah, northern Arizona, southwestern Colorado, and northwestern New Mexico.

Name adopted at joint conference of J. Gilluly, J. B. Reeside, Jr., H. E. Gregory, and R. C. Moore, from area specially studied by Gregory and Moore, who suggested the name. The name first appeared in print in A. A. P. G. Bull., vol. 11, p. 787, 1927, in paper by Reeside, C. E. Dobbin, A. A. Baker, and E. T. McKnight. More fully defined by Gilluly and Reeside in U. S. G. S. P. P. 150, p. 68, 1928, and by Gregory and Moore in U. S. G. S. P. P. 164, p. 61, 1931. It includes (descending) Navajo ss., Kayenta fm. (so-called Todilto? fm. of original definition), and Wingate ss. Named for exposures in Glen Canyon of Colorado River, Kane Co., Utah, and adjacent areas in Ariz. (See also U. S. G. S. P. P. 183, 1936, p. 4.)

Glencoe marble.

Trade name for a marble quarried from Kimmswick ls. at Glencoe, Mo., according to J. Bridge (letter dated July 10, 1936).

Glendale granite.

Pre-Cambrian (?): Central northern Colorado (Boulder County).

R. D. Crawford, 1909 (Univ. Colo. Studies vol. 6, pp. 97–131). *Glendale granite.*—A massive porphyritic variety of biotite granite. Usually light-colored. Most striking feature is great number and character of phenocrysts. Probably intrusive into the older biotite granite. Occurs on both sides of Lefthand Canyon in vicinity of Glendale and Rowena [Boulder Co.].

Glendale shale.

Mississippian (early): Southeastern Tennessee (Chattanooga quadrangle).

J. H. Swartz, 1924 (Am. Jour. Sci., 5th, vol. 7, pp. 24–26). *Glendale sh.*—Hard gray sh. full of concretions, becoming much darker toward base. Thickness 2 ft. 4 in. at Chattanooga and 2 ft. 11 in. about 16 mi. E. of Chattanooga. *Lingula melie* abundant from 4 to 6 in. above base, and establishes correlation with lower part of Cuyahoga sh. of Ohio. Heretofore included in Fort Payne chert of this area, but in this rept excluded from Fort Payne. Overlies Chattanooga sh. Named for exposures at Glendale Station, just outside Chattanooga, on electric road to Signal Mtn.

Glendale beds.

Eocene (Jackson): Eastern Texas (Trinity County).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1316). *Glendale beds.*—John L. Brice traced across Trinity Co. a fossiliferous zone, about 8 ft. thick, which crops out at Glendale, Trinity, and S. of Groveton, and gave name *Glendale* to a section 515 ft. thick, including Manning beds of this paper. Burford and Olcott found the same fossiliferous ss. and attempted to trace it to Sabine River. Study of their geol. columns shows their Glendale ss. horizon ranges in interval in Whitsett fm. considerably above Dilworth sand (basal zone of Whitsett).

Glen Dean limestone. (Of Chester group.)

Mississippian: Southern Illinois and Indiana, Kentucky, Tennessee, and southwestern Virginia.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., p. 97). *Glen Dean ls.*—Varying proportions of ls. and sh., including, locally at least, a little ss. In Breckinridge Co., Ky., consists of (descending): (1) 40 to 100 ft. of ls. and sh. with a little red sh.; (2) 30 to 60 ft. of thick- or thin-bedded ls., in part generally rather coarse-grained or crinoidal and of light- to bluish-gray color; (3) 0 to 10 ft. of green and red sh. resting on Hardinsburg ss. Is overlain by Tar Springs ss. Named for exposures along railroad on both sides of Glen Dean, Breckinridge Co., Ky.

Glendon limestone. (In Vicksburg group.)

Oligocene (lower): Coastal Plain of southwestern Alabama and Mississippi.

This name first appeared in print in 1917 (U. S. G. S. Bull. 661H, pp. 298, 300), when it was used by O. B. Hopkins for top memb. of Marianna ls., and credited by him to unpublished ms. by C. W. Cooke.

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, pp. 187, 195). *Glendon ls. memb. of Marianna ls.*—A series of ledges of hard, partly crystalline yellowish or pinkish ls. interbedded with softer strata of impure ls. composed largely of Bryozoa, Foraminifera, and shells of *Ostrea vicksburgensis* and *Pecten poulsoni*. Is distinguished from other parts of Marianna ls. mainly by its lithology, but a few species of organisms are restricted to it. At Glendon, [Clarke Co., SW. part of] Ala., it is 18 or 20 ft. thick and overlies 20 ft. of "chimney rock" [a facies of Marianna ls.]. Because of its hardness it is most conspicuous part of Vicksburg group in Miss. Is top memb. of Marianna ls. In Miss. it rests on Mint Spring calc. marl memb. of Marianna ls., but in Ala. it rests on the "chimney rock" facies of Marianna. Is overlain by Byram calc. marl.

In 1923 (U. S. G. S. P. P. 133) the Glendon was elevated by Cooke to formational rank and identified eastward into Ga., where, according to him, its lithology changes to sands, clays, and cherts and where it was called *Glendon fm.* These rocks in Ga. had heretofore been included in Chattahoochee fm., but mapped in part as Chattahoochee fm. and in part as Ocala ls. and Vicksburg fm. Later Cooke decided the beds in Ga. and Fla. which had been called *Glendon* were younger than true Glendon ls., and he renamed them *Flint River fm.* Still later he named the beds in eastern Fla. which had previously been called *Glendon* the *Suwannee ls.*, which he regards as probably contemp., at least in part, with Flint River fm. of western Fla. and Ga.

Glenerie limestone. (In Oriskany group.)

Lower Devonian: Southeastern New York.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). The Oriskany lss. at Glenerie are named *Glenerie ls.*, from town [in Ulster Co.]. Underlie Esopus grit and overlie Connelly cgl. [Thickness not stated.]

This is present definition of N. Y. State Survey, according to W. Goldring, 1931 (N. Y. State Mus. Hdb 10, pp. 370, 380).

Glen Eyrie shale member (of Fountain formation).

Pennsylvanian: Eastern Colorado (El Paso County region).

G. I. Finlay, 1907 (Jour. Geol., vol. 15, pp. 586–589). *Gleneyrie fm.*—Gray and buff, finely laminated sss., composed almost wholly of quartz grains with thin bands of black sh. near bottom. Can be traced northward from Manitou region to Glen Eyrie Creek [El Paso Co.], where it is well exposed, although overlying Fountain fm. comes down to basal granite a short distance to N. Pennsylvanian plants in sh. bands near base, which D. White says are of Pottsville age. Is uncon. overlain by Fountain fm. [restricted] and uncon. underlain by series of lss., the lower part of which are of Ord. age.

J. Henderson, 1909 (Colo. Geol. Surv. 1st Rept, 1908, pp. 149–184, fig. 27). [Shows *Gleneyrie ss.* of Manitou region as conformable with overlying Fountain cgl. of that area, and as=basal part of Fountain cgl. of Boulder region.]

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). Lowermost 90 ft. of Fountain fm. is here separately mapped as *Glen Eyrie sh. memb. of Fountain fm.* It consists of gray ss. and sandy sh. with thin beds of black fossiliferous sh. containing traces of coal. This memb. is strikingly unlike great body of Fountain fm., altho *transitional beds occur at its top.* It is important not only because it is a readily separable lithologic unit, but because of its flora. The Glen Eyrie memb. is found only in Manitou embayment, where it crops out btw. Glen Eyrie and Manitou. Rests uncon. on Manitou ls.

Glenham belt.

Glenham gneiss

See under *Matteawan granite.*

Glenkirk limestone.

Silurian (Niagaran): West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 566, 578–582, 692). [See explanation under *Lego ls. memb.*]

Named for Glenkirk, Wayne Co.

†Glenn formation.

Pennsylvanian: Central southern Oklahoma.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Glenn fm.*—Blue sh., with thin brown sss. and occasional thin lss. Thickness 1,000 to 3,000 ft. Overlies Caney sh. and may include highest Carbf. rocks exposed in Tishomingo quad.

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull., vol. 6, No. 1). *Glenn fm.* of Ardmore Basin divided into (descending) Hoxbar memb., Deese memb., Cup Coral memb., Otterville ls., and Springer memb. Total thickness 12,000 to 19,000 ft.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331–347). We are convinced it was not Taff's intention to include in Glenn fm. the beds called Hoxbar memb. by Goldston. Typical Glenn includes only Deese and "Cup Coral" members of Goldston. [For their views regarding Otterville and Springer members of Goldston see under *Otterville* and *Springer.*]

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 25). According to Goldston the Glenn fm. is exposed only S. of Arbuckle Mtns, in SW. Johnston and northern Carter Counties, and extends across east-central Carter into northern Love Co.

H. D. Miser, 1925 (Okla. Geol. Surv. Bull. 35, p. 26, footnote). [See entry under *Hoxbar memb.*]

S. Powers, 1927 (A. A. P. G. Bull., vol. 11, No. 10, pp. 1067–1085), mapped Glenn fm. as underlying Hoxbar fm. and overlying Springer fm.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7–21), recognized following units in Carter Co. (descending): Hoxbar fm., 4,000± ft.; Deese fm., 5,000± ft.; Dornick Hills fm., 1,500–4,000 ft. (including Otterville ls., 25± ft. thick, in lower part); and Springer fm., 3,000 or more ft. thick.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). Springer fm. was included in *Glenn fm.* by Taff in Tishomingo folio, but was excluded from Glenn by Girty, Roundy, and Miser. Best solution of Glenn is to drop it, as suggested by Gould (personal communication).

F. A. Melton, 1930 (Okla. Geol. Surv. Bull. 40LL). *Springer fm.* is lowest subdivision of Glenn fm. of Taff.

Named for Glenn, Carter Co.

Glenn sand.

A subsurface sand, of early Penn. (Cherokee) age, 10 to 200± ft. thick, in Okla., lying lower than Red Fork sand, higher than Tucker or Taneha sand, and correlated with lower sand of the series to which name *Bartlesville sand* has been applied. The typical Glenn, of Glenn pool, Carter Co., lies at 1,350 ft. depth and the Taneha at 1,550 ft.

Glenn Creek shale member (of Jefferson limestone).

Middle Devonian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 42 and passim). *Glenn Creek sh. memb.*—Underlies Coopers Lake ls. and overlies White Ridge ls.; all members of Jefferson ls. Thickest (66 ft.) at type loc. on White Ridge; thinnest

(7 ft.) in Nannie Basin region. Type loc. on S. side of SW. peak of White Ridge, where it consists of (descending): (1) 31 ft. of dull- and brighter-red calc. sh. with several beds (up to 14 inches thick) of gray argill. ls., and at top thinner bedded very argill. lavender-red ls.; (2) 20 ft. of thin-bedded red clay sh. with green-gray fissile sh. in upper 2 ft.; (3) 8 ft. of dull-red thick-bedded calc. sh. and shaly argill. red-gray ls. Named for Glenn Creek, whose middle branch heads at E. base of White Ridge. On Saypo topog. sheet the names Glenn Creek and Moose Creek have been interchanged.

Glenogle shale.

Ordovician: British Columbia and Alberta.

L. D. Burling, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 128), and 1922 (Geol. Mag., vol. 59, pp. 453, 454). *Glenogle shales*, Ord., B. C.

C. D. Walcott, 1923 (Smithsonian Misc. Coll. vol. 67, No. 8, p. 463), gave complete definition and assigned the fm. to Lower Ord. All subsequent repts by Canadian geologists assign the fm. to Ord.

Named for Glenogle Creek, Lower Kicking Horse Canyon, near Glenogle Station, B. C.

Glen Park formation. (In Kinderhook group.)

Mississippian: Central eastern Missouri and southwestern Illinois (Jersey and Calhoun Counties).

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Glen Park ls. memb.*—Oolitic ls., 5 ft. thick, forming middle memb. of Sulphur Springs fm. Overlain by Bushberg ss. memb. and underlain by 0 to 15 ft. of sh. forming basal part of Sulphur Springs fm.

See under *Sulphur Springs fm.* The 5 ft. of oolitic ls. to which Ulrich applied name *Glen Park* appears to be only a minor part of the fm. later called *Glen Park ls.* by Moore and others.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., opp. p. 282), showed *Glen Park ls.* as present in only Jersey and Calhoun Counties, Ill., and in SE. Mo., and he showed it as underlying Hannibal sh. and overlying (with uncon. in places) Louisiana ls., and as absent in Pike Co., Ill. In 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245) he showed Glen Park of western Ill. and NE. Mo. as lying btw. Hannibal above and Louisiana ls. below, and the Glen Park of SW. Ill. and SE. Mo. as uncon. underlying Fern Glen ls. (the uncon. representing Chouteau ls. and Hannibal sh.) and uncon. overlying Chattanooga sh., the Louisiana ls. being absent.

Named for exposures at Glen Park Station, Jefferson Co., Mo.

Glenray limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 432). *Glenray ls.*—Gray, usually hard and somewhat sandy, but sometimes shaly, 44 to 125 ft. thick. Marine fossils. Underlies Webster Springs ss. and overlies Lillydale sh.; all members of Bluefield group [fm.]. Type loc. in Summers Co., on NW. side of Greenbrier River, opposite Glenray. Also observed in Mercer and Monroe Counties, W. Va., and in Tazewell Co., Va.

Glenrock limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 86, 88). *Glenrock ls.*—Dark gray, dense ls.; weathers light gray or slightly buff. Thickness 1 to 2 ft. in Nebr. and NE. Kans. Underlies Bennett sh. and overlies Johnson sh., all included in Elmdale sh. memb. Named for exposures high in valley side just NW. of Glenrock, Nemaha Co., Nebr.

G. E. Condra, 1935. (See under *Howe ls.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Glen Rose limestone. (In Trinity group.)

Lower Cretaceous (Comanche series): Texas.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 507). *Glen Rose or alternating beds.*—Soft yellow mag. fossiliferous beds, siliceous at base, alternating with fine argill. sand with occasional dimension layers of almost pure crystalline lss., chalk, and mag. lss., often oolitic in structure Overlies Trinity or Basal sands and underlies Paluxy sands.

Middle fm. of Trinity group. Underlies Paluxy sand and overlies Travis Peak sand (†Basal sands).

Named for Glen Rose, Somervell Co.

Glens Falls limestone. (Of Trenton group.)

Middle Ordovician: Eastern New York (Mohawk and upper Hudson valleys).

R. Ruedemann, 1912 (N. Y. State Mus. Bull. 162). *Glens Falls ls.* proposed for basal Trenton ls., 17 ft. thick in Flat Creek ravine at Sprakers, 2½ mi. E. of Canajoharie ravine. Consists of thin layers of very fossiliferous ls. with sh. intercalations near top and a 2-inch cgl. layer at base, separating it from Tribes Hill ls. Contains ripple marks and other signs of shallow-water conditions. Fauna of both the ls. and shaly intercalations is basal Trenton. Traced by outcrops around SE. side of Adirondacks to Saratoga and Glens Falls. Are lower than any beds exposed at Trenton Falls, and therefore given distinct name. We have called them *Jacksonburg ls.*, but Jacksonburg of N. J. (typical) contains beds of Amsterdam and Lowville age, and therefore is not appropriate for these basal Trenton beds. At Glens Falls [Warren Co.] the fm. underlies Canajoharie sh. and overlies Amsterdam ls.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 39). *Glens Falls ls.* is well developed in Mohawk and upper Hudson valleys.

H. P. Cushing and R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169). *Glens Falls ls.* at Saratoga Springs and vicinity consists of 40 ft. of alternating black sh. and thin black ls. Assigned to Basal Trenton, but fauna shows it lies below beds of Trenton Falls section. Underlies Canajoharie sh. and uncon. overlies Amsterdam ls.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258). *Glens Falls ls.*, 24 ft. thick, underlies Canajoharie sh. in lower Mohawk Valley. Is older than any part of the Trenton exposed at Trenton Falls.

The present N. Y. State Survey assigns Glens Falls ls. to Trenton group. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931.)

Glenwood shale. (In Platteville limestone.)

Middle Ordovician (Lowville): Northeastern Iowa, western Illinois, southern Minnesota and Wisconsin.

S. Calvin, 1906 (Iowa Geol. Surv. vol. 16, pp. 60, 61, 75). *Glenwood sh.*—Sh., 3 to 15 ft. thick in Glenwood Twp [Winneshiek Co., Iowa], lying btw. St. Peter ss. below and Platteville ls. above, described as "Basal Sh." in earlier repts, and supposed to represent initial phase of Trenton series. In lower 8 to 10 ft. it shows streaks and bands of sand, indicating close relationship with St. Peter ss. This lower part is assigned to St. Peter stage of Canadian series.

The shaly beds forming basal part of Platteville ls. in some areas consist of transitional shales and lss. 7 to 110 ft. thick, and are by most writers, including E. O. Ulrich, 1924, included in Platteville ls.; but A. Bevan (Ill. Geol. Surv. Rept. of Investigations, No. 9, 1926) advocated making them a distinct fm., under the name *Glenwood beds;* and Iowa Geol. Surv. (vol. 33, 1928, vol. 34, 1929) not only treated them as a distinct fm. but included them in *Lower* Ord. In Iowa Geol. Surv. vol. 33, pp. 33–36, 1928, many well logs record a thin bed of ls. btw. Glenwood sh. and underlying St. Peter ss., and record upper part of the Glenwood as consisting of 0–15 ft. of ss., and in SW. part of State rept a thickness of 80 ft. for the Glenwood.

F. W. Sardeson, 1933 (Pan-Am. Geol., vol. 60, p. 90). *Glenwood shales* is merely a new name for what is long known as the top of Peter ss. [St. Peter ss.].

C. R. Stauffer, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 1, pp. 125–169), described, discussed, and figured conodonts from these beds, which he stated (pp. 130–131) are "filled with Middle Ord. life, and most of its fauna is of that age." Also that "the fossil-bearing Glenwood beds belong in Mohawkian series, and are not much older than Platteville ls."

G. M. Kay and G. I. Atwater, 1935 (Am. Jour. Sci., 5th, vol. 29, Feb., pp. 98–111), treated these beds as basal memb. of Platteville ls., as did Kay (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, pp. 285–286), and the "Conf. classification," fig. 1; but according to fig. 2 of this Conf. Rept. the Iowa and Ill. Surveys exclude these beds from Platteville ls. Kay stated Glenwood memb. is overlain by Pecatonica ls. On pp. 383 to 384 of this Conf. Rept. A. Bevan stated that near Oregon, Ogle Co., NW. Ill., the *Glenwood* consists of 2½ to 12 ft. of glauconitic ss., which "in this paper is considered as a separate fm., rather than as a memb. of the Platteville." C. R. Stauffer, 1935 (Jour. Pal., vol. 9, No. 7, p. 597), also treated Glenwood as distinct fm.

†Globe limestone.

Carboniferous and Devonian: Southeastern Arizona (Globe region).

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Globe ls.*—Hard buff and gray lss., 700 ft. thick. Underlie Whitetail fm. (Eocene ?) and overlie Apache group.

Replaced by Tornado ls. (Penn. and Miss.) and Martin ls. (Upper and Middle Dev.).

Named for development at and around Globe.

Glorieta sandstone.

Permian: Central northern New Mexico (Glorieta Mesa, Santa Fe and San Miguel Counties).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257, 262; and Conspectus of geol. fms. of N. Mex., pp. 2, 7). *Glorietta sss.*—Main body of Dakotan series (Cret.) around S. end of Rocky Mtns. Thickness 300 ft.

D. Hager and A. E. Robitaille, 1919 (Geol. rept. on oil possibilities in eastern N. Mex.). *Glorietta ss. is top memb. of Yeso fm. It consists of 500 ft. of massive* ss., even-grained and white when broken open but weathering reddish brown.

C. L. Baker, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 111, 118, 119, 126). *Glorieta ss.*, basal memb. of Upper Trias, outcrops along valley of Pecos from Glorieta Mesa downstream to somewhere btw. Puerto de Luna and Fort Sumner, and at Santa Rosa. Near Anton Chico it rests on Yeso fm.

J. L. Rich, 1921 (Am. Jour. Sci., 5th, vol. 2, pp. 295, 296). Baker has confused Glorieta ss. in parts of area with the younger (Upper Triassic) Santa Rosa ss. The Glorieta ss. is coarse, gray, massive, 300 to 500 ft. thick, underlies San Andreas ls., overlies Yeso fm., and is of Perm. age.

As there is no fm. btw. San Andres ls. and Yeso fm. as defined (now called Yeso memb. of Chupadera fm.), the ss. of Glorieta Mesa is top part of Yeso memb. of that area.

Gloucester formation.

Ordovician: British Columbia, Ontario, Quebec.

C. W. Drysdale, 1912 (Canada Geol. Surv. Summ. Rept. 1911, pp. 134, 135). *Gloucester fm.*—Crystalline ls., light to dark gray, which occurs as irregular masses interfolded with Franklin group (of greenstone, altered tuff, jasperoid, and silicified argillite), of Paleozoic (Upper?) age. [On p. 138 he states that the Gloucester property is situated on Gloucester Creek slope of Franklin Mtn, B. C., and that the rocks there are *Franklin group greenstones.*]

In 1916 P. E. Raymond used this name in Ont. (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, p. 255). In 1921 R. Ruedemann (N. Y. State Mus. Bull. 227, 228, p. 71) assigned *Gloucester sh.* of Canada to late Utica and post-Utica. In 1922 (Geol. Soc. Am. Bull., vol. 33, p. 585) Raymond stated that *Gloucester* was proposed for the "Utica" black sh. of Ont., which overlies Collingwood black sh. and ls. In 1924 A. F. Foerste (Canada Geol. Surv. Mem. 138, chart opp. p. 58) placed Gloucester above

Collingwood and assigned both to Utica. In 1925 (N. Y. State Mus. Bull. 258, p. 64) Ruedemann assigned *Gloucester sh.* to upper Utica, correlated it with Atwater Creek and Deer River of N. Y., and placed it above Collingwood sh. On p. 149 he appears to assign topmost part of *Gloucester* to basal Frankfort time. In 1933 G. M. Kay (Am. Jour. Sci., 5th, vol. 26, No. 151, p. 2) applied *Gloucester fm.* in Jefferson Co., N. Y. and assigned it to Trenton group, as he did in 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 227, 228).

Goathaunt member (of Siyeh limestone).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Goathaunt memb. of Siyeh fm.*—Massive impure dark-gray mag. ls., weathering buff; some interbeds of dolomitic metargillite and a few thin beds of ss. Molar teeth and shear structures common in upper part. Thickness 2,000+ ft. Can be studied throughout Glacier Nat. Park. Most accessible on trail to Swift Current Pass. Underlies *Collenia (?) frequens* zone and overlies *Collenia symmetrica* zone of Siyeh fm. [Derivation of name not stated, but probably Goathaunt Mtn.]

Goat Mountain formation.

Jurassic or Triassic: British Columbia.

S. J. Schofield, 1926 (Econ. Geol., vol. 21, p. 273).

Gober tongue of Austin chalk.

Upper Cretaceous: Northeastern Texas (Hunt, Fannin, and Lamar Counties).

L. W. Stephenson, 1927 (A. A. P. G. Bull., vol. 11, pl. 1, pp. 8–12). Above Brownstown marl as here restricted is a tongue of Austin chalk formerly incorrectly correlated with Annona chalk and in this paper designated *Gober tongue of Austin chalk.* Village of Gober, Fannin Co., is located on this chalk. Where this tongue connects with main body of Austin chalk it probably is not less than 400 ft. thick, but it gradually thins out to E. and appears to pinch out entirely in E. part of Lamar Co. Between Honey Grove, Fannin Co., and High, Lamar Co., the lower part of the Gober is composed in part of soft, more or less chalky clay or marl. The lowest layers of chalk exposed in cut 1¼ mi. W. of High are regarded as forming base of Gober tongue. From central Fannin Co. to E. part of Lamar Co. the uppermost bed of Gober tongue is a soft tough ls. facies 1 to 10 ft. thick. It is conformably overlain by Taylor marl.

†Godiva limestone.

Mississippian, Devonian, Silurian (?), and Upper to Lower Ordovician: Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 624). *Godiva ls.*—As distinguished from underlying Eureka ls. is essentially a pure ls., 2,216 ft. thick. For 1,200 ft. above base the prevailing colors are gray and blue and the beds are diversified by occurrence of two or three sandy beds. Upper 1,000 ft. consists mainly of blue crystalline and black carbonaceous beds containing many fossils, with occasional beds rich in chert nodules and lenses. Underlies Humbug intercalated series. [Accompanying map shows Godiva Mtn is largely composed of this fm.]

G. F. Loughlin and W. Lindgren, 1919 (U. S. G. S. P. P. 107), divided these rocks into following fms. (descending): Pine Canyon ls., Gardner dol., Victoria qtzite, Pinyon Peak ls., and Bluebell dol., which range in age from lower Miss. to Lower Ord.

Godiva limestone. (Also spelled *Goldiva.*)

Eocene: Utah.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 36). *Godiva lss.* (also *Goldiva lss.*)—Lss., 800 ft. thick, uncon. below Washakie shales and uncon. above Wasatchan series. Bottom fm. of Greenian series in Utah. [Derivation of name not stated.]

Goen limestone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). [*Goen ls.*, *in lower part of Mineral Wells fm., is shown as separated from overlying* Thurber coal by a thin sh., and as lying 60 ft. above Santo ls., all members of Mineral Wells fm.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 106). *Goen ls.* is memb of Garner fm., the name *Mineral Wells fm.* being restricted to upper part of original Mineral Wells fm.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 16–24). The ls. in upper (Grindstone Creek) memb. of Millsap Lake fm. that caps the knolls around Goen Cemetery and is well seen on N. side of Millsap-Brazos road ½ mi. by road NE. of Goen Cemetery entrance, is here named *Goen ls.* It lies in upper part of Grindstone Creek memb. of Millsap Lake fm., 50 ft. above Santo ls.

Goff coal group. (In Williams Fork formation.)

Upper Cretaceous: Northwestern Colorado (Meeker quadrangle).

E. T. Hancock and J. B. Eby, 1930 (U. S. G. S. Bull. 812, p. 206). *Goff coal group.*—The 700 ft. of coal-bearing beds that underlie Lion Canyon memb. of Williams Fork fm. and is separated from Fairfield coal group below by 1,000± ft. of rocks almost barren of coal.

†Gogebic series.

A name applied in some early repts to †Animikie group (upper and middle Huronian) of Gogebic dist., Mich. (See U. S. G. S. Bull. 360, 1909, index.)

Golconda formation. (Of Chester group.)

Mississippian: Southern Illinois and Indiana, western Kentucky and Tennessee, and northwestern Alabama.

A. D. Brokaw, 1916 (Ill. Geol. Surv. Extr. from Bull. 35) and 1917 (Ill. Geol. Surv. Bull. 35, pp. 19–29, on parts of Saline, Williamson, Pope, and Johnson Counties, SE. Ill.). *Golconda fm.*—Shales and lss., variable in color and character, with a red sh. in places. Thickness 100 to 300 ft. Underlies Hardinsburg ss. and overlies Cypress ss.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., p. 91). *Golconda fm.*—Consists of (descending) solid ls., 30 to 40 ft.; sh. and ls., 80 ft.; dark, argill., coarsely crystalline or fragmental fossiliferous ls. called *Pterotocrinus capitalis* zone, 10+ ft.; and dark sh., 20 ft. Underlies Hardinsburg ss. and overlies Cypress ("Big Clifty") ss. Named for Golconda, Pope Co., SE. Ill., just N. of which the full thickness outcrops on the river bluff.

Gold Creek quartzite.

Middle (?) Cambrian: Northern Idaho (Pend Oreille district).

E. Sampson, 1928 (Idaho Bur. Mines and Geol. Pam. 31, p. 9). *Gold Creek qtzite.*—Distinguished from any rock in Belt series by coarseness of grain. Is rather *coarse-grained throughout, with many pebble beds, some of which contain pebbles* as large as 3 in. diam. Color generally pure white. Cross-bedding is characteristic feature. Is very resistant to weathering and generally forms ridges and cliffs. Probably more than 200 ft. thick and less than 600; 400 ft. is fair approx. *Named for exposures on North and South Gold Creeks near Lakeview.* Conspicuous outcrops on summit of ridge above cement rocks plant at Port Rock. Basal fm. of Camb. in this area. Believed to be uncon. on Algonkian Striped Peak fm. Overlain by Rennie sh. (Middle Camb.).

†Golden formation or group.

Name suggested by A. C. Veatch (Jour. Geol., vol. 15, p. 548, 1907) as appropriate substitute for the so-called "Lower Laramie" (=typical Laramie). From Golden, Colo.

Golden Bar andesite rocks.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], p. 16).

Golden Eagle limestone.

Pennsylvanian: Southwestern Illinois (Calhoun County).

H. E. Culver, 1925 (Ill. Geol. Surv. Coop. Min. ser., Bull. 29, p. 20). [See description under *Piasa ls.* Position within McLeansboro fm. not defined. It appears to be the 5 ft. of gray concretionary ls., containing *Fusulina*, which on p. 39 of book cited is described as one of prominent beds of Calhoun Co., and there lying near top of the Penn., being overlain by 6 ft. of brown sh. and underlain by sandy brown sh. and a concealed interval aggregating 65 ft. Presumably named for exposures at or near Golden Eagle, Calhoun Co.]

†Golden Gate series.

Jurassic (?): Western California.

H. W. Fairbanks, 1895 (Jour. Geol., vol. 3, pp. 416–426). *Golden Gate series.*—Jasper, ss., sh., sl., and large bodies of fine-grained greenish eruptives. Extends from Santa Barbara Co. NW. through Coast Ranges to Klamath Mtns. Uncon. overlain by Knoxville beds and rests uncon. on crystalline basement complex.

Is same as Franciscan fm.

Named for development on N. and S. shores of Golden Gate.

Golden Ray limestone.

Middle Cambrian: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Golden Ray ls.*—Five thick horizons of heavily bedded dark-blue to bluish-gray dolomitic ls., interspaced by 5 relatively thin horizons of fine-grained light-gray to white, thinly laminated impure ls. Thickness 1,559 ft. Underlies Centennial ls. and overlies Tintic sh. [Evidently named for Golden Ray mine.]

These rocks were later subdivided into 3 fms., named (descending) Herkimer ls., Dagmar ls., and Teutonic ls.

Goldenville formation.

Cambrian or pre-Cambrian: Nova Scotia.

J. E. Woodman, 1904 (Am. Geol., vol. 33, p. 368; vol. 34, p. 14). [No age assignment. Later repts, by several geologists, assign it to Camb. or pre-Camb.]

†Golden Wall sandstone. (In Blair formation.)

Upper Cretaceous (Montana): Southwestern Wyoming (Sweetwater County).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 48, 155). *Golden Wall ss.* (also *Golden Wall group*).—Thinly laminated gray and buff ss. forming basal memb. of Point of Rocks group.

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, pp. 23, 32, 33, pl. 1). Massive yellowish sss. near top of Blair fm. give rise to main scarp surrounding Baxter Basin, Sweetwater Co., Wyo., which is often referred to as the "golden wall."

†Gold Hill porphyry.

Eocene: Western central Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48), applied *Gold Hill porphyry* to mass of Elk Mtn porphyry on Gold Hill.

Gold Hill conglomerate.

Triassic (?): Southwestern Colorado (Ouray district).

J. D. Irving, 1905 (U. S. G. S. Bull. 260, p. 56). [In section of Gold Hill the Dolores fm. [Triassic and Jurassic?] is shown as consisting of *Gold Hill cgl.* underlain by ss.]

Gold Hill formation.

Cambrian? (Upper Cambrian?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Gold Hill fm.*—Marine sediments, of probable Upper Camb. age, laid down in shallow water, A series of schistose sl., qtzite, and ss. No fossils except a few annelid trails, but they occur considerably lower than rocks carrying Ord. fossils and bear some lithologic resemblance to known Camb. of other Nevada ranges. Are probably Upper Camb. Exposed thickness 5,000± ft.; base not exposed. Upper 2,500± ft. consists of a series of siliceous schist, ss., and qtzite, the schist predominating. Beneath this succession is (descending): (1) White Caps ls. memb., 30± ft. thick; (2) schist with several thin beds of qtzite, nearly 200 ft.; (3) Morning Glory ls. memb., 15 ft.; (4) siliceous schists, 140 ft.; (5) Pine Nut ls. memb., 10 ft.; (6) a short distance below the Pine Nut memb. lies a thick series of quartzose schists with subordinate calcitic and lime silicate schists and, rarely, thin beds of qtzite. In fault contact with overlying Mayflower schist. Exposed W. of Gold Hill.

Goldiva limestones. (See also *Godiva.*)

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 279, 308). Over a large area of NW. Colo. the Greenian, or Green River, series of Wyo. forms the bedrock. At E. extremity of Uinta uplift the sequence consists chiefly of calc. shales and lss., attains a thickness of 800 ft., and is the Goldiva fm. of Utah and Wyo. This is followed [above] by the whitish Washakie shales, 1,200 ft. thick. The two members are separated by a well-defined erosional uncon.

Derivation of name not stated.

†Gold Ledge porphyry.

A name applied by J. E. Spurr to an altered ls. containing the gold ores of Mercur dist., central northern Utah, which occur in Great Blue ls. (upper Miss.).

Gold Road latite.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Chiefly volcanic flows, with tuff and intrusive material. Mainly biotitic latite, but includes some glassy and lithophysal rocks that should perhaps be classed as rhyolite. Between some flows are layers of tuff. Basal flow is conspicuously biotitic. Thickness 3,000 to 4,000± ft. Overlies Oatman andesite. Named for settlement and mine, both of which are called Gold Road.

Goliad sand.

Pliocene: Southern Texas.

J. T. Lonsdale and J. R. Day, Feb. 9, 1933 (Ground water res. of Webb. Co., Tex., U. S. G. S. Press Bull. 68861). The name *Goliad fm.* has been proposed by Texas geologists and is being considered as a substitute for *Reynosa.*

A. Deussen, 1933 (A. A. P. G. Bull., vol. 17, No. 5, May, p. 485). The fm. which geologists are calling *Goliad ss.* in SW. Tex. according to my interpretation represents basal portion of what I conceive to be Reynosa fm.

W. A. Price, 1933 (A. A. P. G. Bull., vol. 17, No. 5, p. 492). The field name "*Goliad ss.*," first employed by H. A. Noble and Irving K. Howeth in a Shell Co. field rept in 1928, has come into somewhat general use in south Tex. but has no standing in nomenclature, since it has not been described in publication by its authors.

L. Bowling and A. P. Wendler, 1933 (A. A. P. G. Bull. vol. 17, No. 5, p. 529), used *Goliad* (*Reynosa*) in table.

F. B. Plummer, 1933 (Tex. Univ. Bull. 3232, pp. 530, 740, 741, 750–761, 782). [On p. 530 *Goliad fm.* is applied to all Plio. deposits of Tex. underlying Lissie fm. (Pleist.) and overlying Lagarto restricted and Oakville fms. (the latter two being assigned to Plio. and Mio.), and *Goliad* is shown as=*Citronelle group* and is divided, in central and SW. Tex., into (descending) Lababia, Lagarto Creek beds, and Lapara members. On p. 750 Plummer stated:] The need for Citronelle as a group name arises from recent differentiation and mapping in Tex. of new Plio. unit *Goliad fm.*, which outcrops in SW. Tex. btw. Lagarto clay [restricted] and Lissie sand as far NE. as Colorado River. East of Colorado River the Goliad fm. is covered by sands thought to be Plio. in age and as yet unnamed but included in Citronelle group. The Citronelle uncon. overlies Lagarto fm. [restricted] and underlies Lissie sand. The Goliad fm. outcrops along San Antonio River at Goliad, Goliad Co., Tex. It includes most of strata that were placed in Reynosa fm. by Deussen and by Trowbridge. The name has been accepted by San Antonio Geol. Soc., Houston Geol. Soc., and Bur. of Econ. Geol., but San Antonio committee decided to include Lapara sand in Goliad fm. There is important uncon. at base of the Lapara. Average thickness of Goliad est. at 250 ft. The fm. was named by I. K. Howeth and P. F. Martin in ms. presented at annual meeting of San Antonio Geol. Soc., Corpus Christi, Feb. 27, 1932.

Goliad sand is adopted name of U. S. Geol. Survey for the fm. defined in Tex. Univ. Bull. 3232, 1933, i. e., to include all beds below Lissie fm. (Pleist.) and above Lagarto clay as restricted by Plummer (to beds uncon. underlying Lapara sand memb.). (See also under *Uvalde gravel.*)

Gonic formation.

Carboniferous (Pennsylvanian?): Southwestern Maine and southeastern New Hampshire.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 199). *Gonic fm.*—Graywacke schists, mica schists, and garnet-staurolite phyllites, occurring in belt 2 to 4 mi. wide running from Sanford, Me., to Barrington, N. H.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, pp. 172, 174). *Gonic fm.*—Aren. (graywacke) and argill. materials, metamorphosed to schist and phyllite. Mostly rather thin-bedded, fine-grained, and of whitish or light-gray to dark-gray color. Includes mica schist and phyllite and interbedded fine- to medium-grained micaceous graywacke schists in beds up to 2 ft. thick; fine-grained light- and dark-gray phyllites abundantly studded with dark staurolite crystals; and a little coarse muscovite schist composed almost wholly of mica and very thin laminae of quartz. Argill. materials predominate, but the graywacke is also prominent. Thickness unknown. Believed to underlie Rindgemere fm. Assigned to Penn. (?). Named for exposures near Gonic, Strafford Co., N. H.

Gonzales limestone member (of Graham formation).

Pennsylvanian: Central northern Texas (Brazos River region).

C. S. Ross, 1921 (U. S. G. S. Bull. 726G, p. 307). *Gonzales ls. memb. of Cisco fm.*—Coarse-grained dark-gray ls. containing large numbers of *Campophyllum.* Thickness 0 to 4 ft. Lies 96 ft. above Home Creek ls. and 80± ft. below Bunger ls. Strat. position corresponds closely to that of Jacksboro ls. Plummer finds Jacksboro thins to S. and plays out 10 to 15 mi. SW. of Jacksboro, and writer finds Gonzales thins to N. and plays out near N. border of Lacasa area, leaving interval of nearly 40 mi. over which neither bed has been traced; hence local name. To W. replaced by sh. Named for Gonzales Creek, Stephens Co.

The Cisco is now treated as a group in this area, divided into several fms., and Gonzales ls. is now treated as a memb. of Graham fm.

†Gonzales shale.

Pennsylvanian: Central northern Texas (Shackelford and Stephens Counties).

F. B. Plummer, March, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.); showed *Gonzales sh.*, 100± ft. thick, as basal part of Cisco in Palo Pinto Co., and as underlying Gonzales ls. lentil, 0 to 5 ft. thick.

O. F. Hedrick, E. Owens, and P. A. Meyers, 1929 (Tex. Bur. Econ. Geol., geol. map of Shackelford Co.). *Gonzales sh.*, 25 ft. thick, lies in lower part of Cisco group, 15 ft. below Gonzales ls. lentil.

This name is not listed in index to Univ. Tex. Bull. 3232, 1933, nor in list of Penn. units on pp. 103–106.

Gonzales Creek shale member (of Graham formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 127–134). In SE. Young Co. 230± ft. of sh. and ss. occur above Jacksboro ls. This portion of Graham fm. of Brazos River valley is named *Gonzales Creek memb.*, for a creek in Eastland Co. [?]. Where Jacksboro ls. is absent the Gonzales Creek memb. rests on underlying Finis sh. It underlies Bunger ls. memb. of Graham fm., and is composed of poorly bedded, lenticular dark-brown sss., sandy shales, red clays, gypsiferous black clays, 2 ls. lentils, and a coal bed. The sss. are lenticular and the shales variable. One ls. lentil occurs 30 ft. below Bunger ls. and the other 80 ft. below the Bunger.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 112), stated that Home Creek ls. of Jack Co. includes Jacksboro ls.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 61–63), divided the lower 125 ft. of Graham fm. that is present in Palo Pinto Co., into the following members (descending): Bunger ls., 6 ft.; Gonzales Creek sh., 116 ft.; Eastland ss. (new name), 10 to 15 ft.; and Finis sh., 50 ft.

Goobic sand.

See *Gubik sand.*

Goodenough member (of Franconia sandstone).

Upper Cambrian: Southwestern Wisconsin (Juneau County).

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., summer of 1935, fig. 1, pp. 81, 92, 134, 140, 159, 431, 449, 454, 446, etc.). *Goodenough memb. of Franconia fm.*—At Goodenough Hill (NE¼ S. 13, T. 15 N., R. 2 E.) consists of (descending): (1) Coarse white ss., 10.2 ft; (2) covered, 4½ ft.; (3) ss., fine grained, glauconitic, with hematite layer at base, 25.1 ft. Rests on Ironton memb. of the Franconia and underlies Hudson memb. of Franconia. [On p. 309 of this book G. O. Raasch stated that Goodenough memb. is *Conaspis* zone.]

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, Nov. 30, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1700, etc.). *Goodenough memb.* is term proposed by writers for that part of Franconia fm. bearing *Conaspis* fauna. Its discrimination is based primarily on faunal criteria, but it can locally be differentiated into 3 lithologic units (*descending*)—Lower Greensand, Micaceous Sh., and Calcareous strata, which are typically exposed over Tomah-Sparta area. The Lower Greensand consists of 40 ft. of horizontally and cross-laminated glauconitic sss. alternating with thicker beds of nonlaminated glauconitic sss. irregularly mottled by areas of blue or yellow silt. It is called Lower Greensand in contrast to greensand at top of Franconia fm. Type loc. of Goodenough memb. is Goodenough Hill, in southern Juneau Co., btw. Elroy and Mauston.

†Good Hope formation.

Tertiary? (Pliocene?): Southern Maryland and District of Columbia.

W. B. Clark, 1890 (Johns Hopkins Univ. Circ., vol. 9, No. 81, pp. 69–70). The term *Good Hope fm.* has been employed by [N. H.] Darton [in unpublished field notes] for coarse gravels and sands that cap the higher bluffs and show in their topog. relief more extensive denudation than the later and lower Columbia fm.

In subsequent repts the deposits referred to were mapped as "Lafayette fm.," but that term was discarded years ago. According to F. Bascom and C. W. Cooke (personal communication) these beds are of Plio. (?) age. Whether they correspond to Bryn Mawr gravel of SE. Pa. is a debated point.

Named for Good Hope Hill, D. C.

Goodland limestone. (Of Fredericksburg group.)

Lower Cretaceous (Comanche series): Northeastern Texas, central southern and southeastern Oklahoma, and southwestern Arkansas.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 514). *Goodland ls.*—Single persistent layer, representing Fredericksburg or Comanche Peak div. Resembles Caprina [Edwards] ls. in hardness but has Comanche Peak fauna. Considered northern attenuation of Comanche Peak beds. Overlies *Exogyra texana* beds (Walnut clays and *Gryphaea* breccia) or, where they are absent, Paluxy sands.

J. A. Taff, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1). *Goodland ls.* of R. T. Hill is=Texana ls. [Walnut clay] and perhaps Comanche Peak ls.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13). *Goodland ls.* is northward continuation of Caprina ls. [Edwards ls.] and Comanche Peak, and overlies Walnut clay and underlies Kiamitia [Kiamichi] clays.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 114+). *Goodland ls.*= Edwards ls. and Comanche Peak ls.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79) and 1903 (U. S. G. S. Tishomingo folio, No. 98, p. 6). *Goodland ls.*=Edwards ls., Comanche Peak ls., and Walnut clay of Tex.

J. A. Taff, 1905 (U. S. G. S. Bull. 243, pp. 307–312). *Goodland ls.*=Edwards ls. and Comanche Peak ls.

J. A. Udden, C. L. Baker, E. Böse, 1916 (Univ. Tex. Bull. 44, p. 62). In N. part of State it is impossible to separate Comanche Peak from Edwards ls. Both together are represented by *Goodland ls.*, which extends from Grayson to Red River and into Okla.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, pp. 135–137). Basal 3 to 6 ft. of Goodland ls. consists of layers of persistent, hard, thin-bedded coquina-like ls. with interbedded thin layers of dark marly sh., which in this paper [on NE

Tex. and Marshall and Bryan Counties, Okla., just W. of Choctaw Co., Okla., in which is type Goodland] are called *Walnut shaly memb.* These beds were not recognized by Hill (Geol. Soc. Am. Bull., vol. 2, pp. 502–514, 1891) in type section at Goodland, Choctaw Co., Okla. Although Taff's usage of Goodland has been adopted by U. S. G. S., writer believes future investigations will show Goodland ls. should be restricted to massive ls. above this Walnut shaly memb., in accordance with Hill's original usage. [Some geologists believe this bed is younger than any part of typical Walnut clay.]

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869). *Goodland ls.* of Red River region, 10 to 40 ft. thick, is=Edwards ls. and Comanche Peak beds.

W. S. Adkins and W. M. Winton, 1920 (Univ. Tex. Bull. 1945). *Goodland fm.*= Edwards and Comanche Peak.

W. M. Winton and G. Scott, 1922 (Univ. Tex. Bull. 2229, pp. 17–33). *Goodland fm.* is 128 to 140 ft. thick in Johnson Co., Tex., where it exhibits the transition from typical Goodland of No. Tex. to Edwards and Comanche Peak fms. of central Tex. The upper (hard) 35 ft. is=Edwards and lower (soft) 140 ft. is=Comanche Peak. The correlation is proved by transition and fossils. It overlies Walnut fm. and underlies Kiamitia.

W. M. Winton, 1925 (Univ. Tex. Bull. 2544, pp. 9–40). In Denton Co., Tex., *Goodland ls.* is 40 to 75 ft. thick; in W. part of Tarrant Co. it is 116 ft. thick. Is=Edwards and Comanche Peak to S.

H. P. Bybee and F. M. Bullard, 1927 (Univ. Tex. Bull. 2710, p. 21). *Goodland ls.* of Marshall Co., Okla., is=Edwards ls. and Comanche Peak ls.

C. I. Alexander, 1929 (Univ. Tex. Bull. 2907, pp. 14–46). *Goodland fm.* is 20 ft. thick on Red River and 140 ft. on Brazos River. Upper part (white ls. alternating with seams of yellow clay or marl) is=Edwards fm. Lower part (largely laminated clays and shales with a few seams of yellowish marl and several ledges of chalky white soft ls.) is=Comanche Peak fm. It overlies Walnut fm. and underlies Kiamichi.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 334–338). The Comanche Peak is a chalky-limy facies. To N. it is continuous with "Goodland" ls., which is of same lithology and fossils. *Goodland ls.* in Red River Valley is same as Comanche Peak, because (1) Edwards is defined as consisting of the rudistid facies and similar rock, and does not outcrop N. of Fort Worth; and (2) the Goodland contains *Oxytropidoceras acutocarinatum*, a species which marks middle and lower parts of Fredericksburg group. At Goodland is less than 20 ft. thick. [His table on p. 270 shows Goodland overlain by Kiamichi and underlain by Walnut. His table on p. 328 shows Goodland of north-central Tex. is=Comanche Peak plus a thin representative of Edwards ls.]

S. A. Thompson, 1935 (A. A. P. G. Bull., vol. 19, No. 10, pp. 1536, 1537). *Goodland ls.* is a synonym for Comanche Peak ls., which has priority by 30± years. Goodland should be abandoned. Hill, who is author of name Goodland, stated at Dallas, 1934, meeting of A. A. P. G. that Goodland is a synonym of Comanche Peak.

W. C. Mendenhall, 1935 (p. 1537 of book last cited above). It is questioned whether Goodland is actually a synonym of Comanche Peak and should be abandoned. Goodland seems to be a useful name for the northern thin ls. of the Fredericksburg where the Edwards is either very thin or not recognizable as such.

Named for Goodland, Choctaw Co., Okla.

Goodland moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Named for Goodland Twp. Is shown on moraine map (pl. 32) of U. S. G. S. Mon. 53.

Goodnight formation.

Pliocene: Panhandle of Texas.

W. F. Cummins, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 201–203). *Goodnight div.*—Fresh-water deposits of white, yellowish, and red sandy clays, including heavy cgl. bed and some ss. and ls. Contains fossils which differ from the other Tert. fossils of Staked Plains. Thickness 225 ft. Stratigraphically and paleontologically underlies Blanco beds and overlies Loup Fork beds.

J. W. Gidley, 1903 (Am. Mus. Nat. Hist. Bull. 19, p. 632). *Goodnight beds* of Cummins are identical with Clarendon beds, and former name as a distinct horizon should be abandoned.

Mapped as *Ogallala fm.* (*Plio.*) on 1932 geol. map of Tex.

Named for Goodnight, Armstrong Co.

Goodrich quartzite.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 591). *Goodrich qtzite.*—Conglomeratic qtzites and qtzites. Max. thickness 1,550 ft. Included in Ishpeming fm. Equiv. to Bijiki schist of E. part of Marquette dist. Overlies Negaunee fm. Named for exposures at Goodrich mine.

Later repts by C. R. Van Hise and others state that Goodrich qtzite underlies Bijiki schist.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Goodrich qtzite* uncon. overlies Negaunee iron-fm. and underlies Greenwood iron-fm., which is overlain by Clarksburg volcanics, an older fm. than Bijiki iron-fm memb. of Michigamme sl., from which it is separated by lower sl. memb. of Michigamme. [In previous repts Greenwood iron-fm. was included in either Clarksburg volcanics or Goodrich qtzite.]

†Goodridge formation.

Permian and Pennsylvanian: Southeastern Utah (southern San Juan County).

E. G. Woodruff, 1912 (U. S. G. S. Bull. 471, p. 80, etc.). *Goodridge fm.*—Massive-bedded crystalline ls., and soft sandy sh. and ss. Thickness 1,542 ft. Underlies Moenkopi fm. Occupies strat. interval of Rico and Hermosa fms. of SW. Colo. [Named for town of Goodridge, now known as Mexican Hat.]

Later detailed work by several geologists (especially J. B. Reeside, Jr., and A. A. Baker) resulted in subdividing these rocks into Rico and Hermosa fms., and the name "Goodridge fm." has therefore been discontinued.

Goodridge sand.

A subsurface sand in upper part of Rico fm. (Perm.) in southern part of San Juan Co., SE. Utah.

Goodsir formation.

Ordovician and Cambrian: British Columbia.

C. D. Walcott, 1912 (Smithsonian Misc. Coll., vol. 57, No. 7, p. 230). *Goodsir fm.*, Ord., B. C.

L. D. Burling, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 98). *Goodsir sh.* of B. C. is Camb. and Ord.

Several subsequent Canada Geol. Surv. repts, by different authors, assigned this fm. to Ord. and Camb.; Walcott, 1928 (Smithsonian Misc. Coll., vol. 75, p. 232), assigned it to Camb.; P. S. Warren, 1929 (Canadian Field Nat., vol. 43, p. 24), assigned it to Camb. and Ord. (?).

Goodsir series.

A term employed by C. [R.] Keyes (Pan-Am. Geol., vol. 42, 1924, p. 288) for Ord. rocks in Alberta that presumably correspond to Goodsir fm. of Walcott.

Goodsprings dolomite.

Devonian (?) to Upper Cambrian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 11, etc.). *Goodsprings dol.*—Thin-bedded light- and dark-gray mottled dol., with some mag. ls., and, locally, near top 50 to 75 ft. of dolomitic and sandy sh. Thickness 2,450± ft. Underlies Sultan ls. (Dev.) and (outside of Goodsprings quad.) overlies Bright Angel sh. (Middle Camb.), which is not exposed in the quad. Named for town of Goodsprings, to S., W., and NW. of which it covers broad areas. According to E. Kirk the fossils from 1,500 to 2,000 ft. below top are Upper Camb.; a few forms from higher up suggest early Ord., a few fossils from 400± ft. below top suggest Sil.; 2 species from 100± ft. below top are probably Dev. [Mr. Hewett sent an advance copy of his Goodsprings section, and of the names he proposed to apply to the fms., to W. S. Glock, who in 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 326 to 339) described the *Goodsprings dol.* in east-central part of Spring Mtn Range, Goodsprings quad.]

Goodwin formation.

Lower Ordovician: Eastern Nevada (Eureka region).

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, pp. 466–467, 475). *Goodwin fm.*, new name, proposed for lower 1,500 ft. of Pogonip fm., the name *Pogonip* to be restricted to upper part of Pogonip of previous repts. Consists of bluish-gray lss., distinctly bedded. Fossils listed. Named for Goodwin Canyon, Eureka dist. Assigned to lower Ozarkian.

Goodwinian series.

A name applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 78), to lower part of Pogonip ls. of Nev., or to the beds designated by Walcott as *Goodwin fm.* Also to St. Charles ls. (Upper Camb.) of Utah.

Goodwyn sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 358). *Goodwyn ss.*—Greenish gray and massive, or reddish brown and shaly; 25 to 40 ft. thick. Underlies Lower Tophet sh. and overlies Upper Goodwyn sh.; all members of Hinton group [fm.]. Type loc. along Princeton-Narrows road on Fivemile Creek, at Goodwyn Chapel, Mercer Co. Also observed in Summers Co. Should be present in Monroe Co.

Goodwyn shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 359–360). *Upper Goodwyn sh.*—Dark, sandy, fissile; 1½ to 10 ft. thick; underlies Goodwyn ss. and overlies Goodwyn coal or Lower Goodwyn sh. *Lower Goodwyn sh.*—Dark and calc., with marine fossils near top, and red and variegated with streaks of ss. near base; 40 to 75 ft. thick; underlies Goodwyn coal or Upper Goodwyn sh., and overlies Upper Bellepoint ss. All are members of Hinton group [fm.]. Type loc. same as Goodwyn ss.

Goose Bay argillite.

Age (?): British Columbia.

R. G. McConnell, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 42).

Goose Bay formation.

Jurassic (?): British Columbia.

V. Dolmage, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, p. 13).

†Goose Creek marl.

†Goose Creek phase.

Pliocene: Southern South Carolina (Berkeley County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, 19). *Goose Creek phase.*—During Mio. time the gulf waters coursing through Fla. archipelago scoured the coast of Carolina along a shore line a portion of which extended N. of present sites of Wadmalaw and Stono Rivers to Cherokee mines and thence S. of Bees Ferry (on Ashley River), by Yeaman's Hall (Goose Creek), and thence along Cooper River to the Grove, whence it proceeded easterly along Wando River above Cainhoy. Along this shore line the marl was deeply incised to a comparatively abrupt escarpment along a portion of which the thin marl pertaining to Goose Creek phase was more prominently deposited. This marl also formed along southwesterly margin of embayment of eastern Tert. division, where it was succeeded by Pee Dee phase, which extended over depressed areas as far N. as Sparrow Swamp. In eastern Tert. division the Goose Creek type of marl interruptedly appears along Pee Dee River from Bostick to Allison's Landing underlying Pee Dee marl.

According to C. W. Cooke (personal communication, 1935) the beds on Goose Creek belong to Waccamaw fm. (Plio.).

Named for exposures at Yeaman's Hall, on Goose Creek, N. of Charleston, Berkeley Co.

Goose Creek granite.

Pre-Cambrian: Central southern Montana (Stillwater, Carbon, Yellowstone, SE. Park County regions).

T. S. Lovering, 1929 (U. S. G. S. Bull. 811A, p. 16). Gneissic gray granite locally carrying schist inclusions. Oldest rock in Cooke dist., SE. corner of Park Co. Goose Creek flows over it for practically its entire length.

Goose Lake slate.

Pre-Cambrian: Northwestern Michigan.

See 1907 entry under *Wewe sl.*

Goose Neck sand.

A subsurface sand in southern San Juan Co., SE. Utah, that probably lies in Hermosa fm. (Penn.).

†Goose Pond limestone.

Name applied by B. K. Emerson (U. S. G. S. Bull. 159, pp. 51–52, 1899) to Coles Brook (†Hinsdale) ls., as exposed N. and E. of Goose Pond, eastern Berkshire Co., Mass.

Goose Run sand.

Subsurface sand, 10 to 40 ft. thick, lying at horizon of Sewickley ss. memb. of Monongahela fm. (Penn.) in SW. Pa. and Washington and Monroe Counties, eastern Ohio. Discovered in 1899–1900 on Goose Run, E. of Marietta, Washington Co., Ohio. (W. Stout et al., Geol. of nat. gas, A. A. P. G., 1935, pp. 898–900.)

Gordon sandstone. (In Strawn formation.)

Pennsylvanian: Central northern Texas.

E. T. Dumble, 1890. [See under *Richland ss.*]
F. B. Plummer, 1919. [See first entry under *Mineral Wells fm.*]

Probably named for Gordon, Palo Pinto Co.

Gordon shale.

Middle Cambrian: Central western Montana (Powell County).

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444, pp. 7–8, and No. 2, Pub. 2445, pp. 16–19). *Gordon sh.*—A name proposed for the fine argill. shales carrying *Albertella* fauna in Mont. Of greenish and purplish color. Thickness 284 ft. on ridge btw. Gordon and Youngs Creeks, Powell Co. [Detailed section given.] Underlies Meagher ls. and overlies Flathead (?) ss. Type loc. on Gordon Creek, 6 mi. from South Fork of Flathead River, Ovando quad., Powell Co. The sh. extends across the ridge btw. Gordon and Youngs Creek, about halfway btw. Gordon Mtn and Cardinal Peak.

Gordon sand.

A subsurface sand, of late Upper Dev. or early Carbf. age, 6 to 100 ft. thick, lying 2,147 ft. below Pittsburgh coal in E. part of Greene Co., Pa., and in W. Va. Named for Gordon farm, near Washington, Washington Co., Pa., where it was discovered in August 1885. A sand 5 to 100 ft. higher is called *Gordon Stray sand*. The name has also been applied to a subsurface sand, 20 ft. thick, lying 130 to 225 ft. below top of Marble Falls ls. (Penn.) in central Tex.

Gordon Mountain limestone.

Upper or Middle Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 39 and passim). *Gordon Mtn ls.*—Gray to chocolate-gray massive lss. underlying Switchback ls. and overlying Pentagon sh. Thickest (272 ft.) in Dearborn area; thinnest (140 ft.) in Wall Creek area. Most distinguishing characteristic is the number of green sh. zones interbedded at irregular intervals in the lss. Forms top of central and principal peak of Gordon Mtn. Type loc. is middle part of the cliffs which form lower part of E. side of a peak 8,300 ft. elev., the top of which is just 1 mi. S. 48° E. of top of Pentagon Mtn.

Gore limestone. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 889, 898, 903; pls. opp. pp. 889, 900, 912, 921). *Gore ls.*—Dark-blue ls., resembling Zoar ls., but 30 to 40 ft. above the Zoar. Often replaced by flint. Traceable from Hocking Valley to Ohio River.

Later repts state it is Upper Mercer ls. memb. of Pottsville fm. (See Ohio Geol. Surv., 4th ser., Bull. 21, 1918, p. 102.)

Probably named for occurrence at Gore, Hocking Co.

Gorge formation.

Upper Cambrian: Northwestern Vermont (St. Albans quadrangle, Franklin County).

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 359, 367, 368, 375–377). *Gorge fm.*—About Highgate Falls and to N. the Upper Camb. facies is again very different, since here there is (1) a lower massive dol. 80 ft. thick; followed unbroken upward by (2), a thick series (162 ft.) of thin-bedded dark-blue lss., mag. lss., black sl., qtzites, and intraformational flat-pebble cgls. of dol. and ls. pieces, and black dolomitic sl.; in lower part thick beds of ss. The upper Gorge (or No. 3) consists of (descending) a layer of small-pebble intraformational cgl., 1 ft.; banded black sl., 6 ft.; sandy dol., 6 ft.; upper great cgl., 10 to 15 ft.; thin-bedded dolomites and lss., sh., and sandy beds, 12 to 15 ft., with an erratic block of gray dolomites 5 ft. thick and 10 ft. long; massive blue-gray dol. in 5 or 6 beds with intraformational slabby dol. pieces, 15 ft.; lower still is another great cgl. 26 ft. thick; the whole making a thickness of 80± ft. The Gorge fm. is overlain by lower Highgate, consisting of a series of alternating impure lss. and shales in thin beds of about equal thickness. The Gorge fm. rests uncon. on Parker sl. (Lower Camb.), the Middle Camb. being absent. It contains fossils [listed]. Thickness 0–300± ft. The name *Gorge fm.* is unsatisfactory, but for want of a local geographic name it is here applied to all strata in *Highgate gorge* [at Highgate, St. Albans quad.] beneath Highgate fm. There is no apparent break anywhere within Gorge fm. Keith correlates the cgl. zones with Mill River ls. cgl., but writer regards them as local intraformational cgls. and not basal cgls., as in the Mill River. The middle part of Gorge fm. is the Missisquoi of Keith, 1924. [Schuchert shows his Gorge fm. to be=Milton dol. (see under *Milton dol.*), and these beds at Highgate Falls were clearly called *Milton dol.* by Keith in his original definition of Milton.]

Gorham shales.

A term casually applied by J. M. Clarke and D. D. Luther in 1904 (N. Y. State Mus. Bull. 63, pp. 23, 25) to basal beds of Genesee sh. (beneath Genundewa ls.), which were later named *Geneseo sh.* by Chadwick. See explanation under *Genesee sh.*

Gorham sand.

Gorham sand or basal cgl. is name locally applied to lower 20 to 80 ft. of unexposed Penn. rocks of Ness and Hodgeman Counties, SW. Kans., which are correlated with upper part of Des Moines series. (See R. G. Moss, Kans. Geol. Surv. Bull. 19, p. 36, 1932.)

E. A. Koester, 1935 (A. A. P. G. Bull., vol. 19, No. 10, p. 1414). *Gorham sand* is a near-shore phase of basal Penn. Sooy cgl. Name derived from Gorham field. Some geologists believe this sand in Gorham field and elsewhere is Ord. or Camb., but writer believes it is basal Penn.

Gose sand.

A subsurface sand in Cisco group (Penn.) of Archer Co., Tex., which occurs at any place within a 50-foot zone lying from 1 to 20 ft. beneath Gunsight ls. memb. of Graham fm. Is also called *Texhoma-Gose sand, Archer County sand, Miller sand*, and *Swastika sand*.

Goshen schist.

Silurian (?): Western Massachusetts, southeastern Vermont, and southwestern New Hampshire.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Goshen schist*, flaggy, dark, garnetiferous schist, with beds of qtzite and ls. Underlies Conway schist and overlies Hawley schist.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50, also U. S. G. S. Mon. 29, pp. 177–183, pl. 34). *Goshen schist*.—Dark, graphitic, flaggy mica schist, with biotite and garnet. Thickness 2,000(?) ft. Underlies Conway schist and uncon. overlies Hawley schist. Typical region is that surrounding the oval of Hawley schist in Goshen, Mass., where Goshen schist dips away from Hawley schist in all directions. [See also B. K. Emerson, U. S. G. S. Bull. 597, pp. 45–46, 1917.]

Goshen schist.

Pre-Cambrian: Central southern Virginia and adjacent part of North Carolina (Virgilina district).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 19, 23; map). *Goshen schist (Ord. ?)*.—Highly schistose, clastic, acid tuff, probably of volcanic origin, in most places so altered that little or nothing of its original structure and texture is discernible. Color light gray or white. In present condition is a well-defined sericite schist. Is probably a tuffaceous phase of Hyco quartz porphyry. Named for typical occurrence in vicinity of Goshen, in SE. part of Virgilina dist.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). [Under the block of pre-Camb. extrusive rocks younger than Glenarm series and designated "aporhyolite" is statement: "In Virgilina area called Hyco quartz porphyry and tuffaceous facies is called Goshen schist."]

Gosnell shale.

A subsurface part of Repetto siltstone (lower Plio.) in Ventura field, Ventura Co., southern Calif. Formerly included in Pico fm. (middle and upper Plio.). Thickness 75 to 2,000 ft. Lies approx. 3,000 ft. below surface.

Gosport sand. (In Claiborne group.)

Eocene (middle): Southern Alabama.

E. A. Smith, 1907 (Ala. Geol. Surv. Bull. 9, pp. 5, 18). *Gosport greensand*.—Embraces the strata of Claiborne group lying btw. top of Lisbon fm. and base of St. Stephens ls. The beds are in general highly glauconitic sands about 30 ft. thick at Claiborne and Gosport bluffs, and include the fossiliferous greensands which have made the name *Claiborne* famous, and which have furnished greater part of Claiborne fossils described and figured by Conrad and Lea.

Is top fm. of Claiborne group in Ala., and of marine origin.

Named for Gosport, a landing on Alabama River a few mi. below Claiborne Bluff, in Clarke Co.

Goss Mill limestone facies.

Name applied by P. B. Stockdale (Ind. Acad. Sci. Proc., vol. 39, pp. 213–214, 1930; Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 197, etc., 1931) to a local southern development ("that of the type locality") of his Floyds Knob fm. of Ind. (See under *Floyds Knob fm.*)

Gothlandian.

A term that has been applied by some European geologists to Silurian system.

Goulburn quartzite.

Pre-Cambrian: Arctic Canada.

J. J. O'Neill, 1924 (Canadian Arctic Expedition 1913–18, vol. 11, pt. A, p. 23).

Gould coal group.

Name long in use for a group of four coal beds, in Pottsville fm. (Penn.) of Cahaba coal field, central Ala., the upper coal bed lying 100 to 200 ft. below Chestnut ss. memb., and the four coals (one of which is Gould coal) occurring within a vertical section of 50 ft.

Gould shale member. (In Monterey shale.)

Miocene (middle): Southern California (Kern County).

G. M. Cunningham and W. F. Barbat, 1932 (A. A. P. G. Bull., vol. 16, No. 4, p. 418). The sh. btw. *Valvulineria californica* zone of Monterey and "Button bed" of Temblor may appropriately be called *Gould sh. memb. of Temblor.* Thickness 250 ft. in Chico-Martinez Creek area, according to Goudkoff and Hughes. Is called "Monterey sh." in unpublished ms. of A. R. May and J. D. Gilboe.

W. F. Barbat, 1932 (A. A. P. G. Bull., vol. 16, No. 6, p. 611). In reproducing authors' table I, a slight omission was made, which if uncorrected may make table misleading. A horizontal line should be drawn below the marginal word *Monterey* and opposite the dotted line in 1st column separating *Valvulineria californica* zone and "Monterey sh." With table thus corrected there is no implication that the 250 ft. of beds above Button bed in Chico-Martinez Creek area are=any portion of Monterey. Despite fact these 250 ft. of beds are not included in type sections of either Monterey or Temblor fm., authors incline toward grouping them in some way with Temblor fm. because of their faunal affinities with upper Temblor. In table I authors stated this div. is "appropriately called Gould sh. memb. of Temblor." As used in this casual manner the name has no standing in geologic time classification. In view of importance of the unit it is now proposed to define the name and to designate a type section. The *Gould sh.* is described as the 220 to 230 ft. of beds overlying Button bed memb. of Temblor fm. and underlying *Valvulineria californica* zone of Monterey fm. near center of W. half of sec. 14, T. 29 S., R. 20 E., M. D. B. L. and M., and continuing to SE. side of Chico-Martinez Creek, Kern Co. The name is from Gould Hill, on U. S. G. S. McKittrick quad., near type loc.

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169), included Gould sh. in top of what they called *Temblor sh.*, which they placed lower than Monterey sh.

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, pp. 127–146), included these beds in Monterey sh., under name *Gould sh. memb.*, because they properly belong to Monterey type of sedimentation, and not to Temblor ss. type.

Gourd Head Run clay. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Allegheny County).

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 159–161, 308). *Gourd Head Run clay* (local), underlies Mahoning ss. and is separated from underlying Upper Freeport coal by *Gourd Head Run ls.* (local). Upper part is plastic, lower part is nonplastic.

Gourdhead Run limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Allegheny County).

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 159–161, 308). [See under *Gourd Head Run clay.*]

G. B. Richardson, 1932 (U. S. G. S. Bull. 829, p. 17). The *Gourdhead Run ls.* of I. C. White crops out locally in valley of Gourdhead Run in Hampton Twp. It is of very limited occurrence and has not been found outside of this locality. There Upper Freeport coal apparently is absent, but presence of Brush Creek and Upper Freeport lss. serves to determine strat. position of this lens. It lies approx. 30 ft. above Upper Freeport ls. and 50 to 60 ft. below fossiliferous Brush Creek horizon, and therefore occurs in interval [usually] occupied by Mahoning ss. memb. This ls. is a compact, fine-textured buff and dark-colored bed, in which fossils have not been found and which has a max. observed thickness of 3 ft.

Gouverneur moraine.

Pleistocene (Wisconsin stage): Northeastern New York. Named for Gouverneur, St. Lawrence Co. (See Jour. Geol., vol. 32, pp. 645, 661, 1924.)

Gouverneur granite.

Pre-Cambrian: Northern New York (Gouverneur quadrangle, St. Lawrence County).

H. P. Cushing and D. H. Newland, 1925 (N. Y. State Mus. Bull. 259, pp. 40–41). Name *Gouverneur granite* is conveniently applied, for local use, to the granite mass just N. of Gouverneur, an oval-shaped mass with NE. trend. It consists of quite fine and even-grained orthogneiss, composed chiefly of feldspars and quartz with a very small mica content. Shows frequent coarser bands and pegmatites. Inclusions are frequent but very unequally distributed and are almost without exception of amphibolite.

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 55–61). *Gouverneur granite mass* lies just NW. of town of Gouverneur. Forms Gouverneur phacolith, which is 5½ mi. long and 1½ mi. wide. Intrudes Grenville series. [According to p. 52 the Gouverneur phacolith belongs to his Alexandria type of granite.]

Gouverneur limestone.

Pre-Cambrian (Grenville series): Northwestern New York (St. Lawrence and Jefferson Counties).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 136–138 and maps). *Gouverneur ls.*—Crystalline ls., underlying garnet-bearing gneiss of Grenville series in Antwerp, Hammond, and Gouverneur quads., and overlying biotitic feldspar gneiss that composes the oldest fm. of Grenville series of this area. Thickness 5,000 ft. or less.

Government Wells sand.

A subsurface sand in upper Eocene of Driscoll pool, Duval Co., Tex.

Gowanda shale.

Upper Devonian: Western New York (Lake Erie region).

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157). *Gowanda beds.*—Name replaces "Portland beds," preoccupied and withdrawn. Overlie Dunkirk black sh. and uncon. underlie Laona ss. Assigned to Chemung. [The †Portland sh. had been included in Portage group by Clarke, Luther, and Hartnagel.]

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Gowanda sh.* in Chautauqua Co.; *Gowanda beds* in Cattaraugus, Allegany, and Steuben Counties. Of Chemung age. In Cattaraugus Co. is overlain by unnamed ss. and underlain by Dunkirk sh.; in Allegany Co. is overlain by "Rushford ss." and underlain by Canaseraga ss. (=Dunkirk sh.); in Steuben Co. is overlain by Wellsburg ss. and underlain by Prattsburg ss.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 149–157). Name *Gowanda beds* replaces *Portland* (preoccupied). Thickness 500 ft. on Cattaraugus Creek around Gowanda [Cattaraugus Co.], 250 ft. on Lake Erie. Included in Chemung group. The limited fauna of Portage type which Gowanda beds carry on Lake Erie and at Forestville gradually acquires the brachiopod facies of lower Chemung (Cayuta) sh. which it has on Caneadea Creek. Underlies Laona ss. and overlies Dunkirk sh.

See 1931 and later entries under *Chemung group.*

Gowanda moraine.

Pleistocene (Wisconsin stage): Western New York. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Named for Gowanda, N. Y.

Gower dolomite.

Silurian (Niagaran): Central eastern Iowa.

W. H. Norton, 1899 (Iowa Geol. Surv. vol. 9, pp. 422, 423). *Gower stage.*—Lss. constituting upper stage of Niagara series, and all of Niagara present in Scott

Co., the lower (Delaware) stage of Niagara not being recognized. Includes lithological varieties of rocks which have been called *Anamosa substage* and *LeClaire ls.*, but which are contemp. [?]. Overlain by Dev. Wapsipinicon ls.

The Gower dol. (including LeClaire and Anamosa) has been referred to Niagara group in the following repts: S. Calvin, 1901; W. H. Norton, 1901; S. Calvin, 1902; J. A. Udden, 1905; T. E. Savage, 1906; S. Calvin (1906 and 1907); J. E. Carman, 1909; T. E. Savage, 1914; W. H. Norton, 1921; J. V. Howell, 1923; W. H. Schoewe, 1923; G. F. Kay, 1927; and A. Folger, 1928. In 1910 C. Schuchert not only referred Gower (Le Claire and Anamosa) to Niagara group, but overlying Bertram as well. Gower (including LeClaire and Anamosa) was referred to Cayuga group (post-Salina) by E. O. Ulrich in 1911 (Geol. Soc. Am. Bull., vol. 22), and by R. S. Bassler in 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 1). Later repts of Iowa Geol. Surv. describe the Gower as all dol. and 120 ft. thick.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 276), stated: *Gower fm.* belongs to Niagaran series and includes 2 distinct lithologic phases: (1) the Leclaire and (2) the Anamosa and Bertram fms., the former being the "reef" type of sediments. But in same rept. (pp. 249–251) M. A. Stainbrook included Bertram in Otis memb. of Wapsipinicon ls. (Dev.).

Named for Gower Twp, Cedar Co.

Goweran series.

A term introduced by C. [R.] Keyes to include Bertram, Anamosa, and Leclaire dolomites of Iowa, which he refers to Cayuga group.

Gowganda formation.

Pre-Cambrian (Huronian): Western Ontario.

W. H. Collins, 1916 (Canada Geol. Surv. Mus. Bull. 22, p. 4). Included in Cobalt series.

Graford formation (redefined). (In Canyon group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Graford fm.*—Composed largely of sh. members with some thin lss. and a little sand. Top memb. is *Graford ls.*, one of most persistent, and can be recognized by greater height of its scarp than the other ls. members of the fm. The lss. are very fossiliferous, but shells are poorly preserved. Underlies Ranger fm. and overlies Palo Pinto fm.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 34). *Graford fm.*—In Brazos River Valley conformably overlies Palo Pinto ls. and underlies Seaman Ranch sh. memb. of Brad fm. In Colorado River Valley it underlies Cedarton sh. memb. of Brad fm. Includes Adams Branch ls. memb. at top (replaces Graford ls.) and Rochelle cgl. at base. Thickness 170 to 450 ft. [Adams Branch ls. replaces Graford ls. memb.] Named for town of Graford, in Palo Pinto Co. [Brazos River region], where it is typically developed, and where the upper members form prominent escarpment just W. and N. of town.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 33). Devils Den ls. is arbitrarily taken as top memb. of Graford fm. in Wise Co. It is an older ls. than Adams Branch ls., which lenses out completely before Wise Co. is reached.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 111), extended top of Graford fm. up to top of Clear Creek ls. of Drake, because "the top of the Graford fm. as defined at type loc. apparently falls within the Merriman (Clear Creek) ls. equiv. and not at the Adams Branch ls. as given in the original description." Also (pp. 105, 109) he transferred Capps ls. from Graford fm. to top of Strawn group, and included Devils Den ls. in Graford fm. This definition of Graford fm. was adopted by U. S. Geol. Survey in 1935.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+). Graford fm. includes, in Colorado River region, all beds below top of Adams Branch ls. memb. and above base of Capps ls. lentil or, in some areas, base of Rochelle cgl. memb.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 47–48). *Graford fm.* was named by Plummer and Moore, and was made to include all strata from top of Palo Pinto ls. up to top of the ls. that caps the escarpment W. of Graford. This escarpment-forming ls., at time the fm. was named, was thought to be=typical Adams Branch ls. to S. Later work by Cheney, Armstrong, and others has shown that true Adams Branch ls. in Palo Pinto Co. lies much lower in section than uppermost ls. of Graford fm., and that this uppermost ls. is= Merriman ls. of Reeves. The Graford fm. of Palo Pinto Co. consists of Merriman ls. at top and 400± ft. of sh. containing lentils of sand, a lentil of coal, and a few thin layers of ls., and is divided into following members (downward): (1) Merriman ls., 20 to 75 ft., formerly mapped by Plummer and Moore as Adams Branch ls.; (2) Wolf Mtn sh.; (3) Wiles ls., 3 to 8 ft.; (4) Posideon sh., 50± ft. Underlies Brad fm. and overlies Palo Pinto ls. The Brad fm. is divided into Ranger ls. (above) and Seaman Ranch memb. (below).

Wallace Lee and C. O. Nickell in their 1934 field work found it impracticable to draw line btw. Brad and Graford fms. at top of †Clear Creek ls. (preoccupied) in Brazos River region, because this ls. is one of several lss. in this part of the column. They therefore adopted the new name *Winchell memb.* for the group of lss. and separating shales occurring in upper part of Graford fm. as expanded by Sellards and in lower part of Placid sh. memb. of Plummer and Moore. The Winchell memb. includes, in its lower part, the Clear Creek bed of Drake and the lower or ls.-bearing part of Placid sh. memb. of Plummer and Moore in Colorado River region, and Merriman ls. memb. (4 ft. thick) of Reeves in Brazos River region. Their rept has been transmitted and will soon be published by Tex. Geol. Survey.

†Graford limestone member (of Graford formation).

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). Top memb. of Graford fm. [See 1919 entry under *Graford fm.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, p. 101), correlated top memb. of Graford fm. with Adams Branch ls. of Drake and discarded *Graford ls. memb.*

†Grafton quartzite.

Pre-Cambrian: Eastern Massachusetts and northern Rhode Island.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*Grafton qtzite and cgl.* of Worcester Co., Mass., is shown in table as younger than Sutton gneiss. All of definition.]

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, pp. 7, 8, 10, 12–13, and map). *Grafton qtzite.*—Generally a fine-grained massive saccharoidal qtzite of great purity. Varies from white to pale flesh color. In places shows thin lamination and cross-bedding. In other places it is greatly jointed or thinly foliated by crushing or reduced to rude columnar masses by complex strains. Consists of two flanking bands of qtzite and a central band of quartz phyllite and fine-grained micaceous quartz schist, named *Albion schist memb.* Underlies Marlboro fm. and overlies Northbridge gneiss.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 25). "Grafton" qtzite is same as Westboro qtzite, which has priority; "Grafton" is therefore abandoned.

Named for occurrence at Grafton, Worcester Co., Mass.

Grafton sandstone. (In Conemaugh formation.)

Pennsylvanian: West Virginia and western Maryland.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, pp. 244, 255, 298). *Grafton ss.*—Massive pebbly ss., lying 20 to 30 ft. above Ames ls. and a short distance below Elk Lick coal. Appears to crop out at horizon of Birmingham sh. Has been much quarried around Grafton Hills, Taylor Co.

R. V. Hennen, 1911 (W. Va. Geol. Surv. Rept. Wirt, Roane, and Calhoun Counties, p. 240). *Grafton ss.*, 10 to 20 ft. thick, underlies Birmingham sh. and overlies or lies 5 to 10 ft. above Ames Crinoidal ls.

R. V. Hennen, 1912 (W. Va. Geol. Surv. Rept. Doddridge and Harrison Counties). *Grafton ss.*, 10 to 56 ft. thick, is lenticular and often replaces Birmingham sh. almost entirely. Lies 5 to 20 ft. above Ames ls.

D. B. Reger, 1923 (W. Va. Geol. Surv. Rept. Tucker Co.). *Grafton ss.*—Massive, reddish brown, sometimes pebbly ss., 4 to 60 ft. thick. Overlies Ames sh. and separated from overlying *Upper Grafton ss.* by 8 ft. of variegated sh. The *Upper Grafton ss.*, 10 to 38 ft. thick, was not observed in outcrop, but it and the underlying variegated sh. are evidently a part of Birmingham sh.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6). *Upper Grafton ss.* underlies Barton ls. and is separated from underlying Federal Hill coal by Birmingham red bed and other strata. *Lower Grafton ss.* overlies the sh. above Ames ls. and lies a short distance below Federal Hill coal.

Grafton formation.

Pennsylvanian: Southwestern Pennsylvania (Punxsutawney quadrangle).

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas No. 65, Punxsutawney quad., pl. 4). *Grafton fm.*—Extends from base of Ames ls. to top of Barton coal, and includes Grafton ss.

Is a part of Conemaugh fm.

Grafton member. (In Conemaugh formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include Birmingham sh., Duquesne coal, Duquesne clay, Duquesne ls., Grafton ss., Ames ls., and Harlem coal. These boundaries differ somewhat from Grafton fm. of Ashley.

Graham jasper. (In Niobrara formation.)

Upper Cretaceous: Northwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 51). *Graham jasper*, the horizon of jasper near upper limit of Smoky Hill chalk in Kans. Named for Graham Co.

Graham formation. (In Cisco group.)

Pennsylvanian: Central and central northern Texas.

R. C. Moore, 1921 (A. A. P. G. Bull., vol. 5, p. 324). The lower Cisco beds are included in what has been termed *Graham fm.* by F. B. Plummer and R. C. Moore.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 18–42). *Graham fm.*—Basal fm. of Cisco group. Thickness 100 ft. to S.; 500–600 ft. to N. In Brazos River region discon. underlies Avis ss. memb. of Thrifty fm. and discon. overlies Home Creek ls. memb. of Caddo Creek fm. Distinguished from underlying beds by its very clastic character and thinner lss., and from overlying beds by its prolific and characteristic fauna. Divided into following members (descending): Wayland sh., Gunsight ls., South Bend sh., Bunger ls., Gonzales Creek sh., Jacksboro ls., and Finis sh. The older or lower members are present only to N., pinching out southward and being overlapped by younger members. Named for county seat of Young Co. [Brazos River region].

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), redefined Graham fm. by transferring to the underlying Caddo Creek fm. the Jacksboro ls. and Finis sh. of Brazos River region.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+). Graham fm. of Colorado River area includes all beds btw. top of Speck Mtn ls. down to top of Home Creek ls. In Brazos River region it includes all beds below Avis ss. memb. and above Home Creek ls. memb. The Avis ss. of Brazos River region is same as Parks Mtn ss. of Colorado River region.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 61–62). *Graham fm.* was named by Plummer and Moore and made to include all strata from top of Home Creek ls. up to base of Avis ss. Total thickness 400± ft., but only lower 125 ft. is exposed in Palo Pinto Co., Brazos River region, where it is divided into following members (descending): Bunger ls., 6 ft.; Gonzales Creek sh., 116 ft.; Eastland ss. (new name), 10 to 15 ft.; and Finis sh., 50 ft. Type loc. is bluff on Salt Creek W. of Graham, Young Co. [Brazos River region].

Wallace Lee and C. O. Nickell (rept completed and soon to be published by Tex. Geol. Surv.). Graham fm. of Brazos River area includes all beds below Avis ss. memb. and above Home Creek ls. memb. The Graham fm. of Colorado River region includes all beds below Bellerophon ls. of Drake and above Home Creek ls. The Speck Mtn ls. lies in Thrifty fm., considerably above its base. [This definition of Graham fm. has been adopted by U. S. Geol. Survey.]

Graham limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 387). *Graham ls.*—Usually gray and shaly, 0 to 3 ft. thick; marine fossils. Lies 0 to 10 ft. below Graham ss. and rests on Upper Graham sh.; all members of Bluefield group [fm.]. Type loc. same as Graham ss.

Graham sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell and Giles Counties).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Marion, and Summers Counties, pp. 299, 385). *Graham ss.*—Greenish gray, usually shaly but sometimes massive; 15 to 40 ft. thick. Underlies Clayton sh. and lies 0 to 10 ft. above Graham ls.; all members of Bluefield group [fm.]. Type loc. in a cut of Norfolk & Western Ry. about ½ mi. NW. of new station at Graham (now Bluefield), Tazewell Co., Va. Occurs in Mercer, Monroe, and Summers Counties, W. Va. Probably correlates with Big Spruce Knob ss. of Webster Co., W. Va.

Graham shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell and Giles Counties).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 299, 387). *Upper Graham sh.*—Gray, ferruginous, and calc.; marine fossils in upper part, plants at base; 20 to 30 ft. thick; underlies Graham ls. and overlies Graham coal. *Lower Graham sh.*—Red, variegated, and sandy, with thin sss.; 50 to 75 ft. thick; underlies Graham coal and overlies Bertha ss. All members of Bluefield group [fm.]. Type loc. same as Graham ss. Also occurs in Mercer, Monroe, and Summers Counties, W. Va.

Graham oil sand.

A subsurface sand in lower part of Penn. section of Graham field, in NW. part of Carter Co., southern Okla., 110± ft. below Ricketts oil sand and 80 to 135 ft. above Bennett oil sand. Thickness 10 to 200± ft.

Grainger shale.

Mississippian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

A. Keith, 1895 (Phil. Soc. Wash. Bull. 12, pp. 74, 78, pl. 1) and 1896 (U. S. G. S. Morristown folio, No. 27, p. 3). *Grainger sh.*—Sandy shales and shaly and flaggy sss., the latter more numerous in upper layers. Two mi. NW. of Mooresburg a thin bed of quartz cgl. lies at top of series. All beds bluish gray when fresh, and weather green and greenish gray. In bottom flags are many impressions of supposed seaweed *Spirophyton cauda-galli*. Thickness varies from 1,200 ft. in Clinch Basin to 400 ft. in Powell Basin. Of Dev. age. Overlies Chattanooga sh. and underlies Newman ls. in Tenn. Valley.

Above is first definition of fm. in its type area. The name, however, first appeared in print in 1893 (M. R. Campbell, U. S. G. S. Bull. 111, p. 38), in a description of the rocks of Big Stone Gap coal field of SW. Va., Campbell accepting Keith's name and correlating the rocks of SW. Va. with those in Morristown quad. In SW. Va. the fm. was described as consisting of 410 ft. of shales, varying from red calc. sss. at top to ash-colored micaceous shales below, finally merging into underlying Chattanooga black sh. and overlain by Newman ls. "The age of this mass of sandy shales has never been determined; they have somewhat the appearance of a transition bed between the Devonian below and the Mississippian above, but in this paper they are regarded, provisionally, as of Devonian age." The name was also used by Campbell in U. S. G. S. Estillville folio, No. 12, published in 1894, and by Keith in Knoxville folio, No. 16, published in 1895, for the shales and sss. underlying Newman ls. and overlying Chattanooga sh.

A. Keith, 1901 (U. S. G. S. Maynardville folio, No. 75, p. 4). Fossils found in Grainger fm. to NE. indicate upper part is Carbf., while a Dev. age for its lower portion is indicated by its interbedding with Chattanooga sh.

According to E. O. Ulrich and C. Butts, also J. H. Swartz, 1924 (Am. Jour. Sci., 5th, vol. 7, p. 28) and 1929 (Am. Jour. Sci., 5th, vol. 17, p. 441) the typical Grainger sh. of Tenn. is all of Miss. age.

Named for Grainger Co., Tenn.

Grampian limestone.

Ordovician and Cambrian (?): Southwestern Utah (Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Grampian ls.*—Heavy-bedded blue and gray ls., in part dolomitic, with limy sh. at top. Thickness 4,000+ ft. Underlies (probably conformably) Morehouse qtzite. Oldest fm. exposed in Frisco region. Lower Ord. (Chazy and Beekmantown) fossils in upper part. Lower part may be Upper Camb. Type loc. Grampian Hills, Frisco dist.

Grampus gneiss.

Pre-Cambrian: Eastern New York (Long Lake quadrangle, Adirondack Mountains).

H. P. Cushing, 1907 (N. Y. State Mus. 60th Ann. Rept., pt. 2 (also called N. Y. State Mus. Bull. 115), pp. 463, 467–469). *Grampus gneiss.*—Igneous gneisses associated with frequent bands or patches of Grenville (sedimentary) rocks and frequent rocks of doubtful nature but with Grenville look. Differs materially from Long Lake gneiss in considerable diversity shown. Age relations to Long Lake gneiss and Piercefield gneiss undet.

Named for exposures around Grampus Lake, Hamilton Co.

Grampus.

A hard subsurface sand, of Penn. age and 150 ft. thick, found near sea level in Cabin Creek field, about 20 mi. SE. of Charleston, W. Va. Lies 50 to 75 ft. above Salt sand, the basal memb. of the Penn. (See A. A. P. G. Bull., vol. 11, No. 7, p. 709, 1927.)

Granby tuff. (In Newark group.)

Upper Triassic: Central southern Massachusetts and Connecticut (?).

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 451–456). *Granby tufa*, or the diabase tufa of the Triassic of Mass.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50, and U. S. G. S. Mon. 29). [See 1898 entry under *Longmeadow ss.*]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 92, 95–96). *Granby tuff.*—Thick-bedded black tuff and tuffaceous ss. ranging from fine-grained volcanic ss. to coarse diabase breccias and aggls.; from rocks made up wholly of volcanic debris to such as contain abundant fragments of granitic gneissoid rocks. Exposed 1¼ mi. N. of cemetery in Granby. Immediately after outflow of Hampden diabase, and while that sheet was still liquid, an explosive eruption took place locally, and blocks and pulverized dust of diabase were spread by the waters over a broad area, forming the Granby tuff. Then followed the uppermost layer of rusty sands, in which most of the tracks have been preserved. The whole was capped down the middle of the basin by the thin Chicopee sh., in which only leaves and small tracks are found. Is a fm. near top of Newark group.

Granby conglomerate.

Pennsylvanian (?): Southwestern Missouri.

E. R. Buckley and H. A. Buehler, 1906 (Mo. Bur. Geol. and Mines vol. 4, 2d ser., pl. 14, pp. 33, 87, 88, 100, 102). *Granby cgl.*—Basal cgl. of Penn. in Granby area. Resembles a mechanical breccia.

E. R. Buckley, 1911 (Types of ore deposits, p. 118). A ss. in Joplin dist., which was deposited upon residual mantle of broken flint and which probably belongs to the Chester, formed in many places a cgl., which, as it is found today, resembles a breccia. This cgl. has been called the *Granby*.

Probably named for Granby, or Granby Junction, Newton Co., or for Granby Branch Junction, Jasper Co.

Grandad limestone.

Silurian: Southeastern Indiana (Clark County).

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., pp. 138, 143, 146). *Grandad ls.*—Impure ls., 4 ft. thick, near top of Niagara; used for building purposes. Overlain by 20 ft. of mag. ls. (top of Niagara) and underlain by 14 ft. of gray crystalline ls. of the Niagara.

Derivation of name not stated.

Grand Bank series.

Pre-Cambrian: Newfoundland.

N. C. Dale, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 419).

Grand Canyon series.

Provincial series term for rocks of pre-Camb. age in northern Ariz. Introduced by J. W. Powell in 1876 (Geology of eastern portion of Uinta Mtns, pp. 43, 61–62, 70). See also C. D. Walcott, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pp. 518–519). Includes Chuar group (above) and Unkar group (below). Uncon. underlies Tonto group and uncon. overlies Vishnu schist. For complete definition see U. S. G. S. Bull. 769, pp. 113–114.

†Grand Canyon schist.

Pre-Cambrian: Northern Arizona.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns). *Grand Cañon schists.*—Hornblendic and micaceous schists and slates, with beds and dikes of granite. Thickness unknown. Found at bottom of Grand Cañon. Uncon. underlies Grand Cañon group [Unkar group].

Replaced by ***Vishnu schist.***

†Grand Canyon group.

Pre-Cambrian: Northern Arizona.

C. D. Walcott, 1883 (Am. Jour. Sci., 3d, vol. 26, pp. 440–441), divided Grand Canyon series into two uncon. groups, the upper of which he named *Chuar group* and the lower *Grand Canyon group*. Subsequently he replaced latter term with *Unkar group*, the name by which it is now known.

Grande limestone.

Mississippian: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. 19, pp. 7–21). *Grande ls.*—Blue ls., 25 ft. thick, containing the Lake Valley silver ores, which were first opened at Sierra Grande workings. Consists of (descending): (1) Hard, compact, heavily bedded pure soluble ls., 10 ft.; (2) black subcrystalline ls., 2 ft.; (3) massive hard grayish blue coralline rocks, 13 to 15 ft. Underlies Lake Valley ls. [restricted to beds containing lower Burlington fossils] at Lake Valley, and uncon. overlies Dev. Berenda ls.

Grande Grève limestones.

Lower Devonian: Quebec (Gaspe Peninsula).

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 208, footnote). The term *Grande Grève fm.*, suggested by writer some time ago, has recently been accepted by Prof. J. M. Clarke and Mr. Schuchert, whilst they suggest the terms *St. Alban* and *Cape Bon Ami* to include the beds numbered 1 and 2, and 3, 4, 5, 6, respectively, in Billings' Gaspé section. (Inserted on going to press). Assigned to Dev.

J. M. Clarke, 1900 (N. Y. State Mus. Mem. 3, vol. 3, pp. 80–81). For the lss. on Gaspe Peninsula having most pronounced Oriskany traits, and forming beds 7 and 8 of Sir Wm. Logan's 1844 classification, Dr. Ami has suggested the name *Grand Grève lss.*, from the little village on the peninsula where they are best exposed and most readily accessible. To Mr. Charles Schuchert and writer, who have recently spent some time in this region, this name seems happily chosen.

Grand Falls chert member (of Boone limestone).

Mississippian (Keokuk): Southwestern Missouri, southeastern Kansas, northwestern Arkansas, and northeastern Oklahoma.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 7, pp. 417–419). *Grand Falls chert.*—Very dense, hard chert, 30 ft. thick in Shoal Creek section of SW. Mo. Occurs in massive layers 6 or more ft. thick; has a gnarled and knotted structure, producing uneven surface.

C. E. Siebenthal, 1907 (U. S. G. S. Joplin folio, No. 148). *Grand Falls chert memb. of Boone fm.*—Almost wholly heavy beds of solid chert, but is not persistent and in many areas its stratigraphic horizon is occupied by ls. Its distinctive characters are heavy bedding, "live" splintery fracture, fine brecciation and cementation, and spotting. Thickness 15 to 120 ft. Lies about 100 ft. below Short Creek oolite memb. of the Boone, and from 25 to 100 ft. above base of Boone. Fossils [listed] include species distinctly suggestive of Keokuk and none particularly suggestive of Burlington. Named for development around Grand Falls, Newton Co., Mo.

Grandfield conglomerate.

Pliocene or Pleistocene: Southwestern Oklahoma.

M. J. Munn, 1914 (U. S. G. S. Bull. 547, pp. 17, 28–30). *Grandfield cgl.*—Coarse indurated quartz lime cgl., 3 to 5 ft. thick, uncon. overlying Perm. Will probably be correlated with some portion of Seymour fm. of Wichita Co., Tex.

Named for Grandfield, Tillman Co.

Grand Forks schist.

Age (?): Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 9, 10, 118° to 119°). *Grand Forks schists.*—Amphibolite, hornblende schists, etc. [Mapped at and around Twp of Grand Forks, B. C.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 378). [This seems to be regarded as Paleozoic or older.]

†Grand Gulf sandstone.

Miocene: Southern Mississippi and southern Alabama.

B. L. C. Wailes, 1854 (Agric. and Geol. Miss., pp. 216–219). *Grand Gulf ss.*—Ss. of variable color and texture, many specimens having appearance of aggregated grains of coarse, angular black and bluish sand incorporated in matrix of white porcelain or enamel-like character, and approaching fine breccia in composition—a quality which has occasioned it to be spoken of as *petrified rock.* The range of this rock is btw. Big Black River and Bayou Pierre (on both sides of latter in some localities), and extending eastwardly to vicinity of Raymond and Mississippi Springs, near which it occurs of a softer and more uniform character or texture, and from whence that employed in basement and pavements of State House at Jackson was obtained. It is still quarried for building purposes there, and at different points in its course. The rock presents itself in mass in escarpment of bold promontory on the Mississippi, about 1 mi. below mouth of Big Black River, and immediately above town of Grand Gulf, against which the current of the river sets in full force, and by which it is deflected by its effective resistance in such a manner as to create the extensive and formerly dangerous whirlpool or eddy which gave name to the place. At many points within the scope I have mentioned this rock crops out in the beds of the watercourses and upon the sides of the ridges, exhibiting, as in that in Mississippi bluff, such an identity of character as to induce me to characterize it wherever met with as the *Grand Gulf rock.*

Owing to subsequent varied and conflicting uses of *Grand Gulf*, the ss. to which the name had been applied was in 1905 and 1906 (A. C. Veatch: La. Geol. Surv. Bull. 1, pt. 2, pp. 84, 85, 90, 1905; U. S. G. S. W. S. P. 114, pp. 180, 186, 1905; U. S. G. S. P. P. 46, p. 42, 1906) replaced by *Catahoula ss.* The †Grand Gulf ss. of Wailes is upper 14 ft. of the ss. which was called "Grand Gulf ss." in later repts.

Named for exposures in bluff at Grand Gulf, Claiborne Co., Miss.

†Grand Gulf group.

Miocene and Oligocene (?): Gulf Coastal Plain.

E. W. Hilgard, 1860 (Agric. and Geol. Miss., pp. 3, 108, 147–154). *Grand Gulf group* (also *Grand Gulf stage, or Southern Lignitic*).—White or gray ss., usually soft; black, blue, green, and gray clays and sands, with small lignite beds, tree palms, exogenous trees, Arundinaceae. Thickness 150 ft. Includes, at top, *Grand Gulf ss.* proper, 14 ft. thick. Overlain by Newer Tertiary (?) clays of the coast, and underlain by Vicksburg group.

As described and used in different areas included Catahoula ss., Hattiesburg clay, and Pascagoula clay, and the use of the name has been discontinued. Named for development of its principal memb. in bluff at Grand Gulf, Claiborne Co., Miss.

Grandhaven limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

R. C. Moore, May 1, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14). *Grandhaven ls.* underlies Friedrich sh. and overlies Dry sh.

G. E. Condra, late in 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), applied *Grandhaven (?)* to 1 ft. of gray, nodular, aren. ls., forming a memb. in lower part of his Friedrich-Dry sh., and lying 3 ft. above his Dover ls. fm. Derivation of name not stated.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 237). *Grandhaven ls.* overlies Dry sh. and underlies Friedrich sh. Commonly consists of 2 ls. members separated by a few ft. of sh. The lower ls. is ½ to 5 ft. thick, gray to bluish, and unlike the older Dover ls. Contains many fusulinids in some exposures. The upper ls. is 1 to 8 ft. thick, very light-gray, weathering almost white, and is characterized by abundant algal deposits, and closely resembles upper memb. of Dover ls. The sh. btw. the 2 lss. is mostly bluish gray, clayey to calc., and 4 to 10 ft. thick. The Grandhaven ls. is recognized from Shawnee Co. S. to Okla., but is not seen N. of Kansas River. Type loc. is in sec. 31, T. 13 S., R. 14 E., near Grandhaven, Shawnee Co.

Grandian epoch (and series).

Term proposed by G. F. Kay (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 449–452, 1931) to include Aftonian (interglacial) and Nebraskan (glacial) stages of Pleist. epoch (and series), which Kay would elevate to Pleist. period (and system). Named for Grand River Valley, SW. Iowa, where the Aftonian and Nebraskan stages have been studied in detail.

Grand Island formation.

Pleistocene (Kansan): Southern and eastern Nebraska.

A. L. Lugn and G. E. Condra, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 190). *Grand Island fm.* (Kansan), 50 to 100+ ft. thick, lies uncon. on Fullerton bed, and is conformably overlain by Upland fm. (Yarmouth).

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 326, 343–346). *Grand Island fm.*—Largely fluvial inwash-outwash deposits of sand and gravel, fine and coarse, of Kansan age. Thickness 30 to 150 ft. Upper 30 to 50 ft. are usually fine sand. In a section NW. of Holdrege it is 120 ft. thick, and upper 100 ft. is clean fine to medium sand and lower 20 ft. is mixed sand and gravel. Extends continuously under Platte River Valley and plains to N. and S., covering 15,000± sq. mi.

Named for exposures at and around Grand Island, Hall Co.

Grand Lake member.

Middle Devonian: Northeastern Michigan (Presque Isle and Alpena Counties).

A. W. Grabau, unpublished ms., 1915 (as reported by E. R. Pohl in U. S. Nat. Mus. Proc., vol. 76, art. 14, 1930. pp. 4; 25+). *Grand Lake ls. memb.*—Middle memb. of Presque Isle series in Presque Isle and Alpena Counties. Thickness 39 ft. Underlies Long Lake memb. and overlies Bell shales (basal memb. of Presque Isle series and of Traverse group). [Fossils listed. Lithology not described. Derivation of name not stated, but probably is Grand Lake, in E. part of Presque Isle Co.]

Grand Lake formation.

Pre-Pennsylvanian: New Brunswick.

W. S. Dyer, 1926 (Canada Geol. Surv. Mem. 151, p. 9).

Grand Ledge moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Grand Ledge, Eaton Co.

†Grand Portage amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv., vol. 1, pt. 2, pp. 35, 69). *Grand Portage cupriferous amygdaloid.*

R. D. Irving, 1883 (U. S. G. S. Mon. 5, p. 195). *Grand Portage cupriferous amygdaloid* occurs 670 ft. above cgl. No. 8 in Portage Lake section.

Same as Isle Royale amygdaloid, of Central Mine group. The mineralized part is Grand Portage lode.

Named for occurrence in old Grand Portage mine, Houghton Co.

†Grand Portage flow.

Includes Isle Royale (†Grand Portage) amygdaloid and underlying trap.

Grand Portage graywacke.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Grand Portage Indian Reservation).

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 510). *Grand Portage graywacke.*—Slaty greenish-gray rock, 200+ ft. thick. Lies at top of Animikie and above Wauswaugoning qtzite.

U. S. Grant, 1899 (same rept. as cited above). In vicinity of Puckwunge River and along Grand Portage trail there is a fine-grained graywackelike rock which Prof. N. H. Winchell has named *Grand Portage graywacke* and referred to upper part of Animikie above the clastics of Pigeon Point.

N. H. Winchell, 1900 (Minn. Geol. Surv. Final Rept., vol. 5, pt. 1). *Grand Portage graywacke.*—Greenish, gritty, rough and unevenly bedded, having a coarse conchoidal manner of disintegrating under frost and sun. Occurs in Indian reservation at Grand Portage. Is supposed to overlie the black-sl. memb. of the Animikie.

†Grand Prairie formation.

Lower Cretaceous (Comanche series): Eastern Texas.

R. T. Hill and R. A. F. Penrose, 1889 (Am. Jour. Sci., 3d, vol. 38, p. 470). [*Grand Prairie or Upper Cross Timbers fm.* used as a local or Tex. name for Lower Cret. or Comanche series.]

Named for prairie extending from 4 mi. E. of Fort Worth to 7 mi. W. of Weatherford, Tex., which was known to old travelers as the "Grand Prairie." (R. T. Hill, Am. Jour. Sci., 3d, vol. 33, p. 300.)

Grand Pré formation.

Triassic: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 214).

Grand Rapids sandstone.

Devonian (?): Northwestern Ohio.

E. Orton, 1888 (Ohio Geol. Surv. vol. 6, p. 20) and 1890 (Ohio Geol. Surv., 3d Organization, 1st Ann. Rept., p. 24). *Grand Rapids ss.* of Wood Co. probably belongs to same level as Sylvania ss.

Grand Rapids group.

Mississippian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *Grand Rapids group,* 300+ ft. thick, top div. of Sub-Carbf. in Mich. Underlies Parma ss. and overlies Marshall ss.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, p. 10). *Grand Rapids group* consists of 305± ft. of lss. underlain or replaced by shales and dol. with gyp. Lower part called *Michigan salt group* by Winchell. Overlies Marshall ss. and underlies Parma ss.

A. C. Lane, 1900 (Mich. Geol. Surv. vol. 7, pt. 2, btw. pp. 1 and 30) divided *Grand Rapids group* into Bayport ls. above and Michigan fm. below.

Named for exposures at Grand Rapids, where Bayport ls. is quarried.

Grand Rapids sandstone.

Lower Cretaceous: Alberta.

R. G. McConnell, 1893 (Canada Geol. Surv. Ann. Rept., vol. 5, pt. 1, pp. 29D, 55D–58D).

†Grand Rapids limestone.

A term casually applied by A. C. Lane (U. S. G. S. W. S. P. 30, 1899, p. 81) to Bayport ls. of Mich.

Grand Ridge.

Pleistocene (Wisconsin stage): Northeastern Illinois.

See under *Farm Ridge moraine.*

Grand Tower limestone.

Middle Devonian (Onondaga): Eastern Missouri and southwestern Illinois.

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4, pp. 30, 42). *Grand Tower ls.*—Ls., 100 ft. thick in SE. Mo., underlying ls. containing Western Hamilton fossils (called Callaway ls. in table) and overlying Clear Creek ls. Equiv. of Onondaga and Oriskany of previous Mo. repts.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., pp. 109–111). *Grand Tower ls.* (*Keyes emend*).—Overlies Clear Creek ls. or chert of Worthen and is separated from overlying Glen Park ls. memb. of Sulphur Springs fm. by 0 to 15 ft. of sh. that may be Dev. or may be earliest Kinderhook. Contains local representatives of Hamilton and Onondaga lss.

T. E. Savage, 1910 (Ill. Acad. Sci. Trans., vol. 3, pp. 116+). *Grand Tower (Onondaga) fm.*—Consists of 125 ft. of ls. of Onondaga age underlain by 25 to 30 ft. of reddish brown friable ss. Overlies Clear Creek fm. and underlies Hamilton beds. The latter were included in Grand Tower fm. of Keyes in Mo., but in this rept the name is applied to only the western representative of Onondaga ls. of N. Y.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 170–171). *Grand Tower ls.* underlies Lingle ls. and overlies Dutch Creek ss. in Mo. and Ill.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.). *Grand Tower ls.*—Thick lss., in part shaly and locally containing lenses of ss.; ls. varies from fine-grained hard, brittle rock of gray or blue color to white, coarsely crystalline rock of marblelike texture; small amount of chert in lower beds in SE. Mo. In Ste. Genevieve Co., Mo., *rests on Little Saline ls.* In Callaway Co. uncon. overlies Ord. *Thickness* 250 ft. in Ste. Genevieve, Perry, and Cape Girardeau Counties; in Callaway, Montgomery, Warren, Lincoln, and Pike Counties rarely exceeds 15 ft. Overlain by Beauvais ss.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 141–148). *Grand Tower fm.*—While major part of Grand Tower ls. of Keyes bears fauna with Onondaga relationships, the uppermost beds carry fauna having relationships with eastern Hamilton. Savage's definition, which restricts name to western representative of Onondaga ls., is adopted in this rept. In Ste. Genevieve Co., Mo., it is 200 to 250 ft. thick, underlies Beauvais ss., and overlies Little Saline ls. Fossils listed.

Named for exposures in vicinity of Grand Tower, Jackson Co., Ill.

Grand View dolomite.

Upper Devonian: Southern central Idaho (Custer County).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Grand View dol.*—Moderately dark well-bedded dol. in part qtzitic. Thickness 1,250± ft. Underlies Milligen fm. and overlies Jefferson dol. Probably to be correlated with Threeforks ls. Named for Grand View Canyon, 14 mi. S. of Challis, Custer Co.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 963–966, etc.). *Grand View dol.*—Dol. and dolomitic ls., both dark and rusty yellow, in part sandy; some thin beds of qtzite, sh., and ss. Thickness at type loc. (Grand View Canyon, near center of T. 12 N., R. 20 E.) 1,170 ft. [Detailed section.] Overlies Jefferson dol. and underlies Milligen fm. (Miss.). Fossils.

Graneros shale. (Of Colorado group.)

Upper Cretaceous: Eastern Colorado and Wyoming, southeastern Montana, South Dakota, Nebraska, Kansas, northeastern New Mexico.

G. K. Gilbert, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 564). *Graneros sh.*—Name suggested by R. C. Hills. Laminated argill. or clayey gray shales with very little limy or sandy material. Thickness 200 to 210 ft. Bottom fm. of Benton group in Arkansas Valley region, Colo. Underlies Greenhorn ls. and overlies Dakota group. Named for Graneros Creek, Colo. [in Walsenburg quad., Pueblo Co.].

The Niobrara and Benton are not now treated as groups, the broader term *Colorado group*, which includes them both, being considered the more useful group name. Where the Niobrara deposits and Benton deposits are not subdivided, they are called *Niobrara ls.* and *Benton sh.*, respectively.

Granite Creek granodiorite.

Probably Cretaceous or Jurassic: Northern Idaho (Pend Oreille district).

J. L. Gillson, 1927 (Jour. Geol., vol. 35, No. 1). *Granite Creek granodiorite.*—Brilliant white rock, with lustrous black euhedral plates of biotite. More feldspathic than Bayview and Packsaddle granodiorites and contains abundance of two accessory minerals (allanite and titanite) and large amount of epidote.

Named for exposures around mouth of Granite Creek, Bonner Co.

Granite Mountain porphyry.

Early Tertiary (?): Central Arizona (Ray district).

F. L. Ransome, 1919 (U. S. G. S. P. P. 115, p. 126, pl. 45). Of the two varieties of quartz monzonite porphyry in Ray dist., the *Granite Mtn porphyry* occurs almost wholly in S. half of dist., while Teapot Mtn porphyry is characteristic of N. half. Both are intrusive. The principal body of Granite Mtn porphyry is the irregular intrusive mass that makes up much of Granite Mtn.

Granite Park member (of Siyeh limestone).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Granite Park memb.*—Top memb. of Siyeh fm. Consists of 185 ft. of thin-bedded gray lss. with interbeddings of argillite and ls. cgl.; some oolites in lower part. Upper beds commonly crowded with large colonies of *Collenia* sp. Overlies *Collenia? frequens* zone. Is well exposed along the Garden Wall, near Granite Park, Flathead Co.

Grant conglomerate.

Huronian (probably middle): Northern Minnesota (Lake County).

J. W. Gruner, 1929 (Lake Superior Min. Inst. Proc., vol. 27, pp. 184–187). *Grant cgl.*—Belt of steeply dipping cgl. that begins in sec. 10 and extends nearly 4 mi. to N., to Canadian bdy. Is very coarse in many outcrops. Can be most easily studied in vicinity of Grant Lake, Lake Co. Was formerly thought to be Ogishke cgl., but it rests on the ellipsoidal granite; greenstone pebbles numerous at the contact but become inconspicuous a few ft. away. The ellipsoidal granite was formerly thought to be Archean, but it is of later age than Knife Lake slates (which should be assigned to *Lower* Huronian), and it lies on the truncated folded slates. The Grant cgl. is probably Middle Huronian.

Grant shale. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 50). *Grant sh.*—Middle memb. of Winfield fm. Consists of bluish gray, argill. sh. with thin seams of fossiliferous ls. near top in most sections. Thickness 15 or 16 ft. in Nebr. and in northern central Kans., but decreases southward toward Winfield and plays out btw. there and Arkansas City, Kans. In many exposures it carries a thin pebbly subzone near top. Named for Grant Twp, Marion Co., Kans. Type loc. btw. 5 and 6 mi. N. of Florence, Kans. Overlies Stovall ls. memb. and underlies Cresswell ls. memb.

Granton trap.

Upper Triassic: Northern New Jersey (northwest of Jersey City).

N. H. Darton, 1890 (U. S. G. S. Bull. 67). *Granton trap.*—Small intrusive mass, 125± ft. thick, midway btw. Jersey City and Hackensack. [In U. S. G. S. New York City folio, No. 83, 1902, the mass of "trap" N. of Granton, N. J., was mapped as Palisade diabase, which is Upper Triassic.]

Grants Mills granite.

Carboniferous or Devonian: Northeastern Rhode Island.

C. H. Warren and S. Powers, 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 437 (map) and 458). *Grants Mills granite.*—A narrow N.–S. belt of coarse biotite granite, of cream, pale-green, and pink color, passing through Grants Mills, Providence Co.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped this granite as Quincy granite.

Granville beds.

Mississippian: Central Ohio.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, pp. 217–219). *Granville beds.*—Comprise 111 ft. of strata in central part of Licking Co., which are only a local modification of Black Hand cgl. of E. part of county. Consist of (descending): (1) 3 to 18 ft. of coarse ss. and cgl.; (2) fucoid layer 7 to 12 ft. thick; (3) 15 to 21 ft. of compact, argill. drab ss.; (4) 60 ft. of shaly drab sss. and shales. Overlain by Licking shales and underlain by Raccoon shales. All included in Waverly group.

Named for Granville, Licking Co.

Granville enstatite serpentine.

Name loosely applied by B. K. Emerson (U. S. G. S. Mon. 29, p. 90, 1898) to a bed of serpentine in Old Hampshire Co., Mass.

Granville shale facies.

Mississippian: Central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 679–682). *Granville sh. facies of Cuyahoga fm.* of central part of Licking Co. Mostly shales with finer-grained fossiliferous sss. in upper part; cgls. absent or limited to few thin beds. Thickness 588 ft. Includes (descending): Berne memb., 0 to 10 ft.; Black Hand memb. 50 to 100 ft.; Raccoon memb. 20 to 200 ft.

Corresponds to Cuyahoga fm. and lower part of Black Hand fm.

Named for Granville, Licking Co.

Grape Creek shale and limestone. (In Clyde formation.)

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 412, 427). *Grape Creek bed.*—Mostly light-gray or dove-colored, rather friable fossiliferous ls., with more or less clay in southern and northern parts of field. Thickness 100 to 150 ft. Memb. of Albany div. Underlies Talpa bed and overlies bed No. 12 (12 to 75 ft. of clay).

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816). *Grape Creek fm.*, 130 ft. thick, underlies Talpa fm. and overlies Bead Mtn fm. [in which bed No. 12 seems to be included]. Grape Creek fm. is distinguished from Bead Mtn beds by paucity of worm and *Syringopora* remains, the introduction of Mollusca and Molluscoidea, and, most noticeably, by nature of bedding of rocks.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 197, 198). *Grape Creek sh. and ls. bed* is basal memb. of Clyde fm. (of Wichita group). Underlies Talpa ls. and overlies Bead Mtn ls., top memb. of Belle Plains fm.

Named for Grape Creek, Coleman Co.

Grapevine sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 211). *Grapevine ss.*—Massive, grayish white, medium-grained, micaceous, 25 to 40 ft. thick. Underlies Cedar coal and overlies Eagle sl. Named for creek in Mingo Co.

Type loc. is at mouth of Grapevine Creek, Mingo Co.

Grapevine conglomerates.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 79). *Grapevine cgls.*—Cgl., 500 ft. thick, uncon. beneath Greenwater volcanics, and composing lower fm. of Amargosan series (of early Tertic age) in Nev.

Named for good exposures around base of Grapevine Range, on E. side of Death Valley, Inyo Co., Calif.

Graphic lavas.

Pre-Cambrian: Central northern New Mexico (Magdalena Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 7). *Graphic lavas.*—Bedded volcanic sequence superposed on pre-Camb. rocks of Magdalena Mtns. [Derivation of name not given. On p. 4 they are shown as pre-Camb.]

†Graphic-Kelly limestone.

Mississippian: Central or southwestern New Mexico (Kelly district).

C. L. Herrick, 1904 (Am. Geol., vol. 13, pp. 310–312). *Graphic-Kelly fm.*—Crystalline and light-colored lime, separated by close-grained, dense lime resembling lithographic stone known locally as *"Silver-pipe" lime.* The beds above the separating "Silver-pipe" lime are called *Kelly lime,* and the beds below it are called *Graphic lime.* Overlain by Sandia fm. and underlain by qtzite. [Occurs in Kelly mining dist., Socorro Co.]

Grassmere stage.

Name applied by W. H. Sherzer (Mich. Geol. Surv. vol. 7, pt. 1, 1900, pp. 141–142) to a Pleist. beach in Bedford and adjacent Twps, SE. Mich.

Grasston moraine.

Pleistocene (Wisconsin stage): Central eastern Minnesota (Kanabec, Pine, and Mille Lacs Counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 45–47). Named for development at Grasston, Pine Co.

Grassy shale.

A shortened form of *Grassy Creek sh.,* now employed by C. [R.] Keyes.

Grassy Creek shale.

Upper Devonian or Mississippian: Northeastern Missouri, southeastern Iowa, and western Illinois.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59–63). *Grassy Creek sh.*—Black and green shales, carrying characteristically Dev. fish. Underlie Louisiana ls. in vicinity of Louisiana, Mo. Ten mi. W. of Grassy Creek [Pike Co., Mo.] they are 30 ft. thick, but thin out to S. before limits of Pike Co. are reached; are 6± ft. in vicinity of Louisiana.

In 1902 Keyes correlated Grassy Creek sh. with Snyder Creek sh. In 1912 he restricted *Grassy sh.* (his shortened name) to lower 0–50 ft. of black sh. lying uncon. higher than Lime Creek sh., introduced *Saverton sh.* for upper blue sh. underlying Louisiana ls., and assigned both to Miss. He repeated this definition in 1913, 1915, 1917, and 1922. In latter rept. thickness was given as 3 to 60 ft.; on Grassy Creek 40 ft.

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Grassy Creek sh.*, 0–100 ft. thick, underlies Louisiana ls. and lies stratigraphically and uncon. higher than Craghead Creek sh. Assigned to Kinderhook group and correlated with Sylamore ss.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 282, etc.), stated that 20 ft. of *Grassy Creek sh.* is exposed in Pike, Jersey, and Calhoun Counties, Ill., and that it disappears to S.

A. H. Bell, 1932 (Ill. Geol. Surv. Press Bull. No. 24), gave 119 to 170 ft. of *Grassy Creek sh.* in wells of Warsaw area, Hancock Co., Ill., and included it in Kinderhook group, as did R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245).

J. M. Weller, 1935 (Ill. Acad. Sci. Trans., vol. 28, No. 2, pp. 191–192). *Grassy Creek sh.* is well exposed on Grassy Creek near center of sec. 19. The so-called Grassy

Creek sh. at Louisiana, Mo., is 4± ft. thick and is not=Grassy Creek sh. on Grassy Creek, but is Maquoketa sh. The confusion that has resulted from misinterpretation of Grassy Creek section seems to necessitate a redefinition of fms. The simplest solution is to drop name *Grassy Creek* for the basal black Kinderhook sh. If desirable, this name might be redefined and applied to the dark sh. memb. in upper part of Maquoketa. At present it does not seem advisable to distinguish the basal black sh. from the overlying greenish or bluish beds, and it is therefore proposed to expand *Saverton fm.* to include the basal Kinderhook black sh. exposed in vicinity of Louisiana which has been known as *Grassy Creek.*

Some geologists have included this sh. in Dev., others have included it in Miss.

Grassy Island granite gneiss.

Pre-Cambrian (Laurentian): Western Ontario (Rainy Lake region).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 97).

Grassy Knob chert.

Lower Devonian: Southwestern Illinois (Jackson and Union Counties).

T. E. Savage, 1925 (Am. Jour. Sci., 5th, vol. 10, pp. 139–144). *Grassy Knob chert* (of Oriskany age) uncon. overlies Bailey ls. (of New Scotland age) and conformably underlies Little Saline ls. (of upper Oriskany age), or, where that is absent, it uncon. underlies Clear Creek chert (of Onondaga age). Thickness 150 ft. or more. On W. side of Grassy Knob, Jackson Co., the type loc., it consists of more than 125 ft. of chert in irregular rough layers 6 to 30 inches thick, with many cavities containing a few poorly preserved fossils, overlain by 12 to 15 ft. of hard, siliceous and sandy ls. in layers 3 to 8 inches thick grading downward into bands of chert containing particles of glauconite. Not previously recognized in Ill., and does not seem to be recognized at Little Saline Creek or elsewhere in Mo. Probably restricted to area of 5 or 6 sq. mi. in southern Ill.

Grassy Mountain basalt.

Miocene and Pliocene (?): Southeastern Oregon.

K. Bryan, 1929 (U. S. G. S. W. S. P. 597, p. 55) and B. C. Renick, 1930 (Jour. Geol., vol. 38, p. 506). (Named by Renick.) *Grassy Mtn basalt.*—Amygdaloidal olivine basalt overlying and in part interbedded with upper part of Payette fm. Underlies Idaho fm. Thickness at least 400 ft.

Named for fact it caps Grassy Mtn, Malheur Co.

Graters shales. (In Brunswick formation.)

Upper Triassic: Southeastern Pennsylvania (Montgomery County) and western New Jersey.

D. B. McLaughlin, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 179). *Graters shales.*—Two or three 50-foot strata of dark sh., separated by similar thicknesses of red, traced from Grater's Ford [Montgomery Co.], Pa., around end of Chalfont fault and NE. to hills E. of Frenchtown, N. J., a distance of about 40 mi. Are a part of Brunswick fm. [of Newark group].

D. B. McLaughlin, 1933 (Mich. Acad. Sci., Arts, and Lett., vol. 18, pp. 427, 433). *Graters members.*—A group of 3 strata of black sh., separated by comparable thicknesses of red sh., occurring about 2,200 ft. above base of Brunswick fm. in Silverdale section. The term black sh. as here used covers all gray, green, or black shales in Brunswick and underlying Lockatong fm. Consists of (descending): (1) Greenish-gray argillite, massive, 50 ft.; (2) red sh., 30 ft.; (3) gray-green thick-bedded sh., 70 ft.; (4) red sh., 30 ft.; (5) greenish-gray sh., 60 ft. Named for excellent exposures in Landis Brook just W. of Grater's Ford, on Perkiomen Creek.

Gratz shale.

Upper Ordovician: Northern Kentucky and southern Ohio.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 416–418, 569, pl. 27). The first of the deposits succeeding Catheys fm. in Cincinnati dome is *Gratz sh.*, which is best developed on NW. margin of dome along Kentucky River, but is recognized in a thinner bed at mouth of Licking River opposite Cincinnati, and somewhat doubtfully at several localities in Ohio and Ky. from 20 to 30 mi. up the Ohio. Seems absent on southern margin. Fauna much like Hermitage. The last of the Utica

(Fulton sh.) overlapping from the N., extends a short distance over N. flank of dome and rests with slight local uncon. on the Gratz. Of early Utica age.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2) and 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51), and A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided Cynthiana fm., of late Trenton age, into (descending) Rogers Gap, *Gratz,* Bromley, and Greendale.

Named for Gratz, Owen Co., Ky.

Gravel Head formation.

Ordovician: Newfoundland.

G. Van Ingen, 1914 (Table of geol. formations of Camb. and Ord. systems about Conception and Trinity Bays, Newfoundland, based upon 1912–13 field work). [Broadside, Princeton, N. J., private pub.]

Gravel Point stage.

Middle Devonian: Northwestern Michigan (Traverse Bay region).

See under *Charlevoix stage.*

Graves sand.

Upper Cretaceous: Southwestern Arkansas (Smackover oil and gas field, Ouachita and Union Counties).

H. G. Schneider, 1925 (A. A. P. G. Bull., vol. 9, No. 7, pp. 1116–1117). *Graves sand* of Smackover field is 35 ft. thick and lies 460 ft. below top of Nacatoch sand. Is also called 2,400-foot sand, the Meakin sand being called 2,200-foot sand and 2,300-foot sand. Named for farm on which was drilled the first well that produced from it.

Graves Creek formation.

Pleistocene: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Graves Creek fm.*—Fine or mucky clay, sand, and gravel, 100 to 175 ft. thick, in Webster Co. Underlies Recent alluvium and overlies Union fm. (Plio.). Assigned to Pleist.

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 122). The larger part of *Graves Creek fm.* is believed to be older than Union fm., but it is probable the surface part may be contemp. with Union fm. On Graves Creek, Webster Co., a well penetrates 104 ft. of this clay without reaching its base. Assigned to Pleist.

†Gravina series.

Jurassic or Cretaceous and Upper Triassic: Southeastern Alaska (Gravina Island).

A. H. Brooks, 1902 (U. S. G. S. P. P. 1, pp. 40–52, map). *Gravina series.*—Black shales or slates above and massive cgls. below. Occurs at Dall Head and elsewhere on S. end of Gravina Island. Uncon. overlies Vallenar series. Is Mesozoic, probably early Cret.

T. Chapin, 1919 (U. S. G. S. P. P. 120, p. 89). "Gravina series" of Brooks is now known to include 2 sed. fms. (one of Triassic age and one of Jurassic or Cret. age) associated with volcanic rocks of intermediate strat. position.

Gravoisan glacial epoch.

Name proposed by C [R.] Keyes, 1925 (Pan-Am. Geol., vol. 44, pp. 140–141), for time covered by isolated patches of a bouldery till of Pleist. age lying beyond the limit of Kansan till in Mo., and which "appears to be older than the Nebraskan till."

Named for occurrence on Gravois Creek, near Osage River, Morgan Co., Mo.

Keyes has also called the deposits "Gravoisan series" and "Gravoisan till."

Grawunder sand.

A subsurface sand, of Jackson (upper Eocene) age and 15 to 25 ft. thick, which according to L. P. Teas and C. R. Miller (A. A. P. G. Bull., vol.

17, No. 12, pp. 1461, 1464, 1475, 1477, 1933) lies in McElroy fm. in Humble Grawunder No. C.-1, at 3,430 ft. depth in Raccoon Bend field, Austin Co., Tex.

†Gray Band. (Also spelled Grey Band.)

Descriptive term applied in early N. Y. repts to the thin gray ss. later named *Thorold ss. memb. of Albion ss.* The term was probably originally used by Amos Eaton.

Gray porphyry group.

Eocene: Leadville district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230), 1883 (U. S. G. S. Leadville Atlas), 1886 (U. S. G. S. Mon. 12, p. 80), and 1927 (U. S. G. S. P. P. 148), used *Gray porphyry* in a titular sense. This is a color term applied to a group of intrusive porphyries of later age than the White porphyry of Leadville dist. The restricted use of the term in Leadville Mon. 12 applied to Johnson Gulch porphyry, but "the other bodies" which Emmons stated "belong without question to this [Gray] variety" included the porphyries now known as *Lincoln porphyry, Evans Gulch porphyry, Mount Zion porphyry,* and some unnamed porphyritic rocks. Petrographic description is by W. Cross, on p. 330 of Mon. 12.

Grayback wash.

Quaternary: Central southern Colorado (San Luis Valley region).

G. M. Butler, 1910 (Colo. Geol. Surv. Bull. 2, pp. 59–61, pl. 2). *Grayback wash.*—Heavy wash, consisting of monzonite porphyry, Carbf. lss., sss., and occasional iron-ore fragments. Comprises fragments of all rocks in immediate vicinity of Grayback Mtn and some material not now represented there. Shafts 50 ft. deep in Grayback mining dist., Costilla Co., fail to reach bottom.

Grayback formation.

Devonian: Northwestern California (portions of Del Norte and Siskiyou Counties).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, p. 128 and map). *Grayback fm.*—Argillites, cherts, ls. (in part marble), and interbedded flows of basalt. In some respects similar to Kennett fm. of Shasta Co. Dev. fossils. [Little Grayback, a peak in Siskiyou Co., is in midst of area mapped as Grayback fm.]

†Gray Bull beds.

†Gray Bull member.

Eocene (lower): Western Wyoming (Bighorn Basin).

W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, pp. 202–205). The beds underlying Lysite fm. in Bighorn Basin were referred by Sinclair and Granger to Knight fm., but it now seems that a new name is needed to distinguish this most important Lower Eo. faunal horizon, and *Gray Bull beds* is proposed. Consists of 600 ft. of *Systemodon*-bearing gray, red, and yellowish shales; highly fossiliferous. Exposed along Gray Bull River. Overlies, apparently conformably, Sand Coulee beds, which are fossiliferous but do not contain *Systemodon.*

G. L. Jepsen, 1930 (Am. Phil. Soc. Proc., vol. 69, No. 7, pp. 474, 494). *Gray Bull memb. of "Fort Union"* redefined by including in it, at base, the 200 ft. of red-banded beds called Sand Coulee by Granger, for reason that representatives of *Homogalax* were in 1928 found in the Sand Coulee, the apparent absence of that genus being the basis for separating the Sand Coulee from the overlying Gray Bull beds of Granger, which yield *Homogalax* abundantly. Where no uncon. is detected at base of the Gray Bull as here redefined, the base is drawn at top of sediments yielding *Eohippus* (Eo.).

According to H. F. Osborn (U. S. G. S. Mon. 55, 1929) these beds are a faunal zone belonging to his *Systemodon-Coryphodon-Eohippus* zone. The U. S. Geol. Survey does not apply geographic names to faunal zones.

†Gray Cliff group.

Jurassic (?): Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology Henry Mtns, pp. 6, 7). *Gray Cliff group* (also *Gray Cliff ss.*).—Massive cross-laminated ss., buff to red, 500 ft. thick, underlying Flaming Gorge group and overlying Vermilion Cliff group. Often difficult to distinguish by color from Flaming Gorge and Vermilion Cliff groups. [Derivation of name not stated.]

Replaced by Navajo ss., the more widely applied name. (See A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., U. S. G. S. P. P. 183, 1936.)

†Gray Cliff sandstone.

See †*Gray Cliff group.*

†Gray Cliff limestone.

Mississippian: Southeastern Arizona.

See under *Modoc ls.*

Graydon channel sandstone.

Pennsylvanian: Western and central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 7, pp. 422–425). *Graydon Springs ss. and cgl.*—Remnants of more or less friable, usually micaceous ss. of red or yellow color, 25 or more ft. thick, usually underlain by cgl. made up of pebbles and boulders of Lower Carbf. chert. The ss. and cgl. rest uncon. on Lower Carbf. lss., occupying depressions in latter. Shore deposit laid down probably in early Coal Measure times.

E. N. Babcock and J. Minor, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 22–27). State Geol. Buckley, in speaking of this river fm. [Graydon ss.] where it occurs as a cgl. filling old river channels, differentiates btw. this and *Graydon proper*. The fm. filling the channels he terms *Saline Creek cave cgl.*, and this is in places, he says, overlain by the Graydon. This Saline Creek cave cgl. would seem to be but the lower or local beds of Graydon ss. and cgl. The fm. is of river and estuary origin. The deposit at Graydon Springs would seem to be the remains of a great river.

F. B. Van Horn, 1905 (Mo. Bur. Geol. and Mines vol. 3, 2d ser.). *Graydon ss.*, 2 to 70 ft. thick in Moniteau Co., uncon. overlies Burlington and Chouteau lss. and at least in one place the Coal Measures shales.

Named for exposures at Graydon Springs, Polk Co.

Graydon shales.

Pennsylvanian: Southwestern Missouri (Green County).

E. M. Shepard, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, p. 56). *Graydon shales.*—Soft olive-green, sometimes carbonaceous shales or soapstone, frequently containing fossil leaves, evidently in pockets, in Graydon ss., and associated with clays.

†Graydon Springs sandstone and conglomerate.

See *Graydon channel ss.*

Grayhorse limestone member (of Sand Creek formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

K. C. Heald, 1918 (U. S. G. S. Bull. 686K, p. 130). [The strat. section of rocks exposed in T. 27 N., R. 7 E., Osage Co., shows a thin ls., called *Grayhorse ls.*, lying 85 ft. below Foraker ls. and 57 ft. below a micaceous ss. This ls. was named by C. F. Bowen in Bull. 686L, but Heald's chapter in Bull. 686K was released before Bowen's rept in Bull. 686L.]

C. F. Bowen, 1918 (U. S. G. S. Bull, 686L, p. 138). *Grayhorse ls.*—Dark brownish-gray crystalline conglomeratic ls., usually 2± ft. thick but locally 4 ft. thick. Contains numerous small pebbles ranging in size from mere grains to that of a large pea, which weather dirty white and give rock a mottled appearance. In most places contains numerous large specimens of *Myalina subquadrata*, some of which are 3 or 4 in. in longest dimension. The outcrops on steep slopes break off in large slabs as much as 10 ft. across which strew the slope below.

Is older than Foraker ls. and younger than Stonebreaker ls. Named for excellent exposure on crest of Little Grayhorse anticline, in NW¼ sec. 11, T. 24 N., R. 6 E.

Basal memb. of Sand Creek fm. (See under *Sand Creek fm.* Also see 1936 entry under *Caneyville ls.*)

Grayhorse sand.

A subsurface sand, of Penn. age, in central northern Okla., reported to correlate with a part of Pawhuska fm.

Grayson marl member (of Denison formation).

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

F. W. Cragin, 1894 (Colo. Coll. Studies, vol. 5, pp. 43–48). *Grayson marls.*—Yellow, highly calc., sparingly aren., fossiliferous marls, 15 to 40 ft. thick. Top memb. of *Exogyra arietina* marl and of Main Street ls. in Cooke and Grayson Counties. Overlies Choctaw ls. memb. of Main Street ls.

R. T. Hill, 1901 (U. S. G. S. 21st. Ann. Rept., pt. 7, pp. 114–115, 121–124, 245, 246–249, 266–271, pls. 7, 18), restricted *Main Street ls.* to beds underlying Grayson marl, or to those called "Choctaw ls." by Cragin. He defined *Grayson marl* as grayish marls, lighter colored than Main Street ls., 15 to 60 ft. thick, and as forming top memb. of Denison fm. This is definition followed by U. S. Geol. Survey.

Named for numerous outcrops in Grayson Co., Tex.

Grayson granite gneiss.

Pre-Cambrian: Southwestern Virginia (Grayson County).

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Grayson granite gneiss.*—Porphyritic biotite granite gneiss containing coarse pink to white feldspar phenocrysts with numerous dark schistose layers and cut by pegmatite. Probably = part of Cranberry granite. Covers most of Grayson Co.

A. I. Jonas, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 1, p. 55), changed this name to *Grayson granite.*

†Graysonton formation.

Cambrian (Middle and Lower): Southwestern Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 175, 183, and pl. 4). *Graysonton fm.*—Complex mass of red and green shales and interbedded lss., the lss. generally siliceous, showing gradual transition from the siliceous green sh. to a solid ls., the whole highly charged with iron and giving rise to deep-red soils; occasionally a bed of pure blue ls. is seen, but they are not common. No reliable estimate of thickness. Apparently unfossiliferous, but probably of Middle or Lower Camb. age. Basal Paleozoic fm. Underlies, apparently conformably, Shenandoah ls.

Same as Watauga sh., which has been mapped over large area.

Named for Graysonton, Montgomery Co.

†Gray Sparry ls.

A name applied in early New York repts to Onondaga ls.

Grayville formation.

Pennsylvanian: Indiana.

See 1935 entry under *St. Wendell ss.*

†Great limestone. (In Monongahela formation.)

Pennsylvanian: Western Pennsylvania and northern West Virginia.

H. D. Rogers, 1839 (Pa. Geol. Surv. 3d Ann. Rept.). The *Great ls. deposits* consist of numerous beds of ls. separated by thin seams of sh., and aggregate 51 to 72 ft. in thickness. Occur in upper part of Pittsburgh series, being separated from underlying Pittsburgh coal by 75± feet of sh. and ss.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 503–507). *Great ls. bed.*—A series of alternating calc. and argill. strata 60 to 70 ft. thick. Is older than Uniontown coal, younger than Redstone coal, and includes, about in middle, the Sewickley coal. The ls. overlying the Sewickley coal is 22+ ft. thick, and the ls. underlying it 25± ft. thick. [As thus defined "Great ls." apparently included Uniontown ls. at top, Benwood ls., and Fishpot ls.]

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Great ls.*—I propose to limit this term to the double mass occurring btw. Uniontown and Sewickley coals. It is usually in 2 divisions but in one place it is in 3 divisions.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_8), applied the names *Great Pittsburg ls.* and *Pittsburg ls. group* (pp. 88, 100) to lss. extending from top of Uniontown ls. to base of Redstone ls.

The descriptive term "Great ls." as used in Pa. repts for many years included the Benwood and Uniontown ls. members of Monongahela fm.

†Great conglomerate.

Pennsylvanian: Appalachian region.

J. P. Lesley, 1856 (Manual of coal, pp. 91–105). The *Great Cgl.*, No. XII (Millstone Grit of Europe). Underlies the Lower [coal] series and consists of an upper cgl. 15 ft. thick, a middle sh. 50 ft. thick, and a basal cgl. 30 ft. thick. [Corresponds to Pottsville fm. of present terminology.]

Great conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan and Wisconsin.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 186, etc., pls. 17 and 18). *The Great cgl.*—Red ss. and cgl. underlying Lake Shore trap and overlying Marvine's Group C [Eagle River group] of Eagle River section. Thickness 2,200 ft.

Is basal fm. of Copper Harbor group.

Named for fact it was supposed to be very much thicker than Outer cgl. Is well established in the literature.

†Great gabbro.

A name applied in some early repts to Duluth gabbro.

†Great Bend conglomerate.

Name applied in some early repts to Olean cgl. of Warren Co., NW. Pa. (See first entry under *Olean cgl.*) According to F. A. Randall (2d Pa. Geol. Surv. Rept. I, pp. 51–54, 1875) the cgl. at Great Bend, Warren Co., is 40 ft. thick.

Great Bend limestone. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania (Susquehanna County).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 91). *Gread Bend ls.*—Passing down to Susquehanna River we find a thin calc. layer, filled with Chemung shells, at 400 ft. below base of "Fort" 76 cliff or New Milford lower ss. The layer varies from ½ ft. to 2 ft. in thickness and sometimes disappears entirely. It occurs on land of Mr. Lusk, about 20 ft. above level of the Susquehanna. Rests on finely laminated shales, apparently with uncon. in some places. Is present at Great Bend, Susquehanna Co.

Great Bend coal group.

A term applied to a group of strata in lower part of Tongue River memb. of Fort Union fm. in SW. N. Dak., and including coals G, H, and I. (See A. G. Leonard, 1908, N. Dak. Geol. Surv. 5th Bien. Rept.)

Great Blue limestone.

Mississippian (upper): Central northern Utah (Oquirrh Mountains region).

J. E. Spurr, 1895 (U. S. G. S. 16th Ann. Rept., pt. 2, pp. 374–376). *Great Blue ls.*—In Mercur mining dist. consists of (descending): (1) Massive dark-blue ls. interbedded with sss., 1,000 ft.; (2) black sh., 100 ft.; (3) massive dark-blue ls., 2,500 ft.; (4) black sh. 25 ft.; (5) massive dark-blue ls., 1,000 ft. Underlies Upper Intercalated series (alternating sss. and lss.) and overlies Lower Intercalated series (alternating thin lss. and calc. sss.). Occupies most of Mercur Basin. Max. thickness 5,000± ft.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, pp. 7, 29–31, 32). *"Great Blue" ls.* [redefined].—Consists of a lower and an upper ls. separated by shaly beds, 85 ft. thick, herein named *Long Trail sh. memb.* The lower ls. is 500± ft. thick, according to 4 measurements by writer, instead of 1,000 ft. as reported by Spurr. The upper ls. is blue-gray ls. like the lower ls. and contains sporadic chert layers, some sandy ls., and a very subordinate quantity of black sh. In places the upper 200 to 300 ft. of upper ls. memb. consists of interbedded ls. and sh. Estimated thickness of upper ls. 3,000± ft. The upper black sh. of Spurr and the overlying limy shales and interbedded lss., aggregating 1,140 ft., are here separated from the "Great Blue" ls. and named *Manning Canyon sh.* The "Great Blue" ls. rests on Humbug fm. ("Lower Intercalated series" of Spurr).

The term "Great Blue ls.," although nongeographic, is so well known to mining public that no attempt has been made to replace it with a geographic name.

†Great Carolinian bed.

See †*Carolinian bed.*

†Great Copper Harbor conglomerate.

A name that has been applied to Great cgl., of Copper Harbor group.

†Great Falls coal series.

†Great Falls group.

Lower Cretaceous: Central northern Montana (Great Falls region).

J. S. Newberry, 1887 (School Mines Quart., vol. 8, p. 328). *Great Falls coal series* is Lower Cret. and exact synonym of Kootenie of Canada. [In 1891 (Am. Jour. Sci., 3d, vol. 41, p. 193) Newberry called the beds *Great Falls group,* and repeated statement that they are same as Kootenie of Canada.]

Replaced by Kootenai fm., the older name.

Great Slave group.

Pre-Cambrian (upper Huronian?): Canada.

C. H. Stockwell (Canada Geol. Surv. Summ. Rept. for 1932, part C). Occurs on Great Slave Lake, Canada.

Great Smoky conglomerate.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 3). *Great Smoky cgl.*—Cgl., ss., qtzite, graywacke, mica-schist, garnet schist, and sl. Original character of beds is plainest in the cgls., whose layers are 1 to 50 ft. thick. All of rocks except the sl. have a decided gray color, becoming whitish on exposure and weathering of contained feldspar. The cgl. pebbles are not often coarse and seldom exceed half an inch in length. From this they grade into coarse and fine sss., qtzites, and graywackes. Traced southward less and less cgl. is found. There is always a heavy bed at top, however, and usually several near base. Interbedded with the coarse rocks are numerous seams and beds of light- and dark-gray schist and darker sl., usually less than a foot thick, but in places 25 or 30 ft. thick. Thickness of fm. 5,500 to 6,000 ft. Underlies Nantahala sl. and overlies Hiwassee sl.

Named for extensive development in Great Smoky Mtns, in S. part of Knoxville quad., which adjoins Nantahala quad. on N.

Greece Ranch horizon.

Oligocene: Southwestern Washington (southwestern Lewis County).

B. L. Clark, 1924 (Pan-Pacific Sci. Cong., Australia, 1923, Proc., vol. 1, p. 877). At present writer recognizes at least 5 distinct Eocene faunas in western No. Am., with suggestion of a sixth. Four of these have been proved not only to represent distinct faunal units, but strat. units as well—that is, the fms. containing the different faunas are separated one from the other by unconformities in certain areas at least. The *Greece Ranch horizon* is the sixth and questionable Eo. horizon. The fauna may possibly be Eo. It was collected from Greece ranch locality near Vader, on Cowlitz River, and from beds which rest uncon. on Cowlitz fm. and are stratigraphically below beds of Lincoln horizon. It is very possible the fauna represents uppermost Eo. The determination of what is upper Eo. and Olig. in western No. Am. is indirect.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 242–246). The oldest of the 4 Olig. faunas of Wash. is known only at Greece's ranch, on left bank of Cowlitz River ½ mi. below village of Toledo. The fauna was discovered by Anderson and Martin and was described by Dickerson in 1917 (Calif. Acad. Sci. Proc., 4th ser., vol. 7, pp. 157–182). A few more species were added in 1918 by K. E. Van Winkle (Univ. Wash. Pub. Geol., vol. 1, No. 2, pp. 81–92). Presumably the next younger fauna than Greece Ranch is the *Barbatia merriami* fauna, which occurs in Lower Porter beds of Porter and Oakville and definitely underlies Upper Porter beds. [Their 4 Olig. subdivisions are (descending) Blakeley, Porter, Lincoln, and Greece Ranch.]

T. J. Etherington, 1931 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 20, No. 5, pp. 33–56), assigned *Greece Ranch horizon* to oldest Olig., and stated that it rested with marked uncon. on Eocene.

See also *Gries Ranch horizon.*

Greeley gypsum. (In Sumner group.)

Permian: Central Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 10). *Greeley gyp.*—A gyp. bed in Geuda salt measures, about 100 ft. higher stratigraphically than Hope gyp.

G. P. Grimsley, 1899 (Univ. Geol. Surv. Kans., vol. 5, pp. 58–61), gives further description of this gyp. bed.

Named for Greeley Twp, Saline Co.

Green sand.

A subsurface sand, lying at 1,850 to 1,900 ft. depth, in Lawrence Co., Ill.

Greenberry formation.

Mississippian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 20).

†Greenbrier series.

Mississippian: Pennsylvania and northern West Virginia.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). If it is thought best to replace *Umbral* by a geographical term, the series might be called *Greenbrier series*, from Greenbrier River, in W. Va. *Mauch Chunk* is objectionable, because at that locality only shales occur, a condition characterizing the series only in central and eastern Pa., while in all the rest of the enormous area in which this series is exposed there is a large proportion of ls. In Pocahontas Co., W. Va., along Greenbrier River, the conditions are a mean btw. the extremes of ls. and sh., so that the locality would be a fitting one from which to name the series. Underlies Pottsville cgl. and overlies Pocono ss. Includes (descending) Upper Mauch Chunk shales (including Sharon group of coal beds) 82+ ft.; Mountain ls. (exposed in Loyalhanna Gap); Lower Mauch Chunk shales 90 ft., and Siliceous [Loyalhanna] ls. 50± ft.

Includes Mauch Chunk sh. and Loyalhanna ls.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 142). [See this entry under *Cameron red sh. memb.*]

Greenbrier limestone.

Mississippian: Southern Pennsylvania, western Maryland, northern West Virginia and Virginia.

W. B. Rogers, 1879 (Macfarlane's Geol. Ry. Guide, p. 179). *Greenbriar ls.* underlies Greenbriar shales [Mauch Chunk sh.] and overlies Montgomery grits and coal measures [Pocono ss.]. Is=Umbral shales of Pa.

I. C. White, 1882 (The Virginias, vol. 3, pp. 102–103). *Mountain or Greenbrier ls.*—Underlies Greenbrier or Mauch Chunk sh. and overlies Vespertine or Pocono of Pa. At base the "Siliceous ls.," 105 ft. thick, is tentatively included, although in writer's opinion it really belongs to Vespertine.

In some subsequent repts the †Siliceous (Loyalhanna) ls. was treated as a distinct fm., and in other repts it was included in either Greenbrier ls. or Pocono ss. It is now treated by U. S. Geol. Survey as a distinct fm. in Pa. and as a memb. of Greenbrier ls. in western Md. and northern Va. and W. Va., where the Greenbrier replaces lower part of Mauch Chunk sh. It is considered to be of post-Ste. Genevieve age.

Named for exposures on Greenbrier River, Pocahontas Co., W. Va.

†Greenbrier shales.

Mississippian: West Virginia.

W. B. Rogers, 1879 (Macfarlane's Geol. Ry. Guide, p. 179). *Greenbriar shales* of Va. and W. Va. underlie Great cgl. and cgl. coal group (XII of Pa.) and overlie Greenbriar ls. Are = Rogers' Umbral shales of Pa.

Same as Mauch Chunk sh., the name now in common use.

Greenbush cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a portion of upper part of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated.

Greencastle bed.

Middle Ordovician: Central southern Pennsylvania (Franklin County).

R. S. Bassler, 1919 (Md. Geol. Surv. Camb. and Ord. vol., pp. 49, 133, 120, 140–147, 152, 153, 154). *Greencastle bed.*—Heavy impure ls., 0 to 200 ft. thick, forming top memb. of Chambersburg ls. Not developed in Md. Deposited in trough extending from near Mason-Dixon line through Greencastle, Pa. Not known elsewhere in No. Am. Occurs btw. Black River and Trenton time of N. Y. [On p. 154 he says it is late Black River or early Trenton.] Lies uncon. on *Christiana* bed.

Green Cove beds.

Eocene: Western Wyoming (Wind River Basin).

H. E. Wood, 2d, 1934 (Am. Mus. Nat. Hist. Bull., vol. 67, art. 5, pp. 245–249). *Green Cove beds.*—Name suggested provisionally for "so-called Bridger" of Wind River Basin, from the section at Green Cove, E. of Hailey, "so-called Bridger" being an unwieldy term. Sinclair and Granger (1911) described this Bridger (?) as consisting of 375 ft. of ss., sh., and tuff lying btw. the red banded clays of the Wind River [below] and the Uinta [?] shales [above], and as conformable, so far as known, with the Wind River and as possibly uncon. (erosional) with Uinta [?]. Writer found distinct uncon. at base of the beds, where they rest on red-banded Lost Cabin beds. Berry (1925 and 1930) has reported the flora from the beds as approx. = Green River. The beds are probably = some part of the Bridger or Lower Uinta. [The so-called "Lower Uinta" of Uinta Basin, Utah, is = upper part of Bridger fm. of Bridger Basin, Wyo., and is included in Bridger fm. by U. S. Geol. Survey.]

†Green Crinoidal limestone.

A descriptive term applied in early Pa., W. Va., Ohio, and Md. repts to Ames ls. member of Conemaugh fm.

Greendale limestone. (In Cynthiana formation.)

Middle Ordovician (Trenton): Central northern Kentucky.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 19, 211). *Greendale bed.*—Name suggested by J. M. Nickles for argill. lss. interbedded with calc. clays and clay shales, constituting lower part of Cynthiana fm. Overlies Perryville (top div. of Lexington fm.) and underlies Point Pleasant div. (named by Orton) of Cynthiana fm., which is characterized by distinctly less argill. material and by presence in some localities of 80 percent of calcium carbonate and 12 percent of mag. carbonate, with very little silica or alumina, but along Ohio River the siliceous material in lss. at top of Cynthiana fm. is increased to 10 to 20 percent. Thickness of Cynthiana fm. 40 to 90 ft. [Thickness of subdivisions not stated. See also under *Nicholas ls.*]

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. vol. 14, pp. 289–324), divided Cynthiana fm. into (descending) Nicholas ls., *Greendale,* and Perryville, and repeated this classification in 1910 (Denison, vol. 16). In 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, pp. 109–145) Foerste introduced *Millersburg ls. memb. or Orthorhynchula phase of Cynthiana fm.* and stated that it had been included in *Greendale div.* of Cynthiana fm. in former papers; also that "the Greendale memb. as developed near Lexington is regarded as approx. equiv. of the much more richly fossiliferous Millersburg ls. further eastward."

A. M. Miller, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 651–657) and 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 2), divided Cynthiana fm. into Point Pleasant ls. above and Greendale ls. below (the Perryville being excluded from Cynthiana).

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 1) and 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51), and A. F. Foerste, 1924 (Canada Dept. Mines Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided Cynthiana fm. into (descending) Rogers Gap, Gratz, Bromley, and Greendale.

Probably named for Greendale, Fayette Co.

Greene formation. (Of Dunkard group.)

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K, pp. 35–44). *Greene County group.*—Includes all the rocks of the Upper Barren Series above Upper Washington ls. Thickness 800± ft. Satisfactorily exposed only in Greene Co., although it has a considerable thickness in Washington Co. Typical section is in Centre Twp, Greene Co., Pa. [The foregoing definition conforms to present usage.]

Top fm. of Dunkard group. The present Pa. Geol. Survey classifies the Dunkard as a *series* and the Greene as a *group*. The U. S. Geol. Survey classifies the Dunkard as a *group* and the Greene and Washington as *fms.*

Named for exposures on high lands of central and SW. parts of Greene Co., Pa.

†Greene County group.

Permian and Pennsylvanian: Western Pennsylvania.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 503–507). *Upper or Greene County group.*—Includes Pittsburg coal at base and a considerable thickness of strata above Waynesburg coal. Thickness 800 to 900 ft. [As thus used the name covers all of Monongahela fm. and part at least of overlying Dunkard group. The term "Greene County group" has also been used in a restricted sense, or for the beds now known as *Greene fm.*]

Greenfield dolomite.

Silurian (Cayugan): Western Ohio and Vanceburg, Kentucky.

E. Orton, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, p. 307 and fig. 1, opp. p. 310). *Greenfield stone.*—The Helderberg ls. of Highland Co. [SW. Ohio]. Thickness 15–100 ft. Overlain by Dev. black sl. and underlain by Hillsboro ss., top fm. of Niagara group.

E. Orton, 1874 (Ohio Geol. Surv. vol. 2, pt. 1). *Greenfield stone.*—In all SW. Ohio the Helderberg ls. or Waterlime group can be perfectly distinguished by local name *Greenfield stone,* derived from its most extensive and valuable exposures, which occur at Greenfield, Highland Co. Consists chiefly of even, thin-bedded light-brown mag. ls. scarcely to be distinguished in chemical composition from the heavy beds of Niagara ls. beneath, but it has peculiarities of color and bedding that serve to distinguish it from all other lss. associated with it. It disappears at Latham, Pike Co., and is not seen again till a few mi. below Buffalo, N. Y.

A. W. Grabau, 1898 (Sci., n. s., vol. 8, p. 800). I propose to call the so-called "bullhead" ls. of vicinity of Buffalo, N. Y., the *Greenfield ls.* from town in [SW.] Ohio near which this bed both attains strong development and afforded the first fossils described from it.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, btw. pp. 519 and 546). Grabau's name *Greenfield ls.* (1898) is certainly appropriate for "Lower Helderberg or Waterlime fm." in central and southern Ohio in case further study shows that Monroe fm. is not suitable for the Waterlime in this part of State.

A. W. Grabau, 1906 (N. Y. State Mus. Bull. 92, pp. 120–124), used *Cobleskill (Bullhead) ls.* for western N. Y. and stated: The name *Greenfield ls.* has been used by the author for this western type of the Cobleskill, from Greenfield, Ohio, where it is well developed.

According to A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau (Sci., n. s., vol. 27, p. 409, 1908) the *Greenfield fm.* extends into western N. Y. and is represented by Cobleskill ls. of eastern N. Y. They also call it (Geol. Soc. Am. Bull., vol. 19, 1909) the zone of *Schuchertella hydraulica*, give its thickness as 100+ ft., and treat it as basal fm. of "Lower Monroe or Bass Islands series" of Mich. and northern Ohio.

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, pp. 540–553). *Greenfield dol.* so far known only from O., where it is exposed at Greenfield [Highland Co.] and Ballville [Sandusky Co.].

A. W. Grabau, 1909 (Mich. Geol. and Biol. Surv. Pub. 2, geol. ser. 1, pp. 215–223). *Greenfield fauna* was formerly identified by writer with Bullhead or Akron fauna of western N. Y., but critical comparison shows agreement in few points only. May be called *Schuchertella hydraulica* fauna.

W. H. Sherzer and A. W. Grabau, 1910 (Mich. Geol. Surv. Pub. 2, geol. ser. 1, p. 31). At Greenfield, O., the *Greenfield dol.* discon. underlies upper Devonic Ohio sh. and discon. overlies Hillsboro ss.

J. E. Carman, 1927 (Jour. Geol., vol. 35, btw. pp. 481 and 506). *Greenfield dol.*, 75 to 100 ft. thick. Is known near Carey, Findley, and Tiffin, also in western Allen, SW. Putnam, and Van Wert Counties. No outcrop is known showing relations to Tymochtee shaly dol., but Tymochtee lies stratigraphically above Greenfield. Is basal memb. of Bass Island fm. (Lower Monroe).

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, p. 192). The only exposure of Greenfield dol. known in Ky. is along bank of Ohio River at Vanceburg [Lewis Co.].

R. J. B. Newcombe, 1933 (Mich. Dept. Cons., Geol. Surv. Div., Pub. 38, geol. ser. 32, p. 39), and W. Stout, 1933 (Shore and Beach, vol. 1, No. 3, p. 76) included this dol. in their Bass Island group.

Greenfield bed.

Upper Triassic: Central Massachusetts (Franklin County).

B. K. Emerson, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 65–72). *Greenfield bed.*—For a thickness of 30 to 70 ft. and for a distance of several mi. in vicinity of Greenfield [Franklin Co., Mass.] the basal portion of the trap sheet is a mixture of sand, fragments of various sss. and of various kinds of diabase, some with glass base, some with hyalopilitic base, and some resembling andesites, all unlike the monotonous Triassic diabase, and abundant fragments of glass, all cemented by glass, and variously shattered and recemented, and the interstices filled by a water-deposited mixture of albite, diopside, calcite, aegirine-augite, and hematite. The main mass of the trap sheet is normal and continuous above this confused mass, and in many places the basal portion of the sheet can be seen to be a continuous mass of trap beneath the breccia, so that the latter must have been formed in the midst of the sheet itself.

†Greenfield limestone.

Upper Cambrian: Eastern New York (Saratoga County).

Replaced by *Hoyt ls.*, as explained under *Little Falls dol.* The name was introduced, but not fully defined, by J. M. Clarke in 1903 (N. Y. State Mus. Hdb. 19, pp. 9, 12, and table 2). In tables he showed *Greenfield ls.* as underlying Little Falls dol. and overlying Potsdam ss. in east central N. Y. On p. 12 he stated that in Saratoga Co. the shore deposits of Potsdam ss. are overlain by heavy beds of ls. (*Greenfield ls.*). He probably named the fm. for Greenfield, Saratoga Co.

†Greenfield dolomite. (In Whitehorse sandstone.)

Permian: Southwestern Oklahoma (Blaine and Custer Counties).

C. D. Stephenson, 1925 (A. A. P. G. Bull., vol. 9, No. 3, pp. 626–631). *Greenfield ls.*—For many years the ls. capping the hills immediately W. of Greenfield in Ts. 14–15 N., Rs. 11–12 W., has been called "Day Creek dol.," but this correlation is incorrect, since Day Creek dol. lies directly above Whitehorse ss., and the ls. at Greenfield lies below Whitehorse ss. as defined by Reeves. It is writer's belief Greenfield ls. is strat. equiv. of Verden ss.

N. Evans, 1928 (A. A. P. G. Bull., vol. 12, No. 7, pp. 705–712). *Greenfield dol.* lies in upper part of Lower Whitehorse ss., 12 to 15 ft. below top of that ss. in Weatherford dist., Custer Co.

R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40HH). Greenfield dol. of Stephenson (1925) lies near bdy btw. Marlow and Rush Springs members of Whitehorse ss. This dol. has also been called "Day Creek dol." [See under *Day Creek dol.*]

G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 49, pp. 85, 101–111, 126, 128). *Greenfield dol.* lies in lower part of Whitehorse ss., 110 to 130 ft. above its base. Caps a rather pronounced escarpment facing North Canadian River. In some places consists of 2 ledges separated by 22 to 25 ft. of ss. The upper ledge, 6 in. thick, consists of light-pink to white, rather fine grained banded dol., very pure except for an appreciable amount of quartz sand. The lower ledge, 16 in. to 3 ft. thick, is even purer than upper ledge, as it contains very little quartz, is fine-grained, very hard, banded in various shades of pink to white. Named for exposures just W. of Greenfield, Blaine Co.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4). *"Greenfield" dol.* (preoccupied) is here replaced by *Relay Creek dolomites* (including Upper Relay Creek dol. and Lower Relay Creek dol., separated by 25 ft. of red ss. and sh.).

Greenhorn limestone. (*Of Colorado group.*)

Upper Cretaceous: Eastern Colorado and Wyoming, southeastern Montana, Nebraska, South Dakota, Kansas, northeastern New Mexico.

G. K. Gilbert, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 564). *Greenhorn ls.*—Ls. beds, 3 to 12 in. thick, separated by somewhat thicker sh. beds. Thickness of fm. 25 to 40 ft. Middle fm. of Benton group in Arkansas Valley region, Colo. Underlies Carlile sh. and overlies Graneros sh. Named for Greenhorn Station, 14 mi. S. of Pueblo, Colo., and for Greenhorn Creek [Pueblo and Walsenburg quads.].

The Niobrara and Benton are not now treated as groups, the broader term *Colorado group*, which includes them both, being considered the more useful group name. Where the Niobrara deposits and Benton deposits are not subdivided, they are called Niobrara ls. and Benton sh., respectively.

Greenian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 66, 279, 308). *Greenian series.*—The Green River shales of early writers. Divided. in Utah and Colo., into Washakie shales. 1,200 ft. thick, uncon. on Godiva [also Goldiva] lss.

Green Lake limestone.

Pre-Cambrian: Ontario.

Name applied by W. E. Logan, 1865 (Canada Geol. Surv. 16th Rept. Prog., p. 20, map), to one of the lss. in Grenville series of Ontario.

Green Lake moraine.

Pleistocene (Wisconsin stage): Southeastern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Forms the drift dam enclosing Green Lake Basin, Green Lake Co., on W.

†Greenleaf sandstone.

Lower Cretaceous (Comanche series): Central southern Kansas.

C. N. Gould, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 170–174). *Greenleaf ss.*—Yellowish-brown ss., usually distinctly stratified but occasionally massive or cross-bedded, 40 to 110 ft. thick. Underlies Kirby clays and overlies Spring Creek clays. Included in Medicine beds.

Named for Greenleaf ranch, on upper Medicine River, 10 or 12 mi. W. of Belvidere, Kiowa Co.

This name was discarded by U. S. Geol. Survey in 1921. The ss. is a bed in Kiowa sh. and was regarded as so local as to have no strat. value. The name, however, was revived by W. H. Twenhofel in 1924 (Kans. Geol. Surv. Bull. 9), as explained in 1924 entry under *Belvidere sh.*

Green Lodge formation.

Upper Cambrian: Eastern Massachusetts (Dedham quadrangle).

E. J. Rhodes and W. H. Graves, Jr., 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 364-372). *Green Lodge fm.*—An area of gray crystalline medium-grained qtzites interbedded with dark-gray fine-grained thin-bedded phyllite, occurring at and near Green Lodge, in an area previously mapped as Dedham granodiorite (which we would place in Dev.). Highly metamorphosed, due to shearing and igneous intrusion. Name suggested by Dr. L. LaForge. We found several impressions that we consider to be brachiopods; one resembles an *Obolella* and another an Upper Camb. *Lingula* of indeterminate sp. [Discuss other evidence bearing on age, and conclude by assigning *Green Lodge fm.* to Upper Camb.] Deeper portions of Green Lodge fm. were probably stoped out by igneous intrusion of Dedham granodiorite, leaving present rocks as a roof pendant in the granodiorite. Subsequent erosion reduced fm. to mere remnant, so total thickness as deposited will remain unknown, and even the remnant is largely obscured by drift.

Green Mountain gneiss.

Pre-Cambrian (?): Southwestern and northwestern Vermont (Green Mountains, which cross the State).

C. B. Adams, 1845 (1st Ann. Rept. Vt. State Geol., pp. 60–61). [*Green Mtn gneiss* is listed as next to oldest fm. in Vt., lying below talcose sl. and above "gneiss proper."]

C. B. Adams, 1846 (2d Ann. Rept. Vt. State Geol.), mentioned "the gneissoid mica sl. or *Green Mtn gneiss.*"

A. D. Hager, 1861 (Rept. Geol. Vt., vol. 2, pl. 18, geol. map of Plymouth, SW. Vt.), mapped *Green Mtn gneiss.*

J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 4, p. 370). The so-called *"Green Mtn series"* has been pronounced on lithological evidence to be pre-Sil. and Huronian.

A. Wing, 1877 (Am. Jour. Sci., 3d, vol. 13, pp. 334–347, 404–419), showed oldest fm. of western Vt. as "gneiss, often called Green Mtn. gneiss."

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, p. 464). The *Green Mtn gneiss* underlies the green schists in Green Mtns. The Green Mtns are not Huronian but are flanked by it on both sides in N. half of Vt. They belong to Montalban series and are nearer the Laurentian than the Huronian. The use by Dr. Hunt in 1871 of *Green Mtn gneiss* for the Huronian is improper and inappropriate.

G. H. Perkins, 1910 (7th Rept. Vt. State Geol., pp. 249–256). *Green Mtn series* (of gneisses, schists, etc.) covers E. part of Burlington quad., Vt. I believe they are made of Camb. and Ord. strata.

G. H. Perkins, 1912 (8th Rept. Vt. State Geol., pp. 21–56). The foundation of Green Mtns is of Algonkian age. Archean may be represented in axis of Green Mtns.

C. H. Richardson et al., 1914 (9th Rept. Vt. State Geol., pp. 305–313), assigned *Green Mtn gneiss* to Algonkian; also in 11th Rept. Vt. State Geol.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., pp. 281-288), assigned *Green Mtn gneiss* to Lower Camb., Upper Camb., and Beekmantown (Lower Ord.).

On 1932 geol. map of U. S. the rocks of Green Mtns, Vt. are mapped as Archean gneiss and Algonkian(?) sedimentary schists.

†Green Mountain beds.

Eocene: Denver Basin region, Colorado.

G. L. Cannon, Jr., 1893 (Colo. Sci. Soc. Proc., vol. 4, p. 253). In earlier descriptions the Arapahoe group was called "Willow Creek beds" and Denver group was called "Green Mtn beds," but to prevent confusion with fms. of similar names in other parts of the country it seemed desirable to use *Arapahoe* and *Denver*. Total thickness of Denver beds is exposed only on SW. slopes of Green Mtn, the upper 900 ft. being nowhere else preserved. [The compiler has been unable to find any previous use of *Green Mtn beds.*]

Green Point series.

Ordovician (lowest): Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 38).

Green Pond conglomerate.

Silurian: Northern New Jersey and southeastern New York.

H. D. Rogers, 1836 (N. J. Geol. Surv., p. 127). *Green-pond-mountain cgl.*—Usually a bright-red ss., rather fine grained, imbedding large water-worn pebbles, most commonly white quartz; sometimes the paste is more argill. Constitutes Long Pond, Raffenberg, and Green Pond Mtns. [In some subsequent repts the cgl. of Green Pond Mtn was wrongly designated as Potsdam ss.]

F. J. H. Merrill, 1887 (N. J. Geol. Surv. Rept. 1886). *Green Pond cgl.* (*Oneida*).—Red cgl., thickly bedded, 600 ft. thick. Lies uncon. on Lower Sil. lss. Occurs at Green Pond, Copperas, Kanouse, and Bearfoot Mtns. Lithologically resembles Oneida cgl. Overlain by 200 ft. of red sh. of Medina age.

N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 367, 369, 383). *Green Pond cgl.*—Buff reddish qtzites underlain by coarse red cgls. Pebbles almost all quartz and of white or pinkish color, in which respect differs from Dev. Skunnemunk cgl. Thickness 60 to 250 ft. Grades into overlying Longwood red shales and overlies Hudson shales [Martinsburg sh.]. Age is approx. same as Shawangunk grit and Oneida cgl. and probably also represents all or a portion of the Medina. [In text he refers to the qtzites as *Green Pond qtzite*. Later repts give thickness of Green Pond cgl. as 1,500 ft.]

In 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1, pp. r144 to r150) E. C. Eckel introduced *Pine Hill qtzite* for the "series of qtzite beds overlying the Green Pond cgl. [restricted] and underlying the Longwood shales." The separation of the qtzite beds from Green Pond cgl. seems not to have found favor, for there is no other record of *Pine Hill qtzite*.

This fm. does not contain fossils, but it occupies strat. position of Shawangunk cgl. to NW., and it is correlated with that fm., which has yielded fossils of Salina age, according to some geologists, but other geologists consider the Shawangunk to be of Clinton and Medina age. The present N. Y. State Survey (W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 333) assigns Shawangunk cgl. of N. Y. all to Clinton time, and regards it "as a continuation of" Green Pond cgl. of N. J.

†Green Pond quartzite.

Name used by N. H. Darton in 1894 and by H. B. Kümmel and S. Weller in 1902 (N. J. Geol. Surv. Ann. Rept. State Geol.) to designate the qtzites forming upper part of Green Pond cgl. In 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1) E. C. Eckel named these qtzites *Pine Hill qtzite*, and separated them from Green Pond cgl. Other geologists, however, continue to include them in Green Pond cgl., and there is no other record of *Pine Hill*. The U. S. Geol. Survey does not apply the same name to a geologic unit and to a part thereof, and it therefore does not use the term "Green Pond qtzite."

†Green Pond Mountain group.

F. J. H. Merrill, 1887 (N. Y. Acad. Sci. Trans., vol. 6, p. 59). *Green Pond Mtn group.*—Extends from northern N. J. through Orange Co., N. Y., to Hudson River and for some distance beyond. Includes (descending) slates of Upper Dev. age in valley SW. of Greenwood Lake; blue slates and grits containing fossils of probably Hamilton age; coarse white ss. and cgl. containing Oriskany and Corniferous fossils; ls. containing Lower Helderberg fossils; red cgl. and ss. of Oneida age. Rests uncon. on Magnesian ls. [Kittatinny ls.].

†Green Pond Mountain formation.

D. S. Martin, 1888 (geol. map of New York City and vicinity). *Green Pond Mtn fm.* (Oneida and Medina) assigned to Sil. Underlies Dev. and overlies Ord. mag. ls.

Green River formation.

Eocene (middle): Southwestern Wyoming, northwestern and central western Colorado, and eastern Utah.

F. V. Hayden, 1869 (U. S. Geol. Surv. Terr. 3d Ann. Rept., pp. 89–92). A little E. of Rock Spring station [Wyo.] a new group commences, composed of thinly laminated chalky shales, which I have called the *Green River shales* because they are best displayed along Green River. They are evidently of purely fresh-water origin and of middle tert. age. The layers are nearly horizontal, and, as shown in valley of Green River [SW. Wyo., NW. Colo., and eastern Utah], present a peculiarly banded appearance. Contains a fauna and very extensive flora. One of marked features of the group is great amount of combustible or petroleum slates. Is overlain by Bridger group, of upper tert. age. [Did not explain relations to his Wasatch group, introduced in same vol., but assigned both to middle Tert. and appeared to consider them as in part at least equiv.]

E. D. Cope, 1874 (U. S. Geol. and Geog. Surv. Terr. 7th Ann. Rept., btw. pp. 435 and 444). Hayden named deposits of western area *Wasatch group* and regarded it as synchronous with Green River group of eastern area. Writer has attained same opinion on paleontological grounds and hence has applied name *Green River* in both areas.

A. C. Peale, 1876 (U. S. Geol. and Geog. Surv. Terr. 8th Ann. Rept., p. 148). Wasatch group and Green River group occupy two distinct basins but are considered synchronous by Dr. Hayden and Prof. Cope.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas), divided the Tert. deposits of NE. Utah and adjacent areas into (descending): Wyoming cgl. (Plio.), Uinta (Eo.), Bridger (Eo.), Green River (Eo.), and Vermilion Creek (Eo.). Advance copies of this map were distributed in 1875.

F. V. Hayden, 1877 (U. S. Geol. and Geog. Surv. Terr. Bull. 3, No. 1, pp. 181–185). *Wasatch group* of Hayden is same as Vermilion Creek group of King, and *Wasatch group* has priority. [On p. 608 of this Bull. C. A. White showed Green River group as overlying Wasatch group and underlying Bridger group.]

C. King, 1878 (U. S. Geol. Expl. 40th Par. vol. 1). *Green River group* consists of calc. shales and sss., of fresh-water origin, characterized by abundant lime. Underlies Bridger group, with slight uncon., and uncon. overlies Vermilion Creek group (=Wahsatch group of Hayden). Reaches thickness of 4,000 ft. Perhaps most characteristic development is in neighborhood of Green River City, where Union Pacific R. R. crosses river [SW. Wyo.].

Later studies in SW. Wyo. and NW. Colo. resulted in showing that Green River and Wasatch fms. are in part contemp., red beds of typical Wasatch lithology being interstratified with beds of typical Green River lithology. In U. S. G. S. Bulls. 341 and 381 two of the 4 members into which the fms. were divided were included in Wasatch fm. and two in Green River fm. Later, A. R. Schultz (U. S. G. S. Bull. 702, 1920) included the 4 members in Green River fm., because his studies showed they were all time equivalents of the Green River. His subdivisions of Green River fm. consisted of (descending): (1) Plant beds and Tower ss. of Powell, 0 to 500 ft.; (2) Laney sh. memb., 0 to 950 ft.; (3) Cathedral Bluffs red beds memb., 0 to 1,500 ft.; and (4) Tipton sh. memb., 100 to 325 ft., the latter resting on unquestioned Wasatch fm. Still later the studies of J. D. Sears and W. H. Bradley proved that the Cathedral Bluffs beds are in fact a tongue of typical Wasatch fm. laterally penetrating beds of typical Green River lithology and overlain by Laney sh. memb., and that the Tipton is in reality a tongue of typical Green River deposits laterally penetrating typical Wasatch red beds, and resting on main body of Wasatch fm. (See U. S. G. S. P. P. 132, 1925.) This is present classification of U. S. Geol. Survey.

Named for exposures in valley of Green River, SW. Wyo., NW. Colo., and eastern Utah. They are especially well developed in neighborhood of Green River City, SW. Wyo., where Union Pacific R. R. crosses river.

Greensburg or Flat Rock stone.

Silurian: Southeastern Indiana (Decatur County).

E. T. Cox, 1879 (Ind. Geol. Surv. 8th, 9th, and 10th Ann. Repts., pp. 57, 88–89). *Greensburg or Flat Rock stone.*—Light grayish-buff close-grained, compact mag. ls., 20 to 130 ft. thick, near top of Niagara. At North Vernon is in contact with Hamilton fm.

Extensively quarried on Flat Rock Creek, near St. Paul, Decatur Co., and by Greensburg Stone Co. near Greensburg, Decatur Co.

Greenstone flow.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. (see index), pls. 17 and 18). *Greenstone group.*—Lustre-mottled melaphyres and coarse-grained gabbros and diabase, 1,200 ft. thick, underlying Ashbed group and overlying a group of diabases, diabase amygdaloids, and lustre-mottled melaphyres, including a number of cgl. beds. Includes Marvine's beds 91 to 108, inclusive, which we may appropriately call the *Greenstone group,* since its great basal bed forms the well known Greenstone Ridge, Keweenaw Co.

Throughout the repts on copper dist. of Mich. this fm. has been called *the Greenstone.* According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, 1911) it is 1,130 ft. thick, underlies †St. Marys epidote, overlies Allouez cgl., and is top fm. of Central Mine group.

Greenville dolomite.

Upper Cambrian: Northeastern Tennessee.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34, and Bull 31, p. 16). [*Greenville dol.* applied in table to 400 ft. of rocks underlying Copper Ridge dol. in Athens trough of Tenn., and assigned to "Lower Ozarkian." It is understood name applies to rocks that are equiv., in whole or in part, to Bibb, Ketona, and Brierfield dolomites of Ala. Type loc. not stated, but understood to be *Greenville,* Greene Co.]

Greenville shale. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia (Monroe County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 449, 466). *Greenville sh.*—Black fissile carbonaceous sh. 0 to 100 ft. thick, with marine fossils. Underlies Alderson ls. and overlies Union ls.; all members of Greenbrier series [ls.]. Type loc. in Monroe Co., in road on N. side of Indian Creek 0.1 mi. NW. of Hunter Spring School and 1.6 mi. SE. of Greenville. Observed in only part of Monroe Co.

Greenwater volcanics.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 79). *Greenwater volcanics.*—Term restricted to the tuffs and basalt flows associated with the borate deposits of Death Valley, and presumably of Early Tertic age. Thickness 4,000 ft. Composes upper fm. of Amargosan series in Nev. Uncon. below Redhill sss. and uncon. above Grapevine cgls.

Derivation of name not stated, but probably derived from exposures at or near Greenwater, E. of Death Valley, in Inyo Co., Calif.

†Greenwich formation.

Pre-Cambrian(?): Southwestern Connecticut (Fairfield County).

J. G. Percival, 1842 (Conn. Geol. Surv. Rept., pp. 46, 49, 58, 63, 72 and map). *Greenwich fm.* (*No. 1 of Western Primary system*).—A dark micaceous subporphyritic and porphyritic fm., generally with more or less hornblende disseminated, occupying considerable part of towns of Stamford and Greenwich [Fairfield Co.] and extending along the Sound from E. side of Stamford Harbour into N. Y. State. Most characteristic rock is a very dark micaceous subhornblendic rock, generally very decomposable. Included in Western Primary system.

Mapped as Danbury granodiorite gneiss by H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7).

Greenwich shale.

Cretaceous(?): Southeastern Colorado (Purgatoire Canyon).

W. T. Lee, 1901 (Jour. Geol., vol. 9, pp. 343–352). [In detailed section of Morrison fm. near mouth of Plum Canyon, Lee designated topmost 11 ft. of the Morrison as *Greenwich clay sh., soft and fine-grained.*]

Greenwich formation.

Lower Cambrian: Eastern New York (Washington and Rensselaer Counties).

T. N. Dale, 1904 (U. S. G. S. Bull. 242, pp. 43, 50, and map forming pl. 1), mapped and described the rocks of Hudson Valley btw. Hoosic River and Kinderhook Creek. The Lower Camb. is said to include part of Stockbridge ls., the *Greenwich sl.* of Washington Co., N. Y., and Rutland Co., Vt., the Vermont fm. of Mass. and Vt., and probably some areas of Beekmantown. The Greenwich sl. is not defined.

C. D. Walcott, 1910 (Smithsonian Misc. Coll., vol. 53, No. 6, p. 268). *Greenwich fm.* (*Lower Camb*).—Shales and interbedded lss. and sss. of unknown thickness, but so far as known not over 300 ft. Present in Washington and Rensselaer Counties.

Named for exposures at Greenwich, Washington Co., N. Y.

Greenwood sandstone.

Pennsylvanian: Western Arkansas coal field and central-eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Greenwood ss.*—Ss., 100 ft. thick, composing top memb. of Sebastian stage. Overlies Tomlinson sh. and underlies Poteau stage.

Represents lower part of Savanna ss.

Probably named for Greenwood, Sebastian Co., Ark.

Greenwood iron-formation.

Pre-Cambrian (upper Huronian): Northern Michigan (Marquette district).

J. Zinn, 1933 (Mich. Acad. Sci., Arts, and Lett., vol. 18, pp. 442, 443, 451–454). *Greenwood fm.*—This sediment is not a pure iron fm., and not of economic importance; but was deposited as an interlayered accumulation of clastic material and chemically deposited chert and siderite. The parts exposed in outcrops now consist of grunerite schist, with interlayered chloritic material or quartz sand. The unmetamorphosed parts are probably a sideritic sl. Thickness varies somewhat; minimum perhaps 50 ft. Where metamorphosed it is magnetic and creates a magnetic line that marks top of Goodrich fm. Where overlain by Clarksburg volcanics the interlayered clastic zones seem to be mostly chloritic material, but where Clarksburg is absent, as at Michigamme, the interlayered material is mostly clastic quartz.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Greenwood iron-fm.* underlies Clarksburg volcanics and overlies Goodrich qtzite, all of upper Huronian age.

†Greer formation.

Permian: Southwestern Oklahoma, Panhandle of Texas, and central northern Texas.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 52). *Greer div.*—Red clays, shales, and sss., including dol. memb. (at top) and several named gyp. members. Thickness 150 to 300 ft. Underlies Quartermaster div. and overlies Woodward div.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324–341). Cloud Chief gyp. is eastern area of "Greer." The western area of "Greer" includes Cloud Chief gyp., Whitehorse ss., Dog Creek sh., and Blaine gyp.

C. N. Gould, 1927 (Obsolete Okla. geologic names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, pp. 235–238). *Greer gyp.* was named by Gould from Greer Co., and divided into an eastern and a western area. The western area is now known to be the Blaine; the eastern area was named *Cloud Chief* in 1924, from a town in Washita Co., Okla.

Named for Greer Co., Okla. The type loc. is said by Gould to be the butte known as Cedar Top, in NW. corner of Kiowa Co., Okla. R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3), and R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2), used this name in Kans. to replace Taloga fm. of Cragin (1897), which Cragin divided into Big Basin ss. and Hackberry sh. But the name is not now being used.

Greggs breccia.

Tertiary (late): Western Arizona.

W. T. Lee, 1908 (U. S. G. S. Bull. 352, p. 17). *Greggs breccia.*—Detrital fm. filling Grand Wash Trough and having exposed thickness of 1,400± ft. Composed of coarse unassorted and poorly stratified material, largely blocks of crystalline rock similar to the granite and gneiss of Virgin Mtns to W. Toward top is cemented with lime carbonate, and in places upper 200 ft. consists of travertine containing few rock fragments. This travertine is best exposed S. of Colorado River and E. of Greggs Ferry [NW. corner of Mohave Co.], where it caps conspicuous cliffs which rise 1,400 ft. or more above river. No fossils. Reference to Tert. based largely on physiographic evidence.

Greggs Landing marl member (of Tuscahoma sand).

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1886 (Ala. Geol. Surv. Bull. 1, p. 12). *Gregg's Landing marl.*—Fossiliferous marine marl, 5 to 6 ft. thick, separated from overlying Bell's Landing marl by 20 to 25 ft. of dark-gray sandy clays. Included in Bell's Landing section.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 46–51). *Gregg's Landing marl.*—Dark-gray or bluish sandy clay marl or clayey sand, 4 or 5 ft. thick, with an indurated bed of variable thickness at its base. Has a peculiar group of fossils. Separated from overlying Bell's Landing marl by 20 to 25 ft. of gray sandy clays. Included in Bell's Landing series, about 60 ft. above base.

Is memb. in lower part of Tuscahoma sand.

Named for exposures at Greggs Landing, on Alabama River, in NW. part of Monroe Co.

†Greggs Landing series.

Eocene (lower): Alabama.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 346), applied this name to deposits that have for years been called *Tuscahoma fm.* or *Tuscahoma sand.*

Gregorian series.

A term applied by C. [R.] Keyes to latest Pleist. deposit (his Ashawa terrane) in Iowa. (See Pan-Am. Geol., vol. 63, No. 4, 1935, p. 281). Derivation of name not stated.

Gregory sand.

A subsurface sand, of Upper Cret. age, in Rainbow City field, Union Co., Ark.

Grenada formation. (In Wilcox group.)

Eocene (lower): Mississippi and western Tennessee and Kentucky.

E. N. Lowe, 1913 (Miss. Geol. Surv. Bull. 10, pp. 23–25). The uppermost div. [of Wilcox fm.] is chocolate-colored clays 200 to 250 ft. thick. Become pink on drying. Are associated with lignite outcrops near Grenada, Oxford, and Hernando. Since the correlation of these beds with upper Wilcox beds of Ala. is by no means certain they might be called *Grenada beds,* from place where whole thickness of the series is typically exposed. Overlie Holly Springs sand and underlie Tallahatta fm., of Claiborne group.

In present usage of names the Wilcox is treated as a group and Grenada fm. as top fm. of that group.

Named for exposures at Grenada, Grenada Co., Miss., especially on Yalobusha River, near Grenada.

Grenola formation.

Pennsylvanian: Southeastern Nebraska, across east-central Kansas, and into Oklahoma.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1). *Grenola fm.*—The Neva ls. and certain beds below it are here described as a fm., to which the name *Grenola* is applied, from Grenola, Elk Co., Kans. Dr. R. C. Moore, Director of Kans. Geol. Surv., concurs in erection of this new fm., but has not advised regarding its name. It represents a calc. marine cycle, lying btw. aren. sh. fms. It is erected on basis of its faunal and lithologic zones, which are widely persistent. It has 3 lines of outcrop in SE. Nebr. and for most of distance across east-central Kans., beyond which it is exposed in a single line of outcrops to beyond Arkansas Valley in Okla. Deep-well records show it is deeply buried and widespread in western Kans. and eastern Colo. It is underlain by Roca sh. and overlain by Eskridge sh. It contains more ls. than sh., and therefore contrasts with underlying Roca and overlying Eskridge. It has distinct persistent faunal zones, which is unlike the Eskridge and Roca fms. It is the same as the Dunlap of Kirk (Univ. Kans. Geol. Surv., vol. 1, p. 81, 1896). It is here divided into following members (descending): Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls., all of which are present in type section, which is the ravines and creeks N. and S. of Highway 160, 4 to 5 mi. W. from Grenola. Combined thickness of the 5 members is 40 ft. or more.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8). *Grenola fm.* divided into (descending) Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls. Overlies Roca sh. fm. and underlies Eskridge sh. fm. The Kans. Geol. Surv. correlates Legion sh. and Sallyards ls. with Roca sh. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 50). *Grenola fm.* underlies Eskridge sh., overlies Roca sh. (top part of Elmdale sh. of old classification), and corresponds to Neva ls. of old classification. In revised classification it is divided into (descending) Neva ls. [restricted], Salem Point sh., and Burr ls. [Moore also transferred these rocks to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Grenville series.

The provincial series of pre-Camb. metamorphosed sed. rocks present in northern N. Y. and Ont., and formerly classified as "Algonkian" by U. S. Geol. Survey, but classified as "early pre-Camb. (pre-Laurentian)" by some writers. For definition see U. S. G. S. Bull. 769, pp. 114–119. Also see under †*Oswegatchie series*, a local name applied to the Grenville rocks of Adirondack region of northern N. Y. (Franklin, St. Lawrence, and Jefferson Counties). The relations of the Grenville rocks of Adirondack region to the rocks of Westchester Co., SE. N. Y., which have been called Grenville are still in question. "Algonkian" and "Archean" having been discarded as time terms, the Grenville series is now classified simply as *pre-Camb.*

†Grenville limestone.

Pre-Cambrian: Quebec and northern New York.

W. E. Logan, 1859 (Canada Geol. Surv. Rept. Prog. 1858, pp. 35–40), 1863 (Canada Geol. Surv. 15th Rept. Prog., pp. 43–45), and 1865 (Canada Geol. Surv. 16th Rept. Prog., p. 20, map), applied *Grenville ls.* to one of the lss. of Grenville series. (See U. S. G. S. Bull. 769, 1925, pp. 114–119.)

The U. S. Geol. Survey does not apply the same name to a major unit and to one of its subdivisions.

Grenville quartzite.

Grenville amphibolite.

Pre-Cambrian: Northern New York.

R. Balk, 1932 (N. Y. State Mus. Bull. 290, p. 14). Names applied to parts of Grenville series.

Grenvillian.

A name that has been applied to part of the pre-Camb. rocks of southern New Brunswick. (See U. S. G. S. Bull. 360, 1909, pp. 502–503.)

Greta sand.

A subsurface sand in Greta field, Refugio Co., Tex., which is said to be of middle Olig. age and to overlie Frio fm. Is also called "4,400-foot sand" and "Heterostegina sand," the latter a paleontologic name. Thickness 150 ft. (See A. A. P. G. Bull., vol. 19, No. 4, 1935, pp. 544–557.)

Grey sandstone of Oswego.

A term applied in some early N. Y. repts to *Oswego ss.*

†Grey Band.

See †*Gray Band.*

Greybull sandstone member (of Cloverly formation).

Lower (?) Cretaceous: Central northern Wyoming (Bighorn and Elk Basins) and central southern Montana (Stillwater-Yellowstone-Counties region).

F. F. Hintze, Jr., 1915 (Wyo. Geologist's Office Bull. 10). Upper ss. of Cloverly fm. is locally called *Dakota or Greybull sand.* It closely resembles Dakota ss. Is discon. overlain by "Rusty Beds," 75 to 125 ft. thick, which form basal part of Lower Benton sh. [This may not be first appearance in print of drillers' term *Greybull sand,* but it seems to be the first appearance of the term in a strat. rept.]

C. T. Lupton, 1916 (U. S. G. S. Bull. 621, table opp. p. 166, pp. 167, 168). At type loc. of Cloverly fm., near Cloverly, Wyo., about 15 mi. NE. of Basin, Bighorn Co., Wyo., the Cloverly fm., according to N. H. Darton (U. S. G. S. P. P. 51, p. 52, 1906), consists of 113 ft. of strata, a detailed section of which is here given. Upper 20 ft. (light-buff or tan-colored ss.) constitutes *Greybull sand,* which carries oil and gas in Greybull field and water in Lamb anticline and Torchlight dome. The Greybull sand is overlain by Thermopolis sh.

D. F. Hewett and C. T. Lupton, 1917 (U. S. G. S. Bull. 656, p. 19), defined base of Thermopolis sh. and top of Cloverly fm. as top of Greybull ss. memb. and stated that Thermopolis sh. [of Colorado age] included the "rusty beds" [20 to 100 ft. thick] described by Washburne in U. S. G. S. Bull. 340, p. 350, 1908] as basal memb. of Colorado fm. in Bighorn Basin, Wyo.

In U. S. G. S. P. P. 149, p. 64, 1927, W. T. Lee included in his Greybull ss. memb. of Cloverly fm. the "rusty beds" assigned to Thermopolis sh. by D. F. Hewett and C. T. Lupton in 1917.

Subsequent work in Elk Basin field led committee on geologic names of U. S. Geol. Survey to sanction the transfer of the "rusty beds" to Cloverly fm., as indicated on Wyo. correlation chart compiled by the secretary and dated April 1925. Geologists working in other fields, however, continued to identify Greybull ss. as top memb. of Cloverly fm. and did not discriminate the so-called "rusty beds," but their equivalents, if present, appear to have been included in Thermopolis sh., as the thicknesses of Greybull ss. given range from 0 to 40 ft. In correlation chart (pl. 2) of U. S. G. S. P. P. 149, a thickness of 100± ft. is assigned to Greybull ss. memb. at Greybull, Wyo., and a thickness of 53 to 60 ft. at Thermopolis, Wyo., and Greybull ss. memb. of Greybull section is described (p. 64) as consisting of "many layers of rusty brown ss. and sh. which grade upward into Thermopolis sh." It is quite apparent that the 100± ft. mentioned includes at least a part of the "rusty beds" in Greybull ss. In a previous rept by A. J. Collier (U. S. G. S. Bull. 711D, 1920), the Greybull ss. of Thermopolis region is described as a massive ss. 25 ft. thick, and the "rusty beds" are not mentioned. The present practice of U. S. Geol. Survey is to include the "rusty beds" in Thermopolis sh. and treat Greybull ss. as top memb. of Cloverly fm., in Bighorn Basin, Elk Basin, and other areas in southern Mont. where it has been recognized. (See U. S. G. S. Bull. 822, 1931, pp. 23–28.) Whether this ss. is=Dakota ss. (Upper Cret.) or is an older ss. of Lower Cret. age has not been determined.

Greybull sand.

A subsurface sand believed to be at strat. horizon of *Greybull ss. memb. of Cloverly fm.*

Greyhorse limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and northwestern Missouri.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Greyhorse ls.*—Dark-gray impure ls., 1 ft. thick. Memb. of Pony Creek sh. fm. Overlain by 5 to 6 ft. of gray sandy sh. forming top memb. of Pony Creek fm. Underlain by Caneyville sh. memb. of Pony Creek fm. [Derivation of name not stated.]

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of *Grayhorse ls.* in NW¼ sec. 11, T. 24 N., R. 6 E., Osage Res., Okla. Due to typographical error it is spelled *Greyhorse* in Paper 8. It should read *Grayhorse.*

Greylock schist.

Ordovician: Northwestern Massachusetts.

T. N. Dale, 1891 (Am. Geol., vol. 8, pp. 1–7). *Greylock schists.*—Muscovite (sericite), chlorite, and quartz schist, 1,200 to 2,000 ft. thick on Mount Greylock, Mass., where it overlies Bellows Pipe ls.

†Greylock series.

A term used by W. H. Hobbs, 1892 (Geol. Soc. Am. Bull., vol. 3, p. 460) and 1893 (Jour. Geol., vol. 1, pp. 717–736) to include Greylock schist, Bellowspipe ls., Berkshire schist, and Stockbridge ls. of Mount Greylock region, NW. Mass.

†Greylock limestone.

A name applied in some early repts (R. Pumpelly, U. S. G. S. Mon. 23, 1894) to Stockbridge ls. of Greylock Mtn region, Mass.

Greyson shale.

Pre-Cambrian (Belt series): Western central Montana (Belt Mountains).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Greyson shales.*—Consist of (descending): (1) Dark-gray siliceous and aren. shales, with interbedded bands of buff sandy shales and occasional layers of hard compact greenish-gray and drab siliceous rock; (2) bluish-gray, almost fissile shales; (3) dark coarse siliceous and aren. shales; (4) qtzites interbedded with shales in Deep Creek Canyon, 90 ft.; (5) intraformational cgls., 10 ft. in Deep Creek Canyon. Total thickness 3,000 ft. Underlies Spokane shales and overlies Newland ls. Type loc. on side of ridge btw. Deep and Greyson Creeks, SE. of Townsend.

Gries Ranch horizon.

Tertiary: Western Washington.

W. L. Effinger, 1936 (Geol. Soc. Am. Proc. 1935, p. 411). Recent investigation of "Olig." faunas of western Wash. reveals that fauna commonly referred to as "Gries Ranch fauna," and the deposits with which it is associated, have a widespread distribution throughout western Wash. and represent a distinct strat. and faunal unit in Tert. succession of Northwest. The deposits of this horizon consist of cgls., sss., and shales, with local volcanic tuffs and aggls. and are generally thin, but may reach a thickness exceeding 1,000 ft. Well-preserved Gries Ranch faunas have been recognized in Port Townsend region near town of Woodman and Port Hadlock and on shore of Puget Sound, S. of Oak Bay, and other places [mentioned]. The strat. and faunal relationships of Gries Ranch horizon show it clearly to be older than Lincoln fm. (lower Olig.) and younger than Cowlitz fm. (Eo.).

See also *Greece Ranch horizon.*

Griffin bed.

Miocene (lower): Western Florida and southwestern Georgia.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 52–54). *Griffin bed.*—Hard calc. clay, often deep red or clayey brown, owing to decomposition, full of

Orbitolites and a few other shells. Believe its location to be at top of Chattahoochee bed proper and about 130 ft. above base of Chattahoochee series. Thickness 6 to 8 ft.

Is a bed in Tampa ls. (†Chattahoochee fm.), according to studies of C. W. Cooke.

Named for exposures on Griffin's Creek, 4½ mi. S. of Bainbridge, Decatur Co., Ga., and about ½ mi. W. of Griffin's house.

Grimes sandstone.

Upper Devonian: Western and west-central New York.

D. D. Luther, 1902 (N. Y. State Mus. Bull. 52, pp. 616–629). *Grimes ss.*—Thin sss., 50 ft. thick, that produce the third falls in Grimes Gully, the High falls in Tannery Gully, and prominent escarpment on sides of Hatch Hill and West Hill in Naples section. Separated from overlying High Point ss. by 600 ft. of shales and flags, and correlated with the 25 ft. of ss. that underlies Gardeau flags in Genesee River section. Lies about 600 ft. above Genesee sh. Included in Portage or Nunda group. Carries Portage fauna in base.

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1000–1011). *Grimes ss.*, 25 ft. thick, underlies Gardeau shales and flags (restricted to upper part of Gardeau sh. and flagstones of Hall) and overlies Hatch sh. [On map accompanying this bull. the beds above Grimes ss. are called *West Hill sands*, but in more recent N. Y. repts they are called *West Hill flags and sh.*, also *Gardeau flags and sh.* Luther gives thickness of Grimes in Penn Yan-Hammondsport quads. as 75 ft.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 77). Grimes ss. has been differentiated from not far W. of Genesee Valley to Cayuga Co. Named for occurrence in Grimes Gully, near Naples, Ontario Co.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [Table shows *Grimes ss.* underlying Gardeau sh. in Allegany Co.; underlying Westhill sh. in Steuben Co.; and overlying Hatch sh. in both counties.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Grimes ss.* underlies Gardeau sh. (=West Hill) and overlies Hatch sh. All included in Portage group.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), placed *Grimes ss.* below Gardeau and above Hatch, and included Grimes in Chemung group and Hatch in his Naples group.

In south-central N. Y. (Steuben and adjacent counties) the Grimes ss. underlies West Hill fm. (=Gardeau sh. to E.) and overlies Hatch sh.

Grimsby sandstone.

Silurian (early): Ontario and western New York.

M. Y. Williams, 1914. [In Sci., n. s., vol. 39, pp. 915–918, June, 1914, E. M. Kindle listed the following subdivisions of Medina fm. (restricted to "Upper Medina" or Albion ss.) in Niagara Gorge (descending): Thorold ss., *Grimsby ss.* ("name proposed by M. Y. Williams in paper read [but not published] before Geol. Soc. Am., Jan. 1914"), Cabot Head sh., Manitoulin beds, and Whirlpool ss. The first published definition of the name by Williams is in Canada Geol. Surv. Summ. Rept. for 1913, pp. 179–188, 1914, where he stated that it consists of 6 ft. of gray sh. underlain by thick-bedded mottled red and gray ss. 50 ft. thick in Niagara Gorge. Overlain by Thorold ss. and underlain by Cabot Head sh. Named for good exposures along E. side of gorge at Grimsby, Ont.]

See further explanation under *Cataract fm.*

Grindstaff sandstone member (of Tradewater formation).

Pennsylvanian: Southeastern Illinois (Equality and Shawneetown quadrangles).

C. Butts, 1925 (Ill. Geol. Surv. Bull. 47, p. 44). *Grindstaff ss. memb. of Tradewater fm.*—Coarse gray quartzose and conglomeratic ss., 40 to 60 ft. thick, lying 30 to 40 ft. above Caseyville ss. in Equality and Shawneetown quads, SE. Ill. Prominently displayed in Grindstaff Hollow, NE. corner of sec. 28, T. 10 S., R. 8 E., Equality quad. Extends at least 1½ mi. into Shawneetown quad. Lies 5 ft. below Willis coal (Bell?).

†Grindstone grit.

A name applied in some early repts to Berea ss. of Ohio, and in other repts to basal 20 ft. of Berea ss.

Grindstone Creek member (of Millsap Lake formation).

Pennsylvanian: North-central Texas (Brazos River region).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107). *Grindstone Creek memb.* top memb. of Millsap Lake fm. Used by G. Scott and J. M. Armstrong in ms. on geol. of Parker Co. Overlies Brannon ls. memb. [Type loc. not stated.]

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15, 16, 24). *Grindstone Creek memb.*—Upper memb. of Millsap Lake fm. Was named by G. Scott and J. M. Armstrong in ms. submitted to Tex. Bur. Econ. Geol. in 1933. Includes all strata btw. top of Brannon Bridge ls. (top bed of underlying Lazy Bend memb.) and base of Thurber coal (basal bed of overlying Garner fm.). The lss. of this memb. are here named *Goen ls.* (the younger) and *Santo ls.* (the older), q. v. Type loc. designated by Scott and Armstrong is area W. of Grindstone Creek, in SW. part of Parker Co.

Grinnell argillite.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southeastern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 322). *Grinnell argillite.*—Argillite, dark red, shaly, sometimes aren., ripple-marked, sun-cracked. Thickness 1,000 to 1,800 ft. Type loc. Mount Grinnell (at head of Swift Current Valley), where it is 1,800 ft. thick. Also well exposed on Appekunny and Robertson Mtns. Conformably overlain by Siyeh ls. Overlies Appekunny argillite. It is possible more detailed strat. study may develop fact that Grinnell and Appekunny argillites are really phases of one great fm., and that line of distinction btw. them is one diagonal to stratification.

Griswold conglomerate.
Griswold Gap conglomerate. } (In Pocono formation.)
Griswolds Gap conglomerate.

Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 56, 57). *Griswold cgl.* (also *Griswold Gap cgl.*).—A true cgl., white, very pebbly, solid, and massive; pebbles very white (quartz), somewhat angular and flattish, rather than ovoid, and range from ½ to 2 in. Matrix is rather coarse, brownish gray, and weathers whitish. Near base, just W. of Waymart, in Rix's Gap, is a calc. layer 2 to 3 ft. thick, in which pebbles of red sh., greenish sh., and fish remains are mixed with the ordinary quartz pebbles. Thickness 35 ft. Forms crest of Moosic Mtn. Has two fine sloping outcrops opposite Griswold's Gap, just E. of Forest City, Susquehanna Co.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7). *Griswold Gap cgl.* is bottom memb. of Pocono ss. At Campbell's Ledge, Lackawanna Co., it is 130 ft. thick.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 565–607), called this bed *Griswolds Gap cgl.* and treated it, or its near equiv., as basal memb. of Pocono fm. He stated that it occupies much the same position as *Knapp ss. or cgl.* farther west.

Grizzly formation.

Silurian? (may be Ordovician): Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Grizzly qtzite*, 400 ft. thick. Oldest fm. in Taylor[s]ville region. Tentatively assigned to Sil. (?). Is older than Montgomery ls., of Niagara age.

J. S. Diller, 1892 (Prel. proof-sheet ed. of U. S. G. S. Lassen Peak folio, No. 15). *Grizzly fm.*—Within area represented on map it is composed chiefly of slates, but in Mount Grizzly, near Taylor[s]ville, where the fm. has greatest development, there are, besides slates, both qtzite and ls. The last is of special interest in being Sil., the oldest fossiliferous rock yet discovered in Calif. [The ls. is Montgomery ls., of Niagaran age, which is now treated as a distinct fm., overlying Grizzly fm.]

J. S. Diller, 1908 (U. S. G. S. Bull. 353, on Taylorsville region). *Grizzly fm.*—Gray well-defined but thin-bedded qtzite overlain by lentils of [Montgomery] ls., and interstratified with shaly, often siliceous sl. (argillite) having irregular cleavage. The beds of qtzite range in thickness from 5 to about 20 ft. and run out into sh. in a short distance. The sh. beds are generally thicker than the qtzite, and for most part greenish gray to drab, although sometimes black and more or less flinty, but not much altered. The lighter-colored shales are often sandy and constitute prevailing portion of the fm., although beds of well-marked qtzite are usually present and frequently predominate. The coarser beds of qtzite are near base of fm. and are about 200 ft. thick. Thickness of fm. 400 to 1,000 ft. On E. slope of Grizzly Mtns, near N. end, qtzite prevails immediately beneath a lentil of [Montgomery] ls., but N. of Montgomery Creek shales occupy the corresponding position, and as the section does not continue below the tunnel it does not disclose the coarser beds lying at bottom of Grizzly qtzite horizon. In places is overlain conformably by Montgomery ls. but in most places is uncon. overlain by Taylorsville fm. Rests on ancient metarhyolite.

Since Grizzly fm. underlies Montgomery ls., of Niagaran age, it may be either Sil. or Ord.

Named for exposures on E. and NE. slopes of Grizzly Mtns, Plumas Co.

Grizzly quartzite.

See *Grizzly fm.*

Grizzly Bear formation.

Cretaceous (Upper): Alberta.

S. E. Slipper, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 8). Included in Belly River series.

Grizzly Mountain rhyolite.

Tertiary: Central Colorado (Sawatch Range).

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, p. 477, map). The extrusive material here mapped as *Grizzly Mtn rhyolite* (after the most prominent peak in vicinity) includes the rocks described by Howell (Colo. Geol. Surv. Bull. 17, 1919) as "Grizzly Peak rhyolite" and "Red Mtn rhyolite." All evidence obtained by writers indicates "Red Mtn rhyolite" is merely a part of "Grizzly Peak rhyolite" which has been affected by mineralizing solutions. The name "Grizzly Peak rhyolite" was discarded to avoid confusion with a mtn of that name several mi. to S. The Grizzly Mtn rhyolite is Tert.

†Grizzly Peak andesite.

Pliocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, p. 379 and map). A thick accumulation of lava flows, which for most part are of different petrographic type from underlying basalts, and should be classed as andesites. Though of rather varied character they are grouped together under name *Grizzly Peak andesite*. As mapped they include certain subordinate flows of basalt and intercalations of tuff. There are two rather distinct facies of the andesite; the lower one a medium-textured holocrystalline rock; the upper a dense compact rock, frequently glassy, with a prevailingly porphyritic habit, aggregating 175 to nearly 300 ft. [As mapped the Grizzly Peak andesite rests on rhyolite tuff and is overlain by Siestan fm. As mapped it forms Grizzly Peak, in Berkeley Hills.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). [The *andesite of Grizzly Peak* is included in Moraga fm., according to definition of Moraga, and as mapped.]

Grizzly Peak rhyolite.

Tertiary: Central Colorado (Chaffee and Lake Counties).

J. V. Howell, 1919 (Colo. Geol. Surv. Bull. 17). *Grizzly Peak rhyolite*—Gray fine-grained, easily weathered rock in which are embedded innumerable fragments of gneiss, schist, and other older rocks. Color light gray to brown. Texture that of rhyolite porphyry to pitchstone. In absence of conclusive evidence it seems fairly safe to consider this rhyolite to be of Tert. (Eocene?) age. [Map shows Grizzly Peak, Chaffee Co., in midst of this mass of rhyolite.]

This name has been discarded by J. T. Stark and F. F. Barnes, as explained under *Grizzly Mtn rhyolite.*

Groat sandstone bed. (In Pierre shale.)

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Groat ss. bed.*—Ferruginous and glauconitic ss. and siltstone, 150 ft. thick in N. part of area. Lies near top of Gammon ferruginous memb. of Pierre sh. Named for exposures along Groat Creek in T. 7 S., R. 56 E., Carter Co., Mont.

Groesbeck dolomite.

Permian: Southwestern Oklahoma and central northern Texas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, p. 357). *Groesbeck dolomites.*—Laminated dolomites overlying Quanah gyp. in Hardeman Co., Tex., and Greer Co., Okla.

Named for Groesbeck Creek, Hardeman Co., Tex.

Gros Cap greenstone.

Pre-Cambrian (Keewatin): Western Ontario (Michipicoten district).

A. P. Coleman and A. B. Willmott, 1902 (Toronto Univ. Studies, geol. ser. No. 2, p. 8; Ont. Bur. Mines Rept. 1902, p. 156). *Gros Cap greenstones,* Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 151), assigned *Gros Cap greenstone* to Keewatin.

Grosse Isle moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (fig. 7) in U. S. G. S. Detroit folio (No. 205), p. 9, also on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Grosse Isle, near Detroit.

Gros Ventre formation.

Middle Cambrian: Northwestern Wyoming and central southern Montana.

E. Blackwelder, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 417). *Gros Ventre fm.*—Greenish and gray calc. shales, with gray, striped conglomeratic and oolitic lss., separating overlying Gallatin ls. (as restricted by Hague and his associates) from underlying Flathead qtzite. Contains Middle Camb. fossils. [Gives typical detailed section (which foots 796 ft.) on W. slope of Doubletop Peak, in Gros Ventre Range, where overlying Gallatin ls. and underlying Flathead qtzite are both present.]

Groton granite.

Devonian: Northeastern Vermont (Caledonia County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Quarried in SW. part of Groton Twp, Caledonia Co.

Grove limestone.

Lower Ordovician (Beekmantown): Western Maryland (Frederick County).

G. W. Stose and A. I. Jonas, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 564–565). *Grove ls.*—The main quarry rock at Le Gore quarry [Frederick Co.]. Formerly erroneously called *Beekmantown ls.* Rests conformably on Frederick ls. Is probably of Chazy or later age. [Derivation of name not stated in this publication, but authors stated orally that this ls. was named for Grove quarry and Grove Station, on B. & O. R. R., where it is well exposed in syncline above Frederick ls.]

G. W. Stose and A. I. Jonas collected additional fossils from this fm. which proved its lower Beekmantown age.

†Groveland formation.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Crystal Falls and Felch Mountain districts).

H. L. Smyth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 114–121, 137–139). *Groveland fm.*—Ferruginous rocks (qtzites, cherts, and subordinate schists) well exposed in central part of sec. 31, T. 42 N., R. 29 W., in vicinity of abandoned Groveland mine, in Felch Mtn dist. The magnetite is always an abundant constituent of fm. The rocks have a general family likeness, which makes it very easy in field to distinguish them from all other members of the Algonkian. There are two varieties. The usual one consists of quartz and the anhydrous oxides of iron, and is generally siliceous, heavy and dark colored; the other, and rarer, is made up essentially of an iron amphibole, quite similar to the grünerite of Marquette range, with quartz and iron oxides as associates. Thickness 500± ft. Immediately overlies Mansfield fm. and is uncon. overlain by Upper Huronian mica schists and qtzites. [On p. 16 of rept above cited, C. R. Van Hise correlated Groveland fm. of Crystal Falls dist. with Negaunee fm.]

According to C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 304–305 and chart opp. p. 598), the typical Groveland fm. of Felch Mtn dist. is Vulcan fm., the Negaunee fm. is absent there, and "name Groveland is discarded."

Guadalupe group.

Permian: Western Texas.

G. H. Girty, 1902 (Am. Jour. Sci., 4th, vol. 14, pp. 363–368). Not only are these faunas very different from any known in America elsewhere, but they give evidence of being later in geologic time. For this reason I propose to give them a regional name, which shall be employed in a force similar to *Mississippian* and *Pennsylvanian*. For this none more appropriate than one derived from locality where they were first discovered can be found, and term *Guadalupian* is suggested. The strat. limits of *Guadalupian period* will have to be determined on intrinsic evidence. At present it seems to include the whole section at S. end of Guadalupe Mtns, but the central fauna will be that of the "white" and "dark Permian" as described by Shumard. [The faunas to which name was applied were obtained from 1,700 to 1,800 ft. of ls. (afterwards named *Capitan ls.*), underlain by 2,000 to 2,500 ft. of yellow quartzose ss., underlain by 500 or more ft. of thin-bedded black ls., the ss. and basal ls. being afterward named *Delaware Mtn fm.* The basal ls. (now known as *Bone Spring ls.*) is, because of faunal and lithologic differences, now excluded from Delaware Mtn fm., with which it is uncon., and therefore may not properly be a part of Guadalupe group, although included in original definition. At time "Guadalupian" was introduced the Bone Spring ls. had yielded only a few fossils.]

G. H. Girty, 1908 (U. S. G. S. P. P. 58, pp. 10–11). *Guadalupian series.*—Includes Capitan ls. and Delaware Mtn fm. Appears to be younger than Hueco fm. Overlying fm. undet., being absent in Guadalupe Mtns.

Adopted as group term to include, originally, Capitan ls. and Delaware Mtn fm., which are characterized by unique fauna of Perm. age. Now known to uncon. underlie Castile gyp. (also of Perm. age), and considered to be in part younger and in part contemp. with beds that have been described as Hueco ls. The Delaware Mtn fm. of Delaware Mtns is now known to include in its upper part the time equiv. of Capitan ls. of Guadalupe Mtns. (See repts by P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–793), and W. B. Lang, 1935 (A. A. P. G. Bull., vol. 19, No. 2) and 1937 (A. A. P. G. Bull., vol. 21, No. 7).)

Named for Guadalupe Point, S. end of Guadalupe Mtns, El Paso Co.

Guallava sandstone.

Oligocene: Costa Rica.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 342).

Guanajuato conglomerate.

Tertiary: Mexico.

C. W. Botsford, 1909 (Eng. and Min. Jour., vol. 87, p. 691).
A. Wandke and J. Martinez, 1928 (Econ. Geol., vol. 23, p. 9).

Guanica coral reefs.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 17).

Guantanamo shale.

Oligocene or Miocene: Cuba.

N. H. Darton, 1926 (Wash. Acad. Sci. Jour., vol. 16 p. 327).

Guaracara limestone.

Miocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol. No. 7, p. 56).

Guardarraya intrusion.

Age (?): Mexico.

J. E. Spurr and G. H. Garrey, 1908 (Econ. Geol., vol. 3, p. 694).

Guaso limestone.

Eocene: Cuba.

N. H. Darton, 1926 (Wash. Acad. Sci. Jour., vol. 16, p. 327).

Guayabal limestone.

Cretaceous: Puerto Rico.

G. J. Mitchell, 1922 (N. Y. Acad. Sci. Scientific surv. of Porto Rico and Virgin Islands, vol. 1, pt. 3, p. 256).

Guayabal formation.

Eocene: Mexico.

W. S. Cole, 1927 (Bulls. Am. Pal., vol. 14, No. 51, pp. 6, 9).

Guayama series.

Cretaceous: Puerto Rico.

E. T. Hodge, 1920 (N. Y. Acad. Sci. Scientific surv. Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 142).

Guaynabo formation.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci. Scientific surv. Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 275).

Gubik sand.

Pleistocene: Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 233–252). *Goobic sands.*—Surficial deposit of fine-grained brownish Pleist. sand or loam, 10 to 15 ft. thick. Rests uncon. on Colville series. [Derivation of name not stated.]

F. C. Schrader, 1904 (U. S. G. S. P. P. 20, p. 93). *Gubik sand.*—Surficial deposit of brownish sand or loam with some silt; 10 to 15 ft. thick. Supposed to be Pleist. Uncon. overlies Colville series. Named for Eskimo name of Colville River, along which it forms the surficial terrane of the coastal plain.

Guelph dolomite.

Silurian: Ontario.

J. Hall, 1852 (Pal. N. Y., vol. 2, pp. 340, 341). *Galt ls.*—The fossils from Galt, Canada West, are peculiar, being nearly all new species, and, with one or two exceptions, different from those within the limits of N. Y. In 1848 I visited the locality and obtained many other species. From nature of the ls., which appeared to succeed the well-characterized ls. of Niagara Falls, and from similarity of some of the fossils with those of Onondaga salt group of N. Y., I was inclined to refer the fm. to base of latter group. A simple inspection of plates 79–84 will show that these fossils are typical of a distinct period from that of Niagara group; and though the few species yet known from base of Onondaga salt group of N. Y. seem scarcely sufficient to indicate a well-marked period, or to claim positive identity in age with those of the Galt ls., yet we are compelled either to regard them thus, or to rank the latter as a group entirely distinct from any yet recognized. The Galt fossils as a group are not only distinct from those of Niagara period, but equally distinct from those of succeeding geological periods of Lower and Upper Helderberg lss. They do in fact make a nearer approach to those regarded as devonian types than to any group of silurian age; and yet we are able to prove their position to be quite below the ls. holding *Pentamerus galeatus* and numerous other silurian species which characterize the lss. at base of the Helderberg. And whether we regard them as of the age of Onondaga salt group or not, we know that they lie above the strata typified by the numerous fossils already described as belonging to Niagara group, and strictly should form no part of that group. It is true, nevertheless, that in many places to W. of Cabot Head the Niagara group is very similar in lithological character to Onondaga salt group, though less argill., and never friable, as some beds of latter are. [In a footnote on p. 341 of vol. cited above appears the following quotation from letter by Mr. [A.] Murray to Mr. [Wm.] Logan, the Geologist of Canada, dated Dec. 24, 1850: "With regard to the age of the group of rocks which appear at Galt, and which Mr. Hall proposes to class as a part of the Gypsiferous [†Onondaga salt group] instead of the Niagara fm., this season's examination has tended to show that his suggestion is founded upon correct data." Other portions of Murray's letter were published by Hall in Pal. N. Y., vol. 3, 1859.]

J. D. Dana, 1857 (Canadian Nat. and Geol., vol. 1, p. 411), included *Galt ls.* in Onondaga period, but placed it beneath Onondaga salt group.

W. E. Logan, 1863 (Canada Geol. Surv. Repts. Prog. 1843–63, pp. 336–344). *Guelph fm.*—In Canada the Niagara rocks are succeeded by a series of strata which appear to be wanting in N. Y. They are largely developed in neighborhood of Guelph and Galt, and we have designated the series as *Guelph fm.* It consists of very fossiliferous light-colored dolomites (drab, reddish, buff, light-gray and whitish), often very porous, has small drusy cavities, and frequently is made up of brilliant crystalline strongly coherent grains. Approx. thickness 160 ft. Overlies brown bituminous strata and black, hard, compact bituminous dol. Underlies Onondaga salt group. The Guelph fm. appears to be absent from N. Y., and in Canada it probably has the form of a great lenticular mass, the limit of which btw. Niagara and Guelph is uncertain, though it appears to extend beyond Ancaster.

E. J. Chapman, 1863 (Canadian Jour., n. s., vol. 45, pp. 215–216). Many fossils of *Guelph fm.* are identical with those of Niagara beds, but others appear to be confined to this fm. At present Guelph fm. can only be regarded as a provisional group, its strata appearing more or less to merge into underlying Niagara beds, and in some localities, also, to offer a passage into Onondaga deposits.

J. D. Dana, 1864 (Manual of geol.), used *Salina period* to replace his Onondaga period, and included in his Salina period, but below his Onondaga salt group, the *Guelph epoch, or that of the Guelph and Galt lss.*

J. Hall, 1865 (Am. Jour. Sci., 2d, vol. 39, pp. 353–355), included *Galt or Guelph ls. of Canada* in Niagara group, stating that as it includes an entirely different set of fossils from Niagara ls. he very naturally inferred it belonged to next higher fm., *Onondaga salt group.* [In 1867 (N. Y. State Mus. Nat. Hist. 20th Ann. Rept., pp. 305–308) Hall still considered the ls. at Galt to be "clearly above the great Niagara ls. of the falls," but he included it in his Niagara group.]

A. L. Arey, 1892 (Rochester Acad. Sci. Proc., vol. 2, pp. 104–107), announced "discovery of the strata of the Guelph fm. in Rochester, N. Y.," where it consists of 4 ft. of dark-gray mag. ls. overlying typical Niagara ls.

H. Ries, 1899 (N. Y. State Geol. 17th Ann. Rept.). The upper memb. of this fm. [Niagara ls., now called Lockport dol.] is known as *Guelph ls.,* but it is not coextensive with lower memb. It forms a lenticular bed about 20 mi. long and extends from Rochester westward.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878), included *Guelph dol.* in Niagaran but excluded it from Lockport dol., as did J. M. Clarke 1900 and 1902; A. W. Grabau 1901, 1902, 1906, 1908, 1909; E. O. Ulrich and C. Schuchert 1902; C. Schuchert 1903; J. M. Clarke 1903; C. A. Hartnagel 1903, 1905, 1908, 1912; and G. H. Chadwick 1908.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, pp. 433–434), referring to fauna collected by Prof. Arey at Rochester, stated: It is thus clear the fauna is not simply a local expression of a late stage of Lockport dol. fauna, but represents the true *Guelph fauna* of Ont. In 1903 (N. Y. State Mus. Bull. 69, p. 865) Clarke recognized two invasions of *Guelph fauna* in N. Y., the first of which entered from the W., penetrated as far E. as Orleans Co., and then retreated; the second invasion reached as far E. as vicinity of Rochester, and was separated from first invasion by an interval during which 30 to 40 ft. of Niagaran dolomites was deposited. In 1903 (N. Y. State Mus. Mem. 5, pp. 9–13) J. M. Clarke and R. Ruedemann named the rocks containing these two invasions of Guelph fauna the *Upper Shelby dol.* and *Lower Shelby dol.,* which they appear to have included in Lockport dol., although Clarke the same year (N. Y. State Mus. Hdb. 19) excluded Guelph from Lockport and included his Upper Shelby and Lower Shelby dolomites in the Guelph. (See under *Shelby dol.*) Several geologists had expressed uncertainty as to whether the Guelph was present at Niagara Falls, but in 1906 (N. Y. State Mus. 58th Ann. Rept., 1904, vol. 1, p. 18) J. M. Clarke stated that Guelph fauna had been found in upper layers of the dolomites lying above crest of the falls and forming the reefs of the upper rapids.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114), included in Lockport dol. of Rochester and Ontario Beach quads. the beds containing the Guelph faunas. (See his section under *Shelby dol.*) He stated: "The Guelph fauna is an alien fauna from the west, which temporarily displaced the Lockport fauna." In 1908, however, Hartnagel and D. H. Newland (N. Y. State Mus. Bull. 123) excluded Guelph dol. from Lockport dol. but included it in Niagaran.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28), included Guelph in upper part of Lockport dol., while C. A. Hartnagel in 1912 (N. Y. State Mus. Hdb. 19), as in former years, excluded Guelph from Lockport dol. In U. S. G. S. Niagara folio, No. 190, 1913, the Lockport dol. includes any Guelph element that may be present there.

M. Y. Williams and W. A. Parks, 1913 (Canada Geol. Surv. Guidebook 4), excluded *Guelph fm.* from Niagara, as did Williams in 1914 (Canada Geol. Surv. Summ. Rept. 1913, pp. 179–188).

C. Schuchert, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 308), stated that in highest beds of Lockport dol. in Niagara Gorge are the precursors of Guelph fauna.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4), included Guelph in the Lockport.

M. Y. Williams, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 148–149), excluded Guelph from Lockport and called top memb. of Lockport the *Eramosa beds*, on which he stated the Guelph rests conformably. In 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser.) Williams defined Guelph fm. as intermediate btw. Niagara group below and Cayugan group above, and defined top of Lockport dol. (and Niagara group) as consisting of *Eramosa* beds.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, p. 456), stated he believed the Guelph faunas, which began to invade in Lockport time, continued to live on in a sea of gradually increasing salinity, long after Lockport time and conditions had passed.

E. O. Ulrich and R. S. Bassler, 1923 (Md. Geol. Surv. Sil. vol.), included Guelph in Lockport (as did C. Schuchert in 1924 ed. of his Textbook of geol., p. 264). On pp. 259–260 of Md. Geol. Surv. Sil. vol. Ulrich and Bassler called attention to "well-established presence of the Guelph fauna in Orleans Co., N. Y., within 12 miles of Lockport, hence well within the area that may justly be regarded as containing the typical expression of the *Lockport dol.* The Guelph fauna has also been found to the east, at Rochester, where most of the fossils described as belonging to this fauna by Clarke and Ruedemann were collected. Its horizon has also been established in the gorge section at Niagara Falls. At all these and other places in N. Y. it occurs in the upper part of the series of dolomitic lss. to which the term Lockport ls. was originally applied. Whatever of stratigraphic significance we may give to the one or more zones containing the Guelph fauna, the fact remains that these zones are included in the Lockport. It is for this reason mainly that we have decided to abandon the term *Chicago group*, and to use instead the older name *Lockport* for the upper of the two *groups* into which the Niagaran series is here divided." [Ulrich and Bassler used their *Lockport group* as a time term, and in Central States included in it all beds from base of Laurel ls. to top of Louisville ls., which they classified as of post-Guelph and pre-Cayuga age.]

The beds to which *Guelph fm.*, *Guelph beds*, *Guelph ls.*, and *Guelph dol.* have been applied have usually been included in Niagara group. In Ontario they have usually been treated as a distinct fm. In N. Y. the beds containing the Guelph fossils are treated by U. S. Geol. Survey as an indivisible portion of upper part of Lockport dol. (See under *Niagara group* and *Lockport dol.*)

Guenette granite aplite.

Pre-Cambrian: Quebec.

F. F. Osborne, 1935 (Quebec Bur. Mines Rept. Minister Mines 1934–35, pt. E, pp. 18, 19, 25, map).

Guernsey formation.

Mississippian: Southeastern Wyoming (Hartville uplift).

W. S. T. Smith and N. H. Darton, 1903 (U. S. G. S. Hartville folio, No. 91). *Guernsey fm.*—Massive gray ls., underlain by ss., with 3 to 20 ft. of conglomeratic qtzite at base. Thickness of fm. 75 to 200 ft. Contains Miss. fossils. Uncon. underlies Hartville fm. and rests uncon. on Algonkian Whalen group and also on intrusive granites of Algonkian (?) age. [Mapped around town of Guernsey.]

†Guertie sand.

See *Gerty sand*, the approved spelling of the geographic name.

†Gueydan formation.

Tertiary (lower Miocene or Oligocene): Southern Texas coastal plain.

T. L. Bailey, March 28, 1924 (Sci., n. s., vol. 59, pp. 299–300). *Gueydan fm.*—Consists of (descending): (1) Brownish-pink latite or andesite tuff; (2) in places a bed of pink and green mottled massive bentonitic clay; (3) yellowish-white trachyte tuff; (4) at base a coarse cgl. 20 ft. thick. Uncon. underlies Oakville ss. and uncon. overlies Frio fm. Named for exposures on Gueydan ranch and survey, in SE. part of McMullen Co., Tex.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645). *Gueydan fm.*—Volcanic tuffs interbedded with fluviatile deposits which have been derived mainly from these tuffs. Occupies strat. position btw. Frio clay (redefined by writer) and Oakville ss. Divided into 3 members, named (descending) Chusa memb., Soledad memb., and Fant memb.

Same as Catahoula tuff; Catahoula has priority, and "Gueydan" has been discarded.

Gueydan group.

Oligocene and Miocene(?): Southern Texas coastal plain.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 700–727). Miss Ellisor has identified about 80 typical Vicksburg species of Foraminifera from lower Olig. subsurface strata of Tex. The Olig. beds above this Vicksburg zone carry faunas of younger age and constitute a major part of Olig. section in Tex. The name *Vicksburg group* is therefore likely to be misleading. *Gueydan group* is proposed to designate all strata btw. Fayette fm. (Eo.) and Oakville fm. (Mio.). Gueydan of Bailey (applied to the clays and tuffs of SW. Tex. now referred to Catahoula) has been dropped in favor of older name, and *Gueydan* is therefore available and appropriate to apply to all strata btw. Fayette below and Oakville above. In East Tex. the group comprises only Catahoula fm. In SW. Tex. it is divided into Frio fm. below and Catahoula fm. above. In subsurface sections in deep wells along the coast it is divided into (descending): Catahoula (lower Mio. or upper Olig.); unnamed subsurface strata of middle Olig. age (*Discorbis* zone, *Heterostegina* zone, and *Marginulina* zone); Frio (middle or lower Olig.); and subsurface Vicksburg strata (lower Olig.). The subsurface middle Olig. strata may be the down-dip extension of lower and middle part of Catahoula fm. in outcrop.

Guilford slate.

Silurian (?): Southeastern Vermont.

C. H. Hitchcock, 1912 (Vt. State Geol. 8th Ann. Rept., p. 127). Sl. known as *Guilford sl.* in early days was later known as *Leyden phyllite*.

Guilmette formation.

Middle Devonian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Guilmette fm.*—Chiefly dol. but contains a number of thick ls. beds and several lenticular brownish sss. The most characteristic dol. is a fine-grained rock, dark to medium gray on fresh fracture, weathering lighter shades of gray and containing numerous vugs almost completely filled with white coarsely crystalline dol. Also contains striking dark dolomites filled with fragments of tubular corals. Thickness 890 to 1,200 ft. Is uncon. overlain by Madison ls. (early Miss.), and uncon. overlies Simonson dol. Named for exposures in Guilmette Gulch, Gold Hill region.

See also U. S. G. S. P. P. 177, 1934.

Güines limestone.

Oligocene or Miocene: Cuba.

R. H. Palmer, 1934 (Jour. Geol., vol. 42, No. 2, p. 134).

Gulf series (or epoch).

The provincial series of Upper Cret. sediments of Southwestern States and the time covered by their deposition. For definition see U. S. G. S. Bull. 769, p. 59.

†Gulf group.

Tertiary: Gulf Coastal Plain.

See under †*Atlantic group.*

†Gullette Bluff beds. (In Wilcox group.)

Eocene (lower): Southwestern Alabama.

J. E. Brantly, 1920 (Ala. Geol. Surv. Bull. 22, pp. 148–150). *Gullette Bluff beds,* a name applied to all of Nanafalia fm. above unfossiliferous "Coal Bluff beds." Thickness 60 to 175 ft.; at Gullette Bluff 168 ft. Lower 50 ft. characterized by *Gryphaea thirsae.* The top bed of underlying "Coal Bluff beds" consists of 20 ft. of white to yellow cross-bedded massive sands with blue clay lenses. On this the Gullette Bluff beds rest.

Named for exposures at Gullette Bluff, Wilcox Co.

Gunflint iron-formation.

Pre-Cambrian (middle Huronian): Northeastern Minnesota (Gunflint Lake region and Vermilion district).

C. R. Van Hise and J. M. Clements, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Gunflint fm.*—Iron-bearing; carbonated slates, ferruginous slates, and jaspilites. To SW. changes to coarse amphibolitic and magnetitic quartz rock and a banded rock containing pyroxene and chrysolite. Basal fm. of upper Huronian (Animikie series), of Algonkian system. Underlies upper Huronian sl. [Rove sl.] and lies uncon. above Knife slates.

J. M. Clements, 1903 (U. S. G. S. Mon. 45, pp. 374–387, etc.). *Gunflint fm.*—An iron-bearing fm., consisting of bands of ferruginous carbonates, quartz, magnetitic quartz, magnetitic ore, and augite, hypersthene, hornblende, olivine, grünerite, and magnetite rocks, all apparently representing altered forms of some original ferruginous rocks. Thickness probably 800 to 1,000 ft. Overlain by Rove sl. Rests on rocks of different character and of varying age, from Ely greenstone to W. to Ogishke cgl. and Knife Lake slates still farther W. Occurs at base of Upper Huronian (Animikie) of Algonkian system. Well developed on N. shore of Gunflint Lake.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360) and 1911 (U. S. G. S. Mon. 52), assigned this fm. to upper Huronian, of Algonkian system.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), changed name to *Gunflint iron-fm.,* assigned the fm. to middle Huronian, and stated that it is of Algonkian type.

†Gunnison formation.

Upper Jurassic: Central western Colorado.

G. H. Eldridge, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *Gunnison fm.*—Qtzites and shales with a little ls.; at base heavy white qtzite 50 to 100 ft. thick, usually in a single bed; above it, in some cases succeeded by other ss. layers, is a blue fossiliferous ls.; remainder of fm. consists of gray, drab, pink, and purple clays and marls, through which run thin intermittent beds of drab ls. Thickness 300 to 450 ft. Assignment to late Juratrias is based upon its strat. and lithologic correspondence with Atlantosaurus beds on E. flanks of Rocky Mtns and upon similarity of its molluscan fauna to that of those beds, although in this more western region no vertebrate remains have yet been discovered in it. Rests uncon. on eroded Maroon cgls. or on older fms. Underlies Dakota fm.

C. W. Purington, 1898 (U. S. G. S. 18th Ann. Rept. pt. 3, pp. 758–764). *Gunnison sh.*—Upper memb. of Jura; consists of 700 ft. of gray shattered siliceous shales with interbedded layers of friable light-colored ss. Overlies La Plata ss. and underlies Dakota ss. in Telluride quad.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). Lower memb. of Gunnison fm. is here named *La Plata ss.* and upper memb. is named *McElmo fm.* Latter is same as Gunnison fm. restricted of Purington. Thickness 600–900 ft.

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr. (U. S. G. S. P. P. 183, 1936), the Gunnison fm. of Cross is same as Morrison fm.

Named for exposures in canyon of Gunnison River, Delta and Mesa Counties.

Gunnison River series.

Pre-Cambrian: Colorado.

T. S. Lovering and others, 1935 (geol. map of Colo.). *Gunnison River series.*—Comprises the oldest sed. and igneous rocks exposed in Colo., which are considered to be older than and uncon. separated from Needle Mtns group of SW. Colo. and the qtzite and schist of Coal Creek, Jefferson Co., eastern Colo., and to be much older than Front Range granite group of Colo. Includes Irving greenstone, Dubois greenstone, River Portal mica schist, and Black Canyon schist of SW. Colo.; Idaho Springs fm. of eastern and central Colo.; Swandyke hornblende gneiss of central Colo.; and unnamed gneisses, schists, and greenstones in different parts of State. Named for exposures in Black Canyon of Gunnison River.

Gunn Peak formation.

Carboniferous (?): Central Washington (Snohomish County).

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 7, pp. 34–50). *Gunn Peak fm.*—Metamorphosed qtzites, slates, schists, interbedded volcanic flows, crystalline ls., and conglomeratic qtzite. Thickness 10,000 ft. No fossils, but in composition and general appearance very closely resembles Cache Creek fm. of B. C., which is known from fossils to be Carbf.; therefore provisionally assigned to that period. Named for Gunn Peak region.

Gunpowder granite.

Pre-Cambrian: Northeastern Maryland (Baltimore County).

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 104, 125). *Gunpowder granite.*—Medium-grained potassic granite that contains biotite and muscovite in varying proportions. Intrudes Glenarm series. Is assigned to late pre-Camb. Named for fine outcrops along Gunpowder Falls.

†Gunsight formation. (In Cisco group.)

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Gunsight fm.*—Shales, sandy shales, and thin lss., approx. 100 ft. thick, underlying Breckenridge fm. and overlying Bunger fm. Top memb. is *Gunsight ls.*, which forms a continuous ledge where not obscured by overlying sands and cgls.

Included in Graham fm.

Named for Gunsight, Stephens Co.

Gunsight limestone member (of Graham formation).

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Gunsight ls.* is top memb. of Gunsight fm. [See 1919 entry under †*Gunsight fm.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 126, 127–137, charts, etc.). *Gunsight ls.*—A memb. of Graham fm. (of Cisco group) in Brazos River Valley. Is Campophyllum bed of Drake. Varies somewhat in different counties, but usually consists of two thin ls. layers separated by 20 to 60 ft. of yellow sh. Overlies South Bend sh. and underlies Wayland sh. [In sections given in this rept the upper ls. is 1 to 20 ft. thick, the lower ls. 1 to 12 ft. thick, and the separating beds 1 to 60 ft. thick.]

Named for Gunsight, Stephens Co.

Gunstock gneiss.

Age (?): Eastern New Hampshire (Winnipesaukee quadrangle, Lake Winnipesaukee region).

L. V. Pirsson and H. S. Washington, 1906 (Am. Jour. Sci., 4th, vol. 22, p. 505). The igneous rocks of Belknap massif are in contact with micaceous gneisses along W. bdy. They constitute a distinct fm. worthy of special study. Since lower valley of Gunstock River is cut in this gneiss we may provisionally, for purposes of reference, term it *Gunstock gneiss*. [Petrographic and chemical descriptions.]

Gunter sandstone member (of Van Buren formation).

Lower Ordovician (Beekmantown): Central Missouri.

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., p. 26). *Gunter ss.*—Fine to coarse-grained ss., in places siliceous, in places qtzitic, 0 to 18 ft. thick; the 3d ss. of Swallow. Uncon. overlies Proctor ls. and underlies Gasconade ls. in Miller Co.

Subsequently the lower 35 to 235 ft. of Gasconade fm. was, for faunal reasons, split off from the Gasconade and named *Van Buren fm.* The Gunter is now included in the Van Buren.

C. L. Dake, 1930 (Mo. Bur. Geol. Mines vol. 23, 2d ser., p. 148). Ulrich has questioned vigorously the propriety of using *Gunter* for the basal sss. of next younger beds [Van Buren] above the Eminence in SE. Mo., on grounds they are not of same age as the Gunter of type section at Hahatonka [Gunter or Hahatonka Springs, Camden Co., Mo.]. Since these beds are basal deposit of an encroaching sea, over an eroded landmass, it is to be presumed they are not everywhere of exactly same age, any more than, for example, the basal beds of the St. Peter. That these sands do, however, mark the base of a single encroachment of the sea, seems to writer to be rather clearly established. This seems to be borne out by nearly continuous tracing in deep wells, in which typical Van Buren residues are recovered from just above a ss. that occupies strat. position of the Gunter. It is believed the usage of *Gunter* for the ss. lying btw. the Eminence (including Proctor) and the Van Buren is quite justified in SE. Mo.

Gurabo formation.

Miocene: Dominican Republic.

C. J. Maury, 1919 (Sci., n. s., vol. 50, p. 591).

Gurnee formation. (In Pottsville formation.)

Pennsylvanian: Central northern Pennsylvania (Tioga County).

G. H. Ashley and S. H. Cathcart, 1932 (Pa. Topog. and Geol. Surv. Bull. 102A, p. 6). *Gurnee fm.*—Ss., black sh., and fire clay, with 3-foot coal bed in upper part. Thickness present 30 to 200 ft. Forms upper part of Pottsville in Tioga Co. Overlies Sharon cgl. Type loc. vicinity of Gurnee [Tioga Co.].

Guthrie dolomite.

Permian: Central northern Texas (King County).

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 26, pl. 1). *Guthrie dol.*—Two beds of white dol., upper of which is 1 to 6 ft. thick and locally fossiliferous. The lower memb. is usually separated from the upper by a sandy gyp. 1 to 5 ft. thick. It grades locally into gyp. This memb. is usually 1 ft. thick, but in some areas attains a thickness of 5 ft. Underlies town of Guthrie, King Co., and outcrops along South Wichita River or Salt River E. of the town. Included in Double Mtn group. Younger than Quanah gyp. and older than McCaulley dol. of Fisher Co.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 9, p. 948). *Guthrie dol.* lies 150 ft. below Childress dol. and 90 ft. above Acme dol., and in midst of Dog Creek sh. interval. The *Acme dol.* can be correlated with reasonable certainty with McCaulley beds of Fisher Co.

G. H. Norton, 1929 (A. A. P. G. Bull., vol. 13, pp. 955–956). Some geologists correlate Guthrie dol. with Aspermont dol.; others believe Guthrie is older than Aspermont.

Guthrie Creek member (of Harrodsburg limestone).

Mississippian: Southern Indiana.

P. B. Stockdale, 1929 (Ind. Acad. Sci. Proc., vol. 38, pp. 233–242). *Guthrie Creek memb. of Lower Harrodsburg ls.*—Calc. sh. to shaly ls., blue gray, weathering light yellow; in places sandy. Top memb. of Lower Harrodsburg. Thickness 2 to 10 ft. Overlies Leesville ls. and underlies the more massive, more regular ls. of the Upper Harrodsburg. Named for exposures along Guthrie Creek, in SE. part of Lawrence Co.

Gutoskey sand.

Eocene (Jackson): Southern central Texas (Austin County).

L. P. Teas, 1933 (A. A. P. G. Bull., vol. 17, No. 12, pp. 1461, 1464). *Gutoskey sand* (subsurface) is in basal 40 ft. of Whitsett fm., and is 17 ft. thick.

Guttenberg limestone member.

Middle Ordovician (Trenton): Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

G. M. Kay, 1928 (Sci., n. s., vol. 67, p. 16). *Guttenberg ls.*—Middle memb. of Decorah fm. At type section (in bluff of Miss. River just NW. of town of Guttenberg, Clayton Co., Iowa) it consists of 15½ ft. of brownish fine-textured ls. Northward from this locality this ls. grades into sh. In NW. Ill. the Guttenberg is the "oil rock" memb. at base of Galena fm. In SE. part of outcrop in Iowa the lss. have been irregularly dolomitized. Fossils are of basal Trenton (Rockland) age. Is overlain by Ion memb. and underlain by Spechts Ferry memb. [See also Kay, Jour. Geol., vol. 37, No. 7, Oct.–Nov. 1929, pp. 639–671, who stated this memb. corresponds to "*Ctenodonta* bed" of Minn. and is of late Black River age.]

This memb. has been slightly redefined by Kay. See 1935 entry under *Spechts Ferry memb.* His 1935 rept included this memb. in Trenton.

G. M. Kay, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 295), showed his Guttenberg memb. as present in SE. Minn. and NW. Ill. On p. 286 he showed his Guttenberg memb. as composing all of his restricted Decorah present near Platteville, Wis.

Guyandot sandstones. (In Sewell formation.)

Pennsylvanian: Southern West Virginia.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Guyandot ss. lentil of Sewell fm.*—Coarse heavy-bedded ss. or cgl., 0 to 100 ft. thick, lying about 150 ft. above base of Sewell fm. and 80 to 100 ft. below Harvey cgl. lentil. Well exposed along Guyandot River from Pineville [Wyoming Co.] to Gilbert [Mingo Co.].

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 196). *Lower Guyandot ss.*—Persistent, massive to current-bedded, medium-grained, grayish white to light gray, 0 to 50 ft. thick. Underlies Sewell A coal, lies 0 to 5 ft. above Sewell ("Davy") coal, and *lies 35± ft. below Guyandot ss.* Forms steep slopes and cliffs.

Guye formation.

Miocene: Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Guye fm.*—Shales, sss., grits, sl., and cgls. with a little ls. and chert, and with interbedded basalt and rhyolite flows. Thickness 0 to 3,500 ft. Well exposed on Guye Creek. Known only in NW. ¼ of Snoqualmie quad. Not found in contact with other Mio. sed. fm. (Ellensburg). Flora (identified by F. H. Knowlton) indicates probable Mio. age. Uncon. overlain by Keechelus volcanics.

Guyet formation.

Mississippian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 19).

Guysborough formation.

Cambrian: Nova Scotia and Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 195).

Guzman formation.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci. Scientific surv. of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 267).

Gwin coal group.

A group of coal beds in upper part of Pottsville fm. (Penn.) of central Ala. Includes Thompson Mill and Gwin coals.

Gwinn series.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Marquette County).

R. C. Allen, 1914 (Jour. Geol., vol. 22, pp. 567, 569). *Gwinn series.*—Consists of (descending): (1) Black ls., gray sl., and graywacke, 30 to 100 ft. thick; (2) iron fm., 50 to 125 ft. thick; (3) black sl. and gray sl.; and (4) cgl. and arkose, 0 to 60 ft. Includes [?] Goodrich qtzite. Uncon. underlies Princeton series and uncon. overlies Archean, the lower Huronian not being recognized in Gwinn dist.

Named for occurrence at and around Gwinn, Marquette Co.

Gwinnup sand.

A subsurface sand, of Penn. age, in Dibrell pool, Coleman Co., north-central Tex., lying at 1,900 ft. depth.

†Gwynedd shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1893 (Pa. Geol. Surv. geol. and topog. map of Bucks and Montgomery Counties), and 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, pp. 2589–2638). *Gwynedd shales.*—Black, dark-gray, and red or green shales, 3,500 ft. thick. Underlie Lansdale shales and overlie Norristown shales. Exposed at Gwynedd tunnel.

Same as Lockatong fm.

Gym limestone.

Permian (Manzano): Southwestern New Mexico (Deming region).

N. H. Darton, 1916 (U. S. G. S. Bull. 618, pp. 19, 35). *Gym ls.*—Chiefly light-gray ls., in greater part massively bedded, showing brecciated structure in many beds. In Gym Peak (type loc.) and vicinity the lower memb. is dark, and the one next above of much lighter color, with abrupt change btw. them, and thickness there is at least 700 ft. Occurs in central and SE. parts of Florida Mtns and central part of Victorio Mtns and extends part way around N. end of Tres Hermanas Mtns. Total thickness near 1,000 ft. Rests uncon. on Magdalena, Lake Valley, and older fms. and is uncon. overlain by Lobo fm. (Triassic ?) or Tert. aggl. Fossils discussed.

Habana formation.

Upper Cretaceous: Cuba.

R. H. Palmer, 1934 (Jour. Geol., vol. 42, No. 2, p. 128).

Hackberry shale.

Upper Devonian: Northeastern Iowa.

C. L. Webster, 1889 (Am. Nat., vol. 23, pp. 242, 243). *Hackberry group.*—Yellowish-brown argill. shales and sometimes slightly aren. shaly ls. which weathers to stiff yellow or buff clay. Thickness 45 ft. Overlies blue clay of upper Hamilton (Genesee) age. Highest Dev. fm. in State. Contains two rich and varied faunas, one at base and the other occupying remainder of the division. Replaces provisional name "Rockford shales."

As thus originally defined the Hackberry included, according to C. L. Fenton (Am. Jour. Sci., 4th, vol. 48, 1919), Owen substage of Calvin, 1897, and Cerro Gordo substage of Fenton, 1919, and overlies Sheffield fm. of Fenton 1919 (=Hamilton of Webster, 1889), which has since been renamed *Juniper Hill fm.* by A. O. Thomas. The name *Hackberry substage* has also been applied (W. N. Norton, 1897, Iowa Geol. Surv. vol. 6, pp. 138–151) to the lower or Cerro Gordo substage plus the underlying Sheffield of Fenton. The Hackberry of Webster plus the Sheffield of Fenton is Lime Creek sh. of the literature, according to Fenton.

Named for exposures at Hackberry Grove, Cerro Gordo Co.

Hackberry shale. (In Cimarron group.)

Permian: Central southern Kansas and northwestern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 46). *Hackberry shales.*—Crumbling shales, chiefly maroon-colored, 0 to 20 ft. thick, overlying Day Creek dol. and underlying Big Basin ss. Included in Kiger div.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 362–363). *Taloga fm.* is proposed to include Big Basin ss. and Hackberry sh. [See under *Taloga fm.*]

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2). The sh. underlying Big Basin ss. memb. of Greer fm. has previously been called *Hackberry sh.*, a name that is inapplicable because of prior use for an Upper Dev. div. of Iowa.

Named for Hackberry Creek, Clark Co., Kans. There is no record of any other name having been introduced to replace this one.

Hackett sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 353). *Hackett ss.*—Usually greenish gray, sometimes massive, but often made up of thick hard flags separated by streaks of sh. Thickness 10 to 75 ft. Underlies Payne Branch sh. and overlies Hackett sh.; all members of Hinton group [fm.]. Type loc. in Mercer Co., on ridge road btw. Hackett and Island Creeks, 1.6 mi. NE. of Pettry, where it makes a plateau along the ridge. Also observed in Summers Co.

Hackett shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 354). *Hackett sh.*—Red sh. with occasional streaks of ss. or ls.; occasional marine fossils in lower part; thickness 30 to 290 ft. Underlies Hackett ss. and overlies Tophet ls.; all members of Hinton group [fm.]. Type loc. same as Hackett ss. Also observed in Summers Co.

Haddam granite gneiss.

Pre-Triassic: Central southern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull 6, pp. 115, 143, 145, and map). *Haddam granite gneiss.*—Light-colored, rather fine-grained granitic aggregate of quartz and feldspar, through which are scattered small isolated flakes of biotite. Hornblende sometimes present, also some plagioclase. Small garnets common. In most outcrops is a moderately thick-bedded gneiss. Typical rock is well exposed about Higganum [in Haddam Twp] on both sides of Conn. River.

Hades quartzite.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 37, 47–53, 281, 287, 290). *Hades qtzite.*—Qtzites, 1,000 ft. thick in Utah and 250 ft. thick in Colo., underlying Jefferson lss. and composing basal fm. of Nevadan series (late Devonic) in Utah and Colo. In Colo. the fm. underlies Elbert shales. Is widely but erroneously termed *Ogden qtzite.* [Page 47.] There seems, therefore, to be but small doubt but that Lodore qtzite is really the eastern extension of the mis-called Ogden qtzite, that the erosion uncon. at its base is the horizon of Early Devonic regional planation, and that rather than propose a new title to take the place of Blackwelder's preoccupied Geneva, Powell's original term Lodore qtzite, should not be discarded. However, should the Lodore section finally prove to include more than the "Ogden" bed, the latter may still be christened the *Hades qtzite,* from the hot, gloomy, and inhospitable canyon on E. side of Duchesne River, where it is so finely exposed in towering cliffs. [Page 50.] This Hades qtzite, as it is recently designated, is believed to be continued eastwardly in the Lodore qtzite of Powell at the Colo. line. [Powell used *Lodore group* (not *Lodore qtzite*), and stated that it consisted of soft sss. and shales with cgls. at base.]

Hagerman lake beds.

Pliocene (upper): Southern Idaho (Gooding and Twin Falls Counties).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Hagerman lake beds.*—Nearly horizontal and partly consolidated buff to white clay and silt beds, which in most places contain a gravel cap 20 ft. thick and occasional pebbly lenses and sandy beds near top. In places basic tuffs and flows are present, and one thin intercalated subaqueous basalt flow 200 ft. below top is conspicuous for many mi. along Snake River. Near mouth of Salmon Falls Creek the fm. contains a 20-foot bed of diatomite. Thickness 600± ft. Underlies, uncon., the undiff. series of early Pleist. basalts, and is younger than Banbury volcanics. Vertebrate fossils in upper part are late Plio., according to Gidley. Type loc., Hagerman Valley, Gooding and Twin Falls Counties, where it forms prominent bluffs along Snake River.

Hague gneiss.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Hague gneiss.*—A garnet sillimanite gneiss, included in Grenville series. Max. thickness 50 or 60 ft.; decreases to E. Underlies "Dixon" schist and overlies Trumbull gneiss. Type loc. is Lakeside mine at Hague [Warren Co.]. In Johnsburg Twp., Warren Co., there is 50 ft. of qtzite which writer regards as = Hague gneiss, and which he calls *Hague qtzite.* It is decidedly purer than its equiv. at Hague.

H. L. Alling, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 52–54). At Rowland Graphite Company's abandoned mine, Johnsburg, Warren Co., the *Hague gneiss* becomes a qtzite; near Conklingville it is highly micaceous. Typically exposed at Hague and at Graphite. Thickness 60 ft. In places underlies and in places is included in "Dixon" schist.

Hague quartzite.

See under *Hague gneiss.*

Hague gas sand.

See under *Sheffield gas sand.*

Haida member. (Of Queen Charlotte series.)

Cretaceous: British Columbia.

C. H. Clapp, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 21). [Assigned to Jurassic, but J. D. MacKenzie, on pp. 36 and 43, assigned it to Cret., as he did in 1916 (Canada Geol. Surv. Mem. 88, p. 54).]

R. W. Goranson, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 175). *Haida fm.* is Cret.

Haiku volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Haiku volcanics.*—Basalt and tuff. Included in lower part of Honolulu volcanic series [q. v.]. Occurs in Haiku Valley, along Haiku Stream and the coast near its mouth.

Hailey shale.

Upper Cretaceous: Central Wyoming.

S. W. Williston, 1905 (Sci., n. s., vol. 22, p. 504). *Hailey shales.*—Dark-blue shales containing new armored dinosaur. Thickness 30 to 75 ft. I believe the beds are of Niobrara age, but they may represent Belly River. Have been traced continuously more than 40 mi. Thin to W., where they plainly show littoral and river disturbances. Rest conformably on Benton. [Apparently named for town of Hailey, in E. part of Fremont Co.]

Probably lower part of Frontier fm.

Haileyburnian.

Pre-Cambrian: Ontario.

W. G. Miller and C. W. Knight, 1920 (Canadian Min. Jour., vol. 41, p. 653).

Haileybury formation.

Ordovician: Ontario.

G. S. Hume, 1920 (Am. Jour. Sci., 4th, vol. 50, p. 301).

Haines granite.

Post-Triassic and pre-Tertiary: Northeastern Oregon (Baker quadrangle).

U. S. Grant and G. H. Cady, 1914 (Oreg. Bur. Min. and Geol., Min. Res. Oreg., vol. 1, No. 6, pp. 133–144). *Haines granite.*—Coarse-grained gray hornblende-biotite granite. Intrusive. Clearly later than the Triassic rocks and much earlier than the Tert. basalt. Named for town in Baker dist.

Hakatai shale. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Hakatai sh.*—Red argill. sh. grading upward into aren. red sh. and ss. Nearly all beds contain sun cracks and ripple marks. Thickness 580 ft. Cut by a thick sill of intrusive diabase, which has converted the sh. into sl. and jasper near the contact. Conformably overlain by Shinumo qtzite and conformably underlain by Bass ls., all of which belong to Unkar group. Named for Hakatai Canyon, where typically exposed.

Hale formation. (In Morrow group, Arkansas.)

Hale sandstone member (of Morrow formation, Oklahoma).

Pennsylvanian: Northern Arkansas and northeastern Oklahoma.

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville folio, No. 119). *Hale ss. memb. of Morrow fm.*—Soft thick-bedded yellowish-brown ss. and flaggy layers, with some carbonaceous and light-colored shales. Basal part of Morrow fm. Uncon. overlies Pitkin ls. Top is limited by base of Brentwood ls. memb. of Morrow fm.

A. H. Purdue, 1907 (U. S. G. S. Winslow folio, No. 154). Basal 50 ft. of *Hale fm.* usually sandy sh. interbedded with thin layers of ripple-marked ss. Rest of fm. more or less massive calc. ss., relative amounts of sand and lime varying. Thickness 100 to nearly 200 ft. Basal fm. of Morrow group. Underlies Bloyd sh. and overlies Pitkin ls. Usually separated from overlying Brentwood ls. memb. of Bloyd sh. by 5 to 10 ft. of black sh. like rest of Bloyd sh. Of Pottsville age.

In NE. and central eastern Okla. the basal part of Morrow fm. is called *Hale ss. memb.*

Named for Hale Mtn, Washington Co., Ark.

Hales limestone.

Cambrian (probably Upper Cambrian): Central Nevada (northern Nye County).

H. G. Ferguson, 1933 (Univ. Nev. Bull., vol. 27, No. 3, p. 15). *Hales ls.*—Almost wholly ls., of bluish-gray color, thin-bedded but with a few massive members; near base lenses and nodules of chert; at base about 50 ft. of brown shaly ls. transitional from calc. slates of underlying Tybo sh.; in places these transitional slates are absent; in upper part of fm. are one or more beds of qtzite, one of which is 200 ft. thick. Thickness of fm. 3,000± ft. Named for Hales shaft of Tybo mine, which is almost entirely within this fm. Few scanty fossils below the qtzites are pronounced by Resser to probably all be Upper Camb. Overlain by Pogonip ls. in Tybo dist. Grades into overlying and underlying fms.

Half Dome quartz monzonite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 126, map). Name proposed by H. W. Turner, in unpublished ms. Medium-grained light-gray rock; contains nearly equal amounts of biotite and hornblende. Chiefly nonporphyritic, but in part obscurely porphyritic. Included in Tuolumne intrusive series, in which it is next younger than Sentinel granodiorite, and next older than Cathedral Peak granite.

Named from fact that it composes Half Dome, in Yosemite Nat. Park.

Halfway horizon. (In Duchesne River formation.)

Oligocene: Eastern Utah (Uinta Basin).

See under *Randlett horizon.*

Halgaito tongue (of Cutler formation). Also **Halgaito member.**

Permian: Southeastern Utah (San Juan County) and northeastern Arizona.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1420, 1423, 1424, 1441, 1443, 1446). *Halgaito tongue of Cutler fm.*—Red sss. and sandy sh., 0 to 430 ft. thick, forming basal part of Cutler fm. in S. part of San Juan Co. and NE. Ariz. Underlies Cedar Mesa ss. memb. of Cutler and overlies Rico fm. In earlier repts called Supai (?) fm. Well exposed near Halgaito Spring, SW. of Mexican Hat (Bluff P. O.), Utah, but btw. Lees Ferry and Kayenta, NE. Ariz.

Halifax formation.

Cambrian or pre-Cambrian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 195).

Halifax chlorite schist.

Upper Cambrian (?): Southeastern Vermont (Windham County).

Geo. D. Hubbard, 1924 (14th Rept. Vt. State Geol., pp. 288–291 and map). *Halifax chlorite schist.*—Characteristic mineral dark-green chlorite, which composes 75 to 85 percent of rock, the remaining 15 to 25 percent being quartz. Believed to be of sed. origin. Thickness of fm. probably 2,000 to 3,000 ft. and possibly more. Overlies Readsboro schist, with which it is interbedded at the contact. We did not become familiar with next fm. above, which outcrops farther E., and do not know nature of the contact on that side. We have found variations from the true green chlorite schist in several places E. of the line placed as our farthest bdy. Whether they should be separated as a new fm. our studies are insufficient to determine. Is=Savoy schist of Mass., which is assigned to Ord. by Emerson.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this fm. to Upper Camb. and=Bethel schist, but without discussion of the evidence.

Apparently named for development in Halifax Twp, Brattleboro and Wilmington quads.

Hall series.

Triassic: British Columbia.

C. W. Drysdale, 1917 (Canada Geol. Surv. Mem. 94, p. 27).

Hall.

Name applied to a Pleist. glacial lake in N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, p. 615, 1932.)

Hall Canyon formation.

Pleistocene (lower): Southwestern California (Ventura Basin).

J. E. Eaton, 1928 (A. A. P. G. Bull., vol. 12, No. 2, pp. 111–141). *Hall Canyon fm.*—A new fm., which lies uncon. above San Pedro fm. (restricted), uncon. below Palos Verdes fm. (uppermost Pleist.), and is absent btw. these 2 fms. at their type loc. Best exposed in Hall Canyon, Ventura Basin. Almost entirely marine in W. part of basin, but almost wholly nonmarine farther E. Is chiefly fine-grained yellow shaly sand, poorly bedded and poorly consolidated, with minor gray-sand layers; lenses of gravel scattered throughout, and these commonly make up large proportion of basal sediments. Lithologically very different from San Pedro fm., but its warm-water faunas are very similar to upper or warm-water faunas of San Pedro, and both are assigned to lower Pleist. Thickness 0 to 2,500 ft. Arnold included Hall Canyon fm. in San Pedro terrace deposits. The Saugus fm. of Kew includes Hall Canyon fm., San Pedro fm. (restricted), and Saugus fm. (restricted) of this rept, the latter of which is Plio.

J. E. Eaton, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 379–381). The term *Hall Canyon* was necessitated by reason of delimiting a lower Pleist. unit which lies in the fuller sections uncon. btw. Arnold's lower and upper San Pedro units, and which had not been previously recognized in Calif. It is highest marine lower Pleist. unit in Calif. Fauna not very distinctive.

Hall City limestone.

Carboniferous: Northern California (Klamath Mountains).

J. S. Diller, 1903 (Am. Jour. Sci., 4th, vol. 15, pp. 342–362). [Mentions (but does not describe or locate in the section, except to say it belongs to southwestern Carbf. belt) *Hall City ls.* On a later page reference is made to Hall City mines, to which one of the Carbf. lss. extends.]

Hallett sand.

A subsurface sand, of Penn. age and 40 ft. thick, in central northern Okla. In Hallett pool, Pawnee Co., it lies at 2,210 ft. depth, the Cleveland sand (25 ft. thick) at 2,140 ft., and the Peru at 2,355 ft.

†Hallopus beds.

A paleontologic name, introduced by O. C. Marsh and used in some early repts, for marine beds forming upper part of Lykins fm. of Front Range, Colo., according to J. B. Reeside, Jr.

†Halymenites sandstone.

Upper Cretaceous: Northwestern New Mexico (San Juan County).

J. J. Stevenson, 1879 (Ann. Rept. Chief of Engrs, 1879, pt. 3, p. 2257). *Halymenites ss.*—Gray to yellowish-gray ss., 50 to 80 ft. thick, lying 70 ft. above base of Laramie group.

Replaced by *Pictured Cliffs ss.*, which carries *Halymenites major* in abundance. (See C. M. Bauer, U. S. G. S. P. P. 98, 1917, p. 274.)

†Hambergian series (also †Hamburgian).

A name applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 51, 53, 79), to Hamburg ls. of Nev. and to supposedly contemp. deposits in other States.

Hambre sandstone. (In Monterey group.)

Miocene (middle): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Hambre ss.*—Medium-textured slightly ferruginous sss. with some sandy shales. Thickness 1,200 ft. A fm. of Monterey group. Conformably underlies Rodeo sh. and conformably overlies Tice sh. Named for exposures along Arroyo del Hambre, Contra Costa Co.

Hamburg limestone.

Upper Cambrian: Eastern Nevada (Eureka region).

Arnold Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 255–259). *Hamburg ls.*—Dark-gray granular ls., surface weathering rough and ragged, with only slight traces of bedding. Rests on transition beds of shaly ls., 25 to 200 ft. thick, which forms top memb. of Secret Canyon sh. Is overlain by Hamburg sh. Thickness 1,200 ft. Exposed at Hamburg mine, Eureka dist.

†Hamburg shale.

Upper Cambrian: Eastern Nevada (Eureka region).

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 255–256). *Hamburg sh.*—Yellow argill. sh., with layers of chert nodules throughout but more abundant near top. Thickness 350 ft. Overlies Hamburg ls. and underlies Pogonip ls. Best exposed opposite Hamburg and Dunderberg mines and in ravine N. of Adams Hill, all in Eureka dist.

Replaced by *Dunderberg sh.*, the name *Hamburg* being retained for the ls.

†Hamburg beds.

†Hamburg clays.

Upper Cretaceous: Western South Carolina.

E. Sloan, 1904 (S. C. Geol. Surv., ser. 4, Bull. 1, pp. 68, 72–75). *Hamburg beds*, divided into upper Hamburg and lower Hamburg, having an aggregate thickness of 181 ft. at Aiken, S. C., and consisting of fine white kaolin; white sands in micaceous kaolinitic matrix; varicolored banded sands; arkose; purple and white kaolin; arkose; subangular boulders and fragments of quartz, sl., and gneiss in arkose matrix. [Detailed section at Aiken given.] Rest uncon. on crystalline rocks and underlie Middendorf beds.

These beds were for a time considered to be of Lower Cret. age and to represent Patuxent fm., but they were later proved by C. W. Cooke and L. W. Stephenson to be of Upper Cret. age and same as †Middendorf fm. of eastern S. C. (See Ga. Geol. Surv. Bull. 40, 1923, and U. S. G. S. P. P. 140F, p. 138, 1926.) Still later "Middendorf" and "Hamburg" were proved to be Tuscaloosa fm., and both of latter names were abandoned. (See C. W. Cooke, U. S. G. S. Bull. 867, 1936.)

Named for exposures at Hamburg, Aiken Co., S. C.

†Hamburg oolite. (In Kinderhook group.)

Mississippian: Southwestern Illinois (Calhoun County).

S. Weller, 1906 (St. Louis Acad. Sci. Trans., vol. 16, pp. 464–467). *Hamburg oolite.*—Fossiliferous oolitic ls., ½ in. to 15 ft. thick at Hamburg, Calhoun Co. May be slightly younger than Glen Park ls. Is time equiv. of upper part of Louisiana ls. Overlain by "Vermicular" ss.

S. Weller, 1914 (Ill. Geol. Surv. Mon. 1, p. 14). *Hamburg oolite.*—White to yellow or flesh-colored oolitic ls., with interbedded layers of sandy sh. Thickness 1 to 15 ft. Underlies Hannibal ss. and sh., and separated from underlying Louisiana ls. by 1 to 8 ft. of brown sandy sh. Included in Kinderhook group.

Preoccupied. Appears to be same as Glen Park ls. memb. of Ulrich.

Named for Hamburg, Calhoun Co.

Hamburg slate.

Pre-Cambrian (middle Huronian): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 61). *Hamburg sl.*—Under this name is included the sl. fm. having considerable distribution in Berlin and Hamburg Twps, Marathon Co. It consists chiefly of sl. and sh., but graywacke and its schistose phases are abundant. Believed original fm. may have been 500 to 1,000 ft. thick in vicinity of area where now exposed. Probably extends over 75 to 100 sq. mi.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to middle Huronian.

Hamburg moraine.

Pleistocene (Wisconsin stage): Western New York. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), 1913, p. 17. Named for Hamburg, Erie Co., N. Y.

†Hamburgian.

See †*Hambergian.*

†Hamburg Mountain gneiss.

Pre-Cambrian: Northern New Jersey.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 439). *Hamburg Mtn gneiss.*—A complex of gneisses, of which most prominent memb. is a course banded hornblendic gneiss, resembling phases of Edison gneiss, with which possibly it might be correlated. In this belt are frequent granitic phases, which are probably intrusive bands.

In U. S. G. S. Franklin Furnace folio, No. 161, 1908, this name was discarded, the rock being an inseparable part of Byram gneiss.

Hamden limestone or member. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio (Muskingum County).

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 173). *Hamden ls.*—Hard, dense gray or nearly black fossiliferous ferruginous ls., 1 ft. to 5 ft. 8 in. thick.

Lies just below or within Oak Hill clay, and on or only a few ft. above Lower Kittanning coal. Named because it occurs at strat. horizon of Hamden iron ore of southern Vinton and northern Jackson Counties.

In later repts called *Hamden memb.*

Hamden sand.

A subsurface sand of Buena Vista (Miss.) age, in Jackson and Vinton Counties, SE. Ohio.

Hamill series.

Pre-Cambrian: British Columbia.

J. F. Walker and M. F. Bancroft, 1929 (Canada Geol. Surv. Mem. 161, p. 9).

Hamilton group (where indivisible **Hamilton formation**).

Middle Devonian: New York, Pennsylvania, Maryland, and western Virginia.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 380). *Hamilton group.*—Shales of dark-blue and olive colors and ss. West Hamilton is locality where the group is well characterized. Underlies Moscow shales and overlies Skaneateles shales. Near Cayuga Lake is separated from Moscow shales by encrinal ls. [As thus defined, *Hamilton group* applied to the sh. later named *Ludlowville sh.*]

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 150–163). *Hamilton group.*—Includes all masses noticed in Ann. Repts under heads of *Skaneateles shales, Dark slaty fossiliferous sh., Compact calc. blue sh., Olive sh., Ludlowville sh., Encrinal ls., Moscow sh., Shales near Apulia and Sherburne,* and *Cazenovia group.* Overlies Marcellus shales and underlies Tully ls. Named for Hamilton, Madison Co., which contains no other rock. Thickness 300 to 700 ft. Extends from near the Hudson to Lake Erie. [Vanuxem's Marcellus of this rept included the lower black shales and 100 to 200 ft. of overlying shaly beds not so highly colored as underlying beds, or apparently the shales later named *Cardiff.*]

J. Hall, 1843 (Geol. N. Y., div. 4, 4th dist., pp. 184–211). *Hamilton group.*—Includes Pyritiferous rock and Third graywacke of Eaton; the Ludlowville, Moscow, and Skaneateles shales; the Dark slaty fossiliferous sh., Compact calc. blue sh., Olive shales, Shales near Apulia and Sherburne; Cazenovia group, Encrinal ls., etc. of Ann. Repts. Rests on Marcellus sh. and is overlain by Tully ls., where present, and by Genesee sl. where the Tully is absent. Along E. shore of Cayuga lake btw. Springport and Ludlowville the group consists of (descending): (1) Moscow sh., (2) Encrinal ls., (3) Ludlowville shales, (4) olive or bluish fissile sh., (5) compact calc. blue sh., (6) dark slaty fossiliferous sh. resting on Marcellus sh. [In later years Hall included Marcellus sh. and Portage and Chemung in his Hamilton group, and still later he excluded them.]

During succeeding years the name *Hamilton* had considerable usage as a time term in each of the following senses: (1) Including Chemung group, Portage group, and Marcellus sh.; (2) including Genesee, Tully, Hamilton, and Marcellus; (3) including Tully, Hamilton, and Marcellus; (4) including Hamilton and Marcellus only. (See †*Hamilton period.*)

In 1885 (N. Y. State Geol. Rept. 1884, pp. 9–22) J. M. Clarke drew top of Hamilton at base of Tully ls. (where top is still placed), but he included Marcellus at base. In 1888 (Trans. Am. Inst. Min. Engrs., vol. 16, pp. 941–947), 1890 (Am. Geol., vol. 6, pp. 205, 206), and subsequent repts, C. S. Prosser definitely placed base of Hamilton at *top* of Marcellus, and gave thickness of Marcellus in central N. Y. as 50 to 82 ft. This definition was followed by G. D. Harris, 1891, by H. S. Williams, 1891, by J. M. Clarke, 1894, 1903, etc., by J. Hall, 1894, 1897, etc., by J. M. Clarke and C. Schuchert 1899, etc., and by nearly all other geologists, and became the established definition of *Hamilton fm.* until 1930 (Cooper). In central N. Y. the Cardiff sh. has been included in Hamilton fm. in some repts, included in Marcellus sh. in some repts, and excluded from both in other repts. The predominant usage, however, has been to restrict Marcellus to the scantily fossiliferous black shales, 62 to 145 ft. thick, and to include the Cardiff in Hamilton fm.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 116–134, 214–236), published the results of a detailed study he had made of the Hamilton strata across N. Y., stating that he found it necessary to "redefine" *Hamilton group* so as to include (ascending) Marcellus sh., Skaneateles fm., Ludlowville fm., and Moscow fm.; and he divided the fms. into many members, to most of which he applied new names. He reported that the occurrence of 3 crinoidal lss. in the Hamilton (Menteth, true Tichenor, and Centerfield, in descending order) had led to many errors in correlating the subdivisions and in drawing the correct boundaries btw. them. He also stated: The results of present study emphasize the close faunal and strat. relationships of the Marcellus with the Hamilton and show that the Marcellus is actually a facies of the Hamilton. Also: The Hamilton beds at type loc. are Skaneateles sh., and the only available good exposures in the Twp are those of the Skaneateles. But according to his map (p. 128) the Ludlowville is present over a large part of Hamilton Twp and to within less than ½ mi. of the village itself. [As first *defined* by Vanuxem the Hamilton rested on Skaneateles sh. and was overlain by encrinal ls. (where that ls. is present), or by Moscow sh. This places it in position of Ludlowville sh.] Cooper also stated that the Marcellus (black) of western N. Y. (Oatka Creek memb.) is characterized by a *Leiorhynchus* fauna; that Cardiff memb. (light-colored) to E. (which he showed is in part contemp. with Oatka Creek memb.) is also characterized by a *Leiorhynchus* fauna; that farther E. the deposits correlated with Cardiff memb. are divisible into (descending) Pecksport memb., Solsville memb., and Bridgewater memb.; that the upper or Pecksport memb. is characterized by a *Leiorhynchus laura* fauna, but that Hamilton species predominate in it; that Solsville memb. is characterized by typical Hamilton fossils in an unusual assemblage; that in underlying Bridgewater memb. the *Leiorhynchus* fauna is common and is associated with many typical Hamilton fossils; and that the underlying Chittenango memb. is nearly barren of fossils. He also stated that the overlying Skaneateles sh. in western N. Y. contains the Second *Leiorhynchus* zone of Cleland, while still higher (in his Ledyard memb. of Ludlowville sh.) occurs the Third *Leiorhynchus* zone of Cleland. Throughout his paper he seemed to recognize the Hamilton fauna as distinct from the Marcellus. He also stated: Writer believes that the Marcellus, and perhaps also the Onondaga, cannot be divorced from the Hamilton.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 190, 192, 369), included Marcellus in Hamilton.

The following recent repts exclude Marcellus from Hamilton: [See list under *Marcellus sh.*]

The following recent repts include Marcellus in Hamilton: [See list under *Marcellus sh.*]

W. Goldring, 1936 (letter dated Jan. 17, 1936). [See under *Marcellus sh.*]

For many years the U. S. Geol. Survey excluded Marcellus sh. from the Hamilton, as did the N. Y. State Survey and most geologists. The N. Y. State Survey has now, however, adopted Cooper's 1930 definition, which includes Marcellus sh. in *Hamilton group*. This is also present classification of U. S. Geol. Survey in N. Y. In south-central Pa., however, it still treats Hamilton and Marcellus as distinct fms.

†Hamilton period.

A term applied by J. D. Dana, in early editions of his Textbook of geology, to include the time covered by deposition of Genesee, Hamilton, and Marcellus shales. He appears to have first used the name in Canadian Nat., vol. 1, No. 6, p. 411, 1857. Subsequently the name was used by others, but it was long ago discontinued, since it conflicts with the earlier and better-established use of Hamilton.

Hamilton Switch sand.

A subsurface sand, of Penn. age, in central eastern Okla. that is correlated with lower sand of Dutcher sand group.

Hamlin shale.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 8–9). ***Hamlin sh. fm.***, 42 to 46 ft. thick, is top fm. of Admire group. Includes, in section from Forest City, Mo., to DuBois, Nebr. (descending) Oaks sh., Houchens Creek ls., and Stine sh. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 50), adopted this name as defined by Condra, assigned the bed to Perm., but did not state derivation of name.

Hammar Bluff formation.

Post-Miocene: Western Washington (King County).

S. L. Glover, Feb., 1936 (Pan-Am. Geol., vol. 65, No. 1, pp. 77–78). *Hammar Bluff fm.*—Sands and clays, probably lacustrine, of post-Mio. age. The clays are bluish gray when damp and light gray when dry. The sands are free of iron. Source of material may be Puget fm. The beds are gently arched, with crest of anticline near Hammar Bluff, a few mi. E. of Auburn, King Co. Overlain by glacial deposits.

Hammar-Haindl sandstone.

A subsurface sand, of Ord. age and 10 to 50 ft. thick, in Oklahoma City field, NE. Okla. Lies 150± ft. higher than Kinter ss. and 0 to 20 ft. below School Land ss. (See A. A. P. G. Bull., vol. 16, No. 10, pp. 967+.) Derivation of name not stated.

Hammond fire clay. (In Kanawha formation.)

Pennsylvanian: Northeastern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 369). ***Hammond fire clay,*** flinty, 1 to 4 ft. thick, overlies or replaces Upper Mercer coal. Named for Hammond, Marion Co.

Hammondville gneiss.

Pre-Cambrian: Eastern New York (Essex County).

D. H. Newland, 1908 (N. Y. State Mus. Bull. 119, pp. 43–50). *Hammondville gneiss.*—A quartz-plagioclase gneiss; ore-bearing; of doubtful relationships. Dr. I. H. Ogilvie considers this gneiss to be eruptive, but it is believed by Mr. Newman and writer that it does not belong to the intrusive series, or at least that it is not contemporary with the other members of it. Occurs at Hammondville mines, Crown Point Twp, Essex Co.

Hampden diabase. (In Newark group.)

Upper Triassic: Southern central Massachusetts and Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50). ***Hampden diabase,*** the "posterior sheet" of Percival. Is younger than Holyoke diabase, and is interbedded in Longmeadow ss. [Derivation of name not stated, but the map shows that, like the Holyoke diabase, it crosses Hampden Co. in belt extending from Ingleside southwestward into Conn., and also occurs farther N. in Holyoke Range, Hampshire Co., Mass.]

†Hampshire formation.

Upper Devonian: Eastern West Virginia, western Virginia, and western Maryland.

N. H. Darton, 1892 (Am. Geol., vol. 10, pp. 13, 17, 18). *Hampshire fm.*—Uppermost series of Dev. sediments in central Appalachian Va. Overlies Jennings fm. and underlies Carbf. Pocono ss. No doubt comprises representatives of the Catskill in their entirety or in greater part. Characterized by thin-bedded, relatively hard, more or less micaceous sss. with sh. intercalations, in greater part of dull-red, dark-gray, and brown color. Thickness 1,000 to 1,400 ft.

Same as Catskill fm., older name, and has been discarded by U. S. Geol. Survey.

Named for Hampshire Co., W. Va.

Hampton shale.

Lower Cambrian: Southwestern Virginia, western North Carolina, and eastern Tennessee.

M. R. Campbell, 1899 (U. S. G. S. Bristol folio, No. 59, p. 3). (Name proposed by A. Keith.) *Hampton sh.*—Over Unicoi ss, lies a bed of sandy sh. which has a thickness of about 600 ft., and which forms most of front of Holston Mtn. Overlying Hampton sh. is another ss. [Erwin qtzite], which appears on summit of the mtn, but it does not extend within limits of this quad.

Named for exposures at Hampton, Carter Co., Tenn., in area mapped by A. Keith.

†Hampton clays.

Pleistocene: Coastal Plain of South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 20). *Hampton clays.*—A fresh-water deposit. In quiet waters, remote from inner or fresh-water shore line, the fine argill. silts deposited to form the white clays of Hampton type, in favored localities, which constituted a broken belt extending from Garnet by Walterboro, by Summerville and thence easterly. While in western area the Hampton clays occur chiefly along a high ridge (60 to 100 ft. M. L. T.), the eastern area affords somewhat similar matter, but as third bottoms, and in depressed basins on the plateaus, at approx. corresponding elevations. Closely identified with the white clay, a more extensive mantle of clay, mottled in highly contrasting pink, red, white, and yellow designs, is substantially coextensive with Lafayette series S. of the littoral line; it roughly conforms to the preestablished topographic irregularities. Its extent may be observed from a point near Jamisons, Orangeburg Co., to Ladsons, Berkeley Co., a distance of approx. 69 mi. At this stage it is probable that the marine Pleist. beds were forming along the ocean beaches. While these white clays accumulated in good bodies in elevated spots, along a favored zone, the argill. silts which were deposited more southerly appear in places interbedded in thin seams with fine varicolored sands, aggregating 20 to 40 ft. in thickness. This appears to have been associated with the formation of an outer reef, barrier, or ridge, designated Ten Mile sands, on seaward slope of which the marine Pleist. deposited. The Ten Mile sands include a capping of reddish loam, which probably represented the terminal expression of the Hampton red clays. The Hampton clays extend from Marion Co. on N. to Beaufort Co. on S. and W. into Aiken, Lexington, Lee, Darlington, and Marlboro Counties.

C. W. Cooke (personal communication 1935). The beds described are Pleist. terrace deposits or beds derived from them.

Probably named for development in Hampton Co.

Hampton granodiorite.

Devonian (?): Southeastern New Hampshire.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 148, 149). [No description. Name is simply listed on pages cited and assigned to Dev. (?). Probably named for exposures at Hampton or in Hampton Twp. Rockingham Co.]

Hampton formation.

Mississippian: Central northern Iowa.

L. R. Laudon, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 174). *Hampton fm.*—Includes beds 3, 4, 5, and 6 of the Kinderhook at Burlington, [SE. Iowa], the Wassonville ls. of Washington Co., the Legrand beds of Marshall Co., and the Chapin, Maynes Creek, Eagle City, and Iowa Falls members of the Kinderhook of north-central Iowa. It carries *in its base* an abundant fauna that can be definitely correlated with upper part of Chouteau of Mo. The upper part of the Hampton carries a fauna derived from this lower fauna. The Hampton is named for county seat of Franklin Co., where it is best exposed. [See also Pan-Am. Geol., vol. 52, Dec. 1929, p. 376, where foregoing is also printed.]

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 344, 347, 366, 387, 419–431). *Hampton fm.* is proposed for the Kinderhook beds of Iowa that lie stratigraphically above English River fm. and below oldest beds of Osage series. In north-central Iowa is divided into (descending) Iowa Falls, Eagle City, Maynes Creek, and Chapin members. [p. 344.] In eastern and north-central Marshall County, in western Tama Co., and in southern Grundy Co. the Hampton fm. is represented by LeGrand beds, which are correlated, by fossils, with lower part of Eagle City memb., Maynes Creek memb., and upper part of Chapin memb. [pp. 419–431]. In SE. Iowa Hampton fm. is divided into North Hill memb. below and Wassonville memb. above. [p. 366.] Hampton fm. has been proposed for the Kinderhook ls. series exposed in north-central Iowa btw. Sheffield fm. below and Alden ls. above. [p. 387.]

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 243, 245), shows major part of Hampton of Iowa as of Burlington and Fern Glen age and basal part only of Chouteau (Kinderhook) age.

L. R. Laudon (on pp. 246–247 of 1935 rept. cited above) stated that not only is the Hampton pre-Osage, but that overlying Gilmore City is also pre-Osage, and that both are of Kinderhook age. He stated that recent work in Iowa has shown conclusively that Hampton fm. should be redefined by excluding from it North Hill memb. as exposed at Burlington and the lower gray ls. ledges of Chapin memb. of north-central Iowa, which are correlatives of the Chouteau of Mo. The redefined Hampton fm. then becomes a distinct lithologic and faunal unit which distributionally follows closely the overlying Gilmore City fm. Fern Glen species are absent in Hampton fauna, which carries all of late Kinderhook species in abundance. The Burlington overlaps the Hampton in SE. Iowa, and Gilmore City fm. lies uncon. on Hampton where exposed near Iowa Falls.

Hampton sand (Archer County, Texas).

See *Lower Freeman sand.*

Hampton moraine.

Name applied to a moraine of Illinoian age in Dakota Co., Minn. (See F. W. Sardeson, Pan-Am. Geol., vol. 59, No. 4, pp. 263–264, 1933.)

Hanaupah formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Hanaupah fm.*—Predominantly fine-textured slaty or flaggy rocks, generally with irregular lumpy fracture; quartz-biotite schist with irregular streaks of sericite, finely banded with gray, green, or chocolate-brown thin, lenticular, and generally corrugated stripes; regularly banded micaceous schist with megascopic tourmaline and magnetite, and characterized by small oval dark-green spots; flaggy rock in which epidotized stripes alternate with finer ones of light-colored aren. and calc. material; and a few beds of white to pink qtzite. Thickness 1,500± ft. Top fm. of Telescope group (lower Paleozoic?) of S. part of Panamint Range. Conformably overlies Redlands dolomitic ls. and conformably underlies Death Valley fm. (lower Paleozoic?). [Derivation of name not stated but probably derived from proximity to Hanaupah Canyons, shown on his map.]

†Hanbury slate.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Hanbury sl.*—Black and gray clay slates, gray calc. slates, graphite slates, graywackes, thin beds of qtzite, occasional beds of ferruginous dol. and rarer bodies of ferruginous chert and iron oxide. Thickness 2,000 to 3,000 ft. Top fm. of Algonkian. Overlies Vulcan fm. and uncon. underlies Lake Superior ss.

C. R. Van Hise and C. K. Leith in 1911 (U. S. G. S. Mon. 52) abandoned *Hanbury sl.*, it being a synonym of Michigamme sl., the older name.

R. C. Allen, 1915 (Jour. Geol., pp. 703+). Michigamme sl. is *upper* Huronian and *Hanbury sl.* is older, and is *middle* Huronian.

R. C. Allen, 1919 (Am. Inst. Min. and Met. Engrs. Bull. 153, p. 2593). Major part (5,000+ ft.) of *Hanbury sl.* is upper Huronian. Lower 500 ft. in places is middle Huronian, and name *Loretto sl.* is here proposed for this basal part, which is absent in places.

Named for exposures in Hanbury Hill, just S. of Hanbury Lake, and for development over broad area around Hanbury Lake.

Hance formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 33, 37, 207, and pl. XLA). *Hance fm.*—Mainly sh., some ss., and coal; 600 ft. thick; underlying Mingo fm. and overlying Lee ss. in Cumberland Gap coal field. Top defined by base of Lower Hance coal; base defined by top of Lee ss. Correlated with lower part of Sewell fm.

Named for Hance Ridge, Bell Co., Ky.

Hancock limestone.

Silurian (upper Cayugan): Northeastern Tennessee.

A. Keith, 1896 (U. S. G. S. Morristown folio, No. 27, p. 3). *Hancock ls.*—Interbedded massive and shaly lss., of blue, gray, or dove color; massive beds more frequent at bottom and top, and attain thickness of 20 ft. In general appearance strongly resembles Chickamauga ls. Fossils throughout fm. show it to be of upper Sil. age. Thickness 0 to 450 ft. Underlies Chattanooga sh. and overlies Rockwood fm.

Foregoing is original definition at type loc. The name, however, first appeared in print in 1894, in U. S. G. S. Estillville folio (No. 12), by M. R. Campbell, who accepted Keith's name, correlating the rocks of Estillville quad. with those of Morristown quad. He described the fm. as consisting of blue fossiliferous ls., very sandy at top and bottom, 180 to 275 ft. thick, underlying Chattanooga black sh. and overlying Rockwood fm.

The beds at type loc. are now considered to be of Sil. (upper Cayugan) age, but the fm. as described and mapped in early repts on SW. Va. is chiefly of Helderberg age (Lower Dev.). At present the U. S. Geol. Survey uses *Cayuga ls.* for the beds of Sil. age in SW. Va. and *Helderberg ls.* for the beds of Lower Dev. age in SW. Va.

Named for Hancock Co., Tenn.

Hancock amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long applied locally to an amygdaloid in upper part of Ashbed group. The mineralized part is the Hancock lode. Named for its occurrence in old Hancock mine, Houghton Co.

Hancock conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years for cgl. No. 17, which is also called *Hancock West cgl.* Occurs near top of Ashbed group. Named for exposures in a ravine just E. of Hancock mine, Houghton Co.

Hancock flow.

Includes Hancock amygdaloid and the underlying trap.

Hancock sand.

A subsurface sand in the Penn. (probably in Bandera sh.) of Chautauqua Co., SE. Kans. Is said to occur 100± ft. below Peru sand and at approx. horizon of Weiser sand of Montgomery Co., Kans.

Hancock West conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Houghton and Keweenaw Counties).

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 77, 83, and chart). Is cgl. No. 17 of Houghton Co.

Is same as Hancock cgl. of Ashbed group.

Probably so named because it lies W. of old Hancock mine, Houghton Co.

Handy Lake volcanics.

Pre-Cambrian: Ontario.

G. Rittenhouse, 1936 (Jour. Geol., vol. 44, No. 4, pp. 455, 469).

Hanford formation.

Lower Cambrian: Newfoundland and New Brunswick.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 196). *Hanford fm.*, Canada and New Brunswick, assigned to Camb.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Hanford fm.*—Fossiliferous green and red sh. with manganiferous lss., and at base phosphorite containing Radiolaria and sponges. Forms upper part of Lower Camb. Discon. overlain by Manuels fm. (Middle Camb.) and discon. underlain by Smith Point fm. (Lower Camb.).

Hanfordian series.

Lower Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Hanfordian series.*—Upper part of Lower Camb. of Newfoundland. Represented by *Hanford fm.* Discon. underlies Middle Camb. (Manuels fm.) and discon. overlies Etcheminian series. [Derivation of name not stated.]

Hanging Rock sandstone.

Pennsylvanian: Central western Indiana (Vermilion County).

F. H. Bradley, 1869 (Ind. Geol. Surv. 1st Ann. Rept., p. 157). Heavy-bedded soft ferruginous ss., 20 ft. thick, locally known as *Hanging Rock ss.* Caps the Hanging Rock and is underlain by black slaty sh. with ironstone nodules. Supposed equiv. of Mahoning ss. [memb. of Conemaugh fm.] of Ohio.

Named for the Hanging Rock, on Big Vermilion River, Vermilion Co.

Hanging Rock sandstone.

Pennsylvanian: Southeastern Illinois (Wabash and Edwards Counties).

A. H. Worthen, 1875 (Ill. Geol. Surv. vol. 6, pp. 51–60), described 2 sss. in upper Coal Measures of Wabash and Edwards Counties, one of which he called *Hanging Rock ss.* and the other *Mount Carmel ss.* Hanging Rock bluff is 3 mi. NE. of town of Mount Carmel, Wabash Co.

†Hanging Rock limestone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 888, 892–895, pls. opp. pp. 889, 900, 912, 921). *Hanging Rock or Gray ls.*—Light-gray semicrystalline fossiliferous ls., 1 to 12 ft. thick, lying strat. btw. Shawnee and Zoar lss. in Hanging Rock dist. Called "Ferriferous" ls. by E. B. Andrews.

Later repts state that it is same as Vanport ls. memb.

Named for Hanging Rock dist., where it is commercially important.

Hanna formation.

Eocene: Central southern Wyoming (Carbon County).

C. F. Bowen, 1918 (U. S. G. S. P. P. 108, pp. 228, 231, etc.). *Hanna fm.*—Alternating beds of sh., ss., cgl., and numerous coal beds. The sh. is dark-gray, yellowish and carbonaceous; the sss. are white, gray and brown, massive to thin-bedded and cross-bedded; the cgls. and conglomeratic sss. contain pebbles of chert, granite, qtzite, ss., Mowry sh., Cloverly cgl., etc. Contains fossil bones of vertebrates, Eocene fresh-water shells, and abundance of Eocene leaves. Thickness 7,000± ft. Uncon. underlies North Park fm. and uncon. overlies Ferris fm. Is well exposed to W. and N. of town of Hanna, Carbon Co. Is upper part of "Upper Laramie" of Veatch, the lower part of that unit being Ferris fm. of this rept.

Hanna Valley bed. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River Valley).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 383). *Hanna Valley bed.*—Clay, 200 or more ft. thick, with some shaly ss. in places. Memb. of Strawn div. Overlies Cottonwood Creek bed and underlies Rough Creek bed.

Named for Hanna Valley, San Saba or Mills Co.

Hannibal shale. (Of Kinderhook group.)

Mississippian: Northeastern Missouri, southeastern Iowa, and western Illinois.

C. R. Keyes, 1892 (Geol. Soc. Am. Bull., vol. 3, p. 289). *Hannibal shales.*—Fossiliferous shales, 70 to 100 ft. thick; upper portion sandy in places and often forms rather compact shaly ss.; lower portion bluish or greenish clay shales. Equiv. of Vermicular shales of Swallow. Underlies Chouteau ls. and overlies Louisiana ls. All included in Kinderhook group.

This continued for many years to be definition of Hannibal sh.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines, vol. 21, 2d ser., table opp. p. 282), showed Glen Park ls. as underlying Hannibal sh. and overlying Louisiana ls. in Jersey and Calhoun Counties, SW. Ill., and that elsewhere (Pike Co., central western Ill., and Pike and other counties in Mo.) the Hannibal is uncon. on Louisiana ls., the Glen Park being absent. In 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245) Moore showed Hannibal sh. as present in only W Ill. and NE. Mo., and that in S. Ill. and SE. Mo. the Fern Glen is uncon. on Glen Park, through absence of Chouteau ls. and Hannibal sh.

Named for exposures at Hannibal, Marion Co., Mo.

Hanover limestone.

Mississippian (lower): Southwestern New Mexico.

H. Schmitt, 1933 (Am. Inst. Min. and Met. Engrs. Contr. 39). *Hanover ls.*—Crinoidal ls. forming top part of Lake Valley ls. in Central Mining dist. or Santa Rita-Hanover-Fierro dist. Because of deformation by the centrifugal peripheral thrust during intrusion of Hanover "stock" the Hanover ls. varies in thickness from 80 to 150 ft., the max. measurement having been made at the crest and the minimum on a limb of the peripheral anticline. Average thickness in undisturbed areas 110 ft. No other fms. in vicinity of Hanover are known to be greatly deformed.

Hanover shale.

Upper Devonian: Western New York (Chautauqua County).

See †*Silver Creek sh.*, 1912, 1919, 1923, and 1924 entries.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 96, 98, 193, 198, 199, 357). *Hanover sh.* overlies Pipe Creek sh. and underlies Dunkirk sh. (Canaseraga ss.). Traceable from Lake Erie to Genesee River, where, still overlain by the Dunkirk, it becomes main mass of Wiscoy sh. Basal part of Wiscoy=Pipe Creek sh.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included this sh. in Chemung group.

Named for exposures in town of Hanover, Chautauqua Co.

Hanoverian series.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 65, No. 4, 1936, p. 315) to include Shakopee dol. and New Richmond ss. (=Richmond ss. of Keyes). Named for twp in Allamakee Co., NE. Iowa.

Happy Hollow limestone. (In Scranton shale.)

Pennsylvanian: Southeastern Nebraska, eastern Kansas, and northeastern Oklahoma.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, pp. 40, 58). [See under *White Cloud sh.*]

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, p. 53), restricted *White Cloud sh.* to beds below Happy Hollow ls., named the sh. overlying Happy Hollow ls. *Cedar Vale sh.*, and stated that *Happy Hollow ls.* persists from Nebr. to Okla. with several ft. of sh. btw. it and Rulo ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 211–212). *Happy Hollow ls.* is traceable from Cass Co., Nebr., across Kans., and at least to S. part of Osage Co., Okla. Thickness 1 to 8 ft. Overlies White Cloud sh. and underlies Cedar Vale sh. Typically it is a single massive bed of pinkish-brown, somewhat impure ls. that weathers in rounded or irregularly porous surfaces; in places very sandy and locally soft and shaly. Type loc., Happy Hollow Creek, NE. Doniphan Co., Kans. [Moore discarded Scranton sh. and treated Happy Hollow ls. as a fm. in his redefined Wabaunsee group.]

Haragan shale.

Lower Devonian (Helderberg): Central southern Oklahoma.

C. A. Reeds, 1911 (Am. Jour. Sci., 4th, vol. 32, pp. 256–268). *Haragan sh.*—Alternating blue to white shales and thin-bedded earthy lss. which weather into yellowish shales. Resembles somewhat Henryhouse sh., but instead of tendency to massive-bedded alternating series of yellow to pink earthy lss. and some sh. beds, there is predominance of sh. members and only occasionally thin ledges of earthy or crystalline ls. Thickness 0 to 166 ft.; average 100 ft. Originally included in middle of Hunton fm. Underlies Bois d'Arc ls. and overlies Henryhouse sh. Contains New Scotland fossils.

Named for exposures along Haragan Creek, Carter Co., 3 to 4 mi. SE. of Dougherty, Murray Co.

Harbison quartz diorite.

Late Jurassic or early Cretaceous: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 115–141, map). *Harbison quartz diorite.*—Type in N. part of Harbison Canyon and vicinity, in southern Peninsular Range, where it covers 6± sq. mi., which, with exception of one small area, is only occurrence of the fm. in this area. Cuts Alpine quartz diorite. Is more acidic than the other quartz diorites of region.

Harbledown formation.

Jurassic: British Columbia.

C. H. Crickmay, 1928 (Calif. Univ. Dept. Geol. Sci. Bull., vol. 18, No. 2, pp. 56, 59).

Harbor Hill moraine.

Pleistocene (Wisconsin stage): Southeastern New York (Long Island).

J. B. Woodworth, 1901 (N. Y. State Mus. Bull. 48, pl. 1, map). *Moraine of the Harborhill stage,* included in Wisconsin epoch. Consists of gravels at Harborhill [near Roslyn] and typical till in other places.

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 762–776), and 1906 (U. S. G. S. P. P. 44). *Harbor Hill moraine* of Long Island is late Wisconsin, and younger than Ronkonkoma moraine.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). Harbor Hill and Ronkonkoma moraines correspond to early Wisconsin of Mississippi Valley region. Thickness of *Harbor Hill moraine* 0 to 30 ft.

Harbor Hill substage.

The time during which *Harbor Hill moraine* was deposited.

Hardesty shale.

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 97). [For definition see first entry under *Pedee group.* Derivation of name not stated. The sh. to which this name was applied is basal part of Lawrence sh. of previous usage, which Moore here divided into (descending) Lawrence sh. [restricted], Haskell ls., Stranger fm., resting uncon. on Hardesty sh. This classification was followed by Moore and Condra in their Oct. 1932 revised chart of Penn. of Kans. and Nebr., and by N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21). See Kans.–Nebr. chart compiled by M. G. Wilmarth, 1936.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 138). *Hardesty sh.* was not properly proposed as a strat. unit, being merely indicated in a chart, and has no standing. It is abandoned. Top of Pedee group is top of Iatan ls., although it is probable that in places there is a certain thickness of sh. btw. Iatan ls. and the post-Missouri discon. that should be included in Pedee group. [See further under *Pedee group.*]

Hardgrave sandstone.

Middle Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Hardgrave ss.*—Red ss., 450 ft. thick, older than Thompson ls. and younger than Foreman beds. [Now known to be much older than Foreman beds.]

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Hardgrave ss.* varies from fine shaly ss. to cgl. and is almost wholly of tuffaceous character. Most common color is red, ranging from brick red to dull brown, but much of it is gray, and the two colors are intermingled irregularly in same bed. Bedding generally well marked. Thickness 450 ft. Is next younger than Trail fm. Is separated from overlying Thompson ls. by Fant meta-andesite. Is limited in distribution within Taylorsville region almost exclusively to slope of Mount Jura, E. of Taylorsville. One belt lies along W. base of Mount Jura. Named for exposures on Hardgrave's ranch, near Taylorsville.

This fm. has been classified as Lower Jurassic, but according to C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, pp. 80–81), it is Middle Jurassic.

Hardgrave tuff.

Middle Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

Hardin sandstone member (of Chattanooga shale).

Upper Devonian or Mississippian: Western Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 136, 137). *Hardin ss.*—Dark fine-grained bituminous ss., weathering gray or grayish yellow; more or less phosphatic. Chiefly interesting because of close association with Swan Creek phosphate, the latter often becoming this ss. Thickness 12 or 15 ft. Overlies Camden chert and underlies Swan Creek phosphate [according to pp. 104 and 136].

Because of thinness and gradation into overlying sh. is treated as a memb. of Chattanooga sh. Uncon. overlies Pegram ls. in some areas.

Named for Hardin Co.

Harding sandstone.

Middle Ordovician: Colorado.

C. D. Walcott, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 154–167). *Harding ss.*—The lower bed is a shore-line deposit following the advance of the sea upon the land; it is formed of coarse grains of quartz and small quartz pebbles imbedded in a fine aren. matrix, and is 5 ft. thick. The succeeding layers of ss. have more or less calc. matter in the matrix; their fossils all prove the littoral origin of the sediments. The closing deposit of the ss. series is coarse drifted sand, containing numerous fragments of larger fish plates than those below. The change to succeeding shaly beds at top is abrupt, and apparently due to deepening of the water and cessation of aren. deposits. The shaly beds are 2 to 4 ft. thick, and consist of red and purple fine-grained argillaceo-aren. sh. Thickness of fm. at Harding's ss. quarry, about 1 mi. NW. of State Penitentiary, Canyon City, 86 ft. Rests uncon. on Algonkian bedded gneiss and micaceous schists. Overlain by Fremont ls.

Is now considered by E. Kirk to be of approx. late Black River or early Trenton age.

Hardinsburg sandstone. (Of Chester group.)

Mississippian: Southern Illinois, western Kentucky, and northern Tennessee.

A. D. Brokaw, 1916 (Ill. Geol. Surv. Extr. from Bull. 35) and 1917 (Ill. Geol. Surv. Bull. 35). *Hardinsburg ss.*—Moderately fine-grained yellowish-brown ss., with small amount of sh., underlying Sloans Valley [Glen Dean ls.] and overlying Golconda fm. in parts of Saline, Williamson, Pope, and Johnson Counties, SE. Ill. Thickness 80 to 100 ft.

C. Butts, 1917 (Ky. Geol. Surv. Mississippian formations of western Ky., p. 96). *Hardinsburg ss.*—Consists of (descending) shaly ss.; massive coarse-grained ss., 10 ft.; somewhat thinner-bedded ss. 10 ft. Thickness 30 to 60± ft. Underlies Glen Dean ls. and overlies Golconda fm. Named for Hardinsburg, Breckinridge Co., Ky., which is built on this ss.

Hardin School limestone. (In Wichita group.)

Permian: Central Texas (Coleman County).

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 254–255). About 50 ft. above base of Santa Anna Branch sh. memb. of Putnam fm., and 125± ft. below top of that memb., is a dense, hard cream-colored ls. about 14 in. thick, which is a good marker. Because of good exposures on hills just N. and W. of Hardin School, in SW. part of Coleman Co., the name *Hardin School ls.* is proposed for it. It lies 9± ft. above another prominent ls., about 18 in. thick, and 5 ft. below a nonpersistent hard gray ls. 1 to 2 ft. thick.

†Hardiston quartzite.

See *Hardyston qtzite.*

†Hardistonville quartzite.

See *Hardyston qtzite.*

Hardman fire clay. (In Allegheny formation.)

Pennsylvanian: Northern West Virginia and western Maryland.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 347). *Hardman fire clay.*—Hard and flinty, 9 ft. thick. Lies immediately under Johnstown ls. and overlies Middle Kittanning coal. Mined 1 mi. N. of Hardman, Preston [Taylor?] Co.

C. K. Swartz et al., 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Hardman fire clay* ("Furnace" clay), underlies Mount Savage iron ore (Johnstown iron ore) and overlies Piney Mtn coal in Allegany and Garrett Counties, Md.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 48, pl. 6). *Hardman ("Furnace") fire clay* underlies Little Montell coal and overlies Piney Mtn coal in Georges Creek Basin, Md.

D. B. Reger, 1924 (W. Va. Geol. Surv. Rept. Mineral and Grant Counties, p. 243). *Hardman fire clay,* 6 ft. thick, usually sandy and impure, underlies Johnstown ls. and overlies Upper East Lynn ss.

Hardwick granite.

Late Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 239–241, 317–318, pl. 34). *Hardwick gneiss* (pp. 239–241); *Hardwick gneissoid granite and granitite* and *Hardwick granite-gneiss* (pp. 317–318); *Hardwick granite* (on map, where it is described as dark thick-bedded biotite gneiss). [See also Emerson, U. S. G. S. Bull. 597, pp. 238–239, 1917, where it is described, on map, as black biotite granite around Fitzwilliam granite, and is shown as extending northward into N. H.]

Named for occurrence at and around Hardwick, Worcester Co., Mass.

Hardwick granite.

Devonian: Northeastern Vermont (Caledonia County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Quarried W. of Hardwick, in Hardwick Twp, Caledonia Co.

Preoccupied by Hardwick granite of central Mass. and southern N. H., which is late Carbf. or post-Carbf.

Hardyston quartzite.

Lower Cambrian: Northern New Jersey and northeastern Pennsylvania.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 442–443, 454–456). *Hardistonville qtzite.*—Oldest fossiliferous rock of region. Olenellus age established by Beecher and Nason. Usually bluish gray when fresh; weathers yellow or brown; often porous, limonitic; frequently contains considerable pyrite; varies in coarseness from fine cgl. to qtzite; shaly phase often present in upper part. Thickness 1 to 30 ft. Grades into overlying Wallkill blue ls. [Kittatinny ls.]. Overlies Franklin white ls. Exposed at brook section in Hardistonville and on hill 1 mi. S. of Hardistonville.

H. B. Kümmel and S. Weller, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 149–150). *Hardiston qtzite.*—Was described and named *Hardistonville qtzite* by Wolff and Brooks, from village of that name, near which there are good exposures. The shorter name used above, which is that of the township, seems preferable, however, and is here proposed. Consists of (descending): (1) Sandy shales (transition beds), 10 to 15 ft.; (2) sandy ls., 15 ft. exposed; (3) ss. or qtzite of variable composition and thickness, usually blue gray when fresh, but some beds are light yellow brown and others nearly white. Thickness 100 to 140 ft., if transition beds at top are to be included. The conglomeratic phase is known to exceed 100 ft. at a number of localities. Lower Camb. trilobites in the calc. ss. beds; no fossils in the vitreous qtzites or the arkose beds. Conformably underlies Kittatinny ls. Rests on pre-Camb. crystallines.

H. B. Kümmel and S. Weller, 1902 (N. J. Geol. Surv. Ann. Rept. State Geol. 1901), changed spelling of name to *Hardyston,* the form adopted by U. S. Geog. Bd.

Hare Indian River shale.

Devonian: Mackenzie.

E. M. Kindle, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 45).

Hare River shales.

Devonian: Mackenzie.

T. O. Bosworth, 1921 (Geol. Mag., vol. 58, p. 287).

Hargett sandstone. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1935 (Miss. Geol. Surv. Bull. 26, pp. 9, 10). [*Hargett ss. (or a sh. memb.) of Alsobrook fm.* is shown in table on p. 9 as underlying Cripple Deer ss. (or a sh. memb.) of Alsobrook fm., and overlying ls. forming basal part of Alsobrook fm. in Tishomingo Co. The columnar section on p. 10 shows 1 ft. of ss. in middle of Alsobrook fm. Derivation of name not stated.]

Harjo sand.

A series, 10 to 70 ft. thick, of sands, sandy limes or limes, of Penn. age, with sh. breaks recorded, lying at 3,180 to 3,380 ft. depth in Cromwell oil field, Okla. Lies 175 to 250 ft. above Cromwell sand and some distance below Brunner sand, which lies 300 to 370 ft. above Cromwell sand. Named for Hannah Harjo lease of Independent Oil & Gas Co., sec. 21-10-8.

Harlan sandstone. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and southwestern Virginia.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 31). *Harlan ss.*—Mainly coarse white ss., with sandy sh. and thin coals, 880 ft. thick. At base massive ss. 100 ft. thick. Forms topmost fm. of Coal Measures in Bigstone Gap coal field of Va. and Ky. Overlies Wise fm.

Belongs to upper part of Pottsville group.

Named for Harlan Co., Ky.

Harlem gneiss.

Pre-Cambrian: Southeastern New York.

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116-120), applied *Harlem gneiss* to one of bodies of gneiss shown on his "Section across New York [Manhattan] Island along southern shore of Spuyten-Duyvel Creek and Harlem River." In U. S. G. S. New York City folio (No. 83) the gneiss of this area is mapped as Fordham gneiss.

Harlem clay. (In Conemaugh formation.)

A name applied to the siliceous clay, 1 ft. thick, underlying Harlem coal in Ohio.

Harmon formation. (In Maysville group.)

Upper Ordovician: Southeastern Indiana.

E. R. Cumings and J. J. Galloway, 1913 (Ind. Dept. Geol. and Nat. Res. 37th Ann. Rept., p. 359). *Corryville-Arnheim* (*Rafinesquina fracta zone*).—Lss. and shales, 110 ft. thick, similar to rest of the Maysville; lss. predominating at base, gradually replaced by sh. toward top. Included in Maysville group. Overlies Bellevue and underlies Waynesville div. of Richmond group. If a single name is desired for this div. we propose Harmon, from Harmon's Station [Dearborn Co.], near which, in cuts 8 to 11, the entire fm. is exposed.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 425). Reason for grouping Corryville, Mount Auburn, and Arnheim together as *Harmon fm.* is that in Ind. the Corryville and Mount Auburn lose their distinctive characters, and the Arnheim, especially in its lower half, is faunistically very much more closely related to the Maysville than to the Richmond.

Harmon Hill gneiss.

Pre-Cambrian: Southwestern Vermont (Bennington region).

C. E. Gordon, 1914 (9th Rept. Vt. State Geol). [In table on p. 345 the pre-Camb. rocks of vicinity of Bennington, Vt., are called "Gneiss of Stamford Mtn and Harmon Hill." On p. 349 is heading: "Petrography of Harmon Hill gneiss."]

†Harney granite.

Pre-Cambrian: Southwestern South Dakota (Black Hills).

H. G. Ferguson and F. N. Turgeon, 1908 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, pp. 273–281). *Harney granite* occurs in northern Black Hills. The intrusive granite of Harney Peak region, in southern Black Hills, is a pegmatitic granite, identical with that found in northern Black Hills. The Harney granite appears to be intruded into only the lower schists of the Algonkian. [The name *Harney granite* is used in title of paper.]

U. S. Geol. Survey does not use a geographic name for this local body of granite. (See under *†Harney Peak granite.*)

Harney formation.

Tertiary? (Pliocene?): Southeastern Oregon (Harney Basin).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr. (U. S. G. S. W. S. P. in press). *Harney fm.*—Massive basaltic tuff and breccia, ss., and siltstone; some incoherent gravel; scoriaceous and massive basalt intercalated at a few horizons. Exhumed basalt memb. caps the extensive plain of intermediate altitude in west-central part of area. Rests uncon. on Danforth fm. Is overlain by Pleist. terrace deposits or late basalt. Thickness 0 to 750 ft. Named for Harney Basin, the type section (468 ft. thick) being in E. face of Dog Mtn along bdy btw. secs. 20 and 28, T. 25 S., R. 30 E.

†Harney Peak granite.

Pre-Cambrian: Southwestern South Dakota (Black Hills).

C. R. Van Hise, 1898 (Geol. Soc. Am. Bull., vol. 9, p. 311), referred to the mica schists and mica gneisses about the *Harney Peak granite* of the Black Hills, "described by writer in Geol. Soc. Am. Bull., vol. 1, pp. 206–210, 1890" [but not there named, being simply called *granite of Harney Peak*].

G. M. Schwartz, 1925 (Econ. Geol., vol. 20, pp. 648–653). *Harney Peak granite* forms core of Black Hills uplift. Intrudes pre-Camb. schists. Classed as pre-Camb. by all investigators who have mentioned its age. The parts of the granite seen by writer are largely pegmatitic. It would not be far from correct to refer to all of exposed Harney Peak granite as a pegmatite.

The U. S. Geol. Survey considers a geographic name for this local body of granite unnecessary, and calls it *granite of Harney Peak.*

Haro formation.

Upper Triassic: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 93, 112–113). *Haro fm.*—Basal 920 ft. consists chiefly of cgl. with occasional thin beds of reddish ss. and sh.; overlying strata are thin-bedded carbonaceous sh., sl., graywacke, grit, and ls., containing *Halobia,* which is restricted to upper Triassic; the uppermost beds are largely concealed by glacial drift. Thickness of fm. 1,250+ ft. Composes peninsula known as Davidson Head, at N. extremity of San Juan Island. Occupies an area of only 48 acres. So far as known no other rock of this age outcrops in San Juan Island region. [Derivation of name not stated.]

Harper sandstone. (In Cimarron group.)

Permian: Central southern Kansas and northern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 18–20). *Harper sss. or beds.*—More or less mottled but prevailingly dull-red or brownish-red argill. and aren. shales and sss., several hundred ft. thick, composing basal fm. of Kiger div. and Cimarron series. Overlies, probably uncon., Wellington sh. and underlies Salt Plain measures. Includes at base transitional beds of calc. sh. which might perhaps be reckoned equally well as constituting the summit of the Wellington.

In Okla. is represented in Enid fm.

Named for exposures in Harper Co., Kans.

Harpers shale. (Also **schist, slate, phyllite,** and **albite schist.**)

Lower Cambrian: West Virginia, Virginia, Maryland, and southeastern Pennsylvania.

A. Keith, 1893 (as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68. The fm. was described, but not named, by Keith in Am. Geol., vol. 10, p. 365, 1892). *Harper's Ferry shales.*—Gray sandy shales, with some ss. beds, scolithus and Lower Camb. fossils. Thickness 1,200 to 1,500 ft. Underlie Antietam ss. and overlie Weaverton [Weverton] ss.

A. Keith, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pls. 22 and 23, pp. 333–335). *Harpers sh.*—Bluish-gray and gray sandy shales with some thin beds of ss. Thickness 800 to 1,200 ft. Underlies Antietam ss. and overlies Weverton ss.

In SE. Pa. the lithologic character of this fm. changes, and it is there called *Harpers schist* in some areas, *Harpers phyllite* in other areas, and *Harpers albite schist* in still other areas.

Named for exposures in gorges of Potomac and Shenandoah rivers at Harpers Ferry, W. Va.

†Harpers Ferry shales.

See *Harpers shale.*

Harpersville formation. (In Cisco group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 39). *Harpersville fm.*—Chiefly sh., but in Brazos River Valley includes Saddle Creek ls. memb. at top, Belknap ls. memb. in middle, and Crystal Falls ls. memb. near base. Thickness 200 to 275 ft. Overlies Breckenridge ls. memb. of Thrifty fm. and underlies Camp Creek sh. memb. of Pueblo fm. Chiefly characterized by presence of coal No. 6, one of most important coals in northern Tex. Named for town 10 mi. S. of Breckenridge, Stephens Co.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 160–168 and charts). *Harpersville fm.*—In Colorado River Valley includes all strata btw. top of Saddle Creek ls. memb. and base of Waldrip bed of Drake. It consists of basal beds of coarse thick sss. which grade in places to cgls.; of middle beds composed of an alternation of fossiliferous buff and yellow-brown lss., irregularly bedded calc. sss., carbonaceous and ferruginous shales, and thin beds of coal; and of upper beds of a thick, massive coarse persistent ss. in many places capped by a hard gray ls. (Saddle Creek ls. memb.). Includes Crystal Falls ls. lentil 40 to 80 ft. above base, and Belknap ls. lentil 60 to 80 ft. above Crystal Falls ls.

†Harpeth shale.

Mississippian: Central Tennessee.

P. M. Jones, 1892 (Geol. of Nashville and immediate vicinity, Univ. Press, Nashville, Tenn., June 1892, p. 14). *Harpeth sh.*—Blue, apparently compact rock, in fresh exposure heavy-bedded, but weathering easily into sh.; at intervals layers of chert 3 to 4 in. thick, which resist weathering much longer than main body of the sh. Thickness 200 ft. or more. Underlies St. Louis ls. and overlies Dev. Black sh. To this group of rocks Dr. Safford, in his rept of geology of Well's Creek Basin (soon to be published), has given the name "Harpeth sh.," from its fine presentation in the picturesque bluffs, along Big Harpeth River, in Cheatham Co.

Replaced by Ridgetop sh.

†Harpeth and Tennessee River group.

Devonian and Silurian: Western Tennessee.

J. M. Safford, 1851 (Am. Jour. Sci., 2d, vol. 12, pp. 353, 357–358). ***Gray ls. or Harpeth and Tennessee River group.***—Fossiliferous ls. which to W. uncon. separates the black sl. from underlying blue ls. of Nashville group containing ***Spirifer lynx*** and its associates. Along Tenn. River consists of (ascending): (1) Thin-bedded fine-grained impure blue ls., of unknown thickness, 40 to 50 ft. being exposed in bluffs and beds of several creeks in Hardin Co.; (2) mostly light-gray sand and thick-bedded ls. containing crinoidal beds, some of lower strata with bright-green points, middle strata banded by reddish layers, which are generally fine-grained, impure, cherty ls. common on the Glades, and upper portion sometimes affording bluish layers of siliceous ls.; all often of marly nature, easily disintegrating and forming the angular gravel of the Glades.

Includes Pegram, Camden, Harriman, Quall, and Linden fms. (Dev.) and Clifton fm. (Sil.).

Named for Harpeth River, Cheatham and Dickson Counties.

Harrell shale. (Of Portage group.)

Upper Devonian: Central Pennsylvania (Bedford, Blair, Huntingdon, and Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523, 532, 536). ***Harrell sh.***—Dove and black fissile (paper) sh., with Burket black sh. memb. at base to W. Thickness 250 ft. Basal fm. of Portage group. Underlies Brallier sh. and overlies Hamilton fm.

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press). ***Harrell sh.***—Very soft brownish gray or olive-colored highly fissile sh. that cleaves into very thin laminae. East of Tussey Mtn thin beds of black sh. alternate with soft brown or gray sh. Correlated with Cashaqua and Middlesex of N. Y. At base Burket black sh. memb., 80 ft thick. Named for exposures at Harrell, Blair Co. [This village and the station have also been spelled ***Horrell.***]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1209–1213), proposed to restrict this name to the beds overlying Burket black sh. memb.

Harricanaw series.

Pre-Cambrian: Quebec.

T. L. Tanton, 1919 (Canada Geol. Surv. Mem. 109, p. 39).

Harriman chert.

Lower Devonian (Oriskanian): Western Tennessee (Decatur County).

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 747). ***Harriman chert.***—Nearly white novaculite; weathers buff; very hard and brittle; in layers a few inches to over 1 ft. thick; thoroughly fractured. Thickness 0 to 55 ft. Is heavier-bedded than overlying Camden chert (restricted), with which it is uncon. Overlies, uncon., Quall ls. Is of upper Oriskany age. Named for Harriman Creek, Decatur Co.

Harrington formation.

Lower Triassic: Southwestern Utah (southeast of Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). ***Harrington fm.***—Thin-bedded shale with interbedded lss. and lenses of qtzite. Thickness 5,000± ft. Overlain by Tert. intrusives and underlain by Elephant ls. (Penn.). Type loc., Harrington-Hickory mine, SE. of Frisco dist.

Harrington River formation.

Carboniferous: Canada.

W. A. Bell, 1927 (Roy. Soc. Canada Trans., 3d ser., vol. 21, pp. 75–108; table).

Harris moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Chisago and Sherburne Counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 80–82). Youngest moraine of Rush Lake morainic system. Named for occurrence at Harris, Chisago Co.

Harris formation.

Miocene: Southern California (Santa Maria district).

R. D. Reed, 1933 (Geol. of Calif., p. 189). In Santa Maria dist. it has become customary to refer to the upper, more diatomaceous part of the siliceous sh. series as the *"Harris" fm.*, which may be = the Santa Margarita or may be younger. (According to recent work by G. D. Hanna, the typical *Harris Grade beds* are Plio.; personal communication.) The pre-Harris beds are at least in part = typical Monterey.

Harris sand.

A subsurface sand, 25 ft. thick, in Strawn fm. (Penn.) of Ranger field of central northern Tex., lying 1,700 to 1,800 ft. below Ranger ls.

Harrisburg gypsiferous member (of Kaibab limestone).

Permian: Southwestern Utah and northwestern Arizona.

H. Bassler and J. B. Reeside, Jr., Aug. 15, 1921 (U. S. G. S. Bull. 726C, pp. 90–92). *Harrisburg gypsiferous memb. of Kaibab ls.*—Gray, thin-bedded ls. (some of it containing many small angular fragments of chert) and gray, red, and yellow sh., some gyp. Thickness 137 to 160 ft. [0 to 280± ft. in U. S. G. S. P. P. 129, p. 56, 1922]. Top memb. of Kaibab ls. Uncon. overlain by Rock Canyon conglomeratic memb. of Moenkopi fm. Named for occurrence in Harrisburg dome, 8 mi. E. of St. George, Washington Co., Utah.

Harrisburg Run sand.

Subsurface sand in Bradford dist., NW. Pa., lying btw. Bradford Second and Bradford Third sands, 230 ft. above latter.

Harris City limestone.

Name casually applied by M. N. Elrod (Ind. Dept. Geol. and Nat. Hist. 12th Ann. Rept., 1881, p. 128, 1883) to ls. quarried at Harris City, Sand Creek Twp, Decatur Co., Ind.

Harrison diorite.

Pre-Cambrian (?): Southeastern New York and western Connecticut.

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, p. 30). *Harrison diorite* is intrusive into Manhattan schist in town of Harrison [Westchester Co.]. A smaller area of similar rock occurs at Ravenswood, L. I., where it intrudes Fordham gneiss; a mass of it forms Milton Point near Rye; and it is abundant along shore of Long Island Sound btw. Portchester and Greenwich.

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83). [*Harrison diorite* classified as Sil. or later, and described as in 1898.]

E. C. Eckel, 1902 (N. Y. State Geol. 20th Ann. Rept., p. r165). *Harrison diorite* is medium-grained granite diorite. Intrusive into Hudson [Manhattan] schist. Covers large part of towns of Mamaroneck, Rye, and Harrison, and extends E. into Fairfield Co., Conn.

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107). *Harrison diorite* may be later than Precambric, and is tentatively classified as Camb.

V. Ziegler, 1911 (N. Y. Acad. Sci. Annals, vol. 21, p. 1). *Harrison diorite* believed to be distinct from Ravenswood granodiorite, and has been more thoroughly metamorphosed than Ravenswood.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 24). Ravenswood granodiorite is related to *Harrison diorite* and considered to be of essentially same age.

†Harrison beds.

Miocene (lower): Western Nebraska and eastern Wyoming.

J. B. Hatcher, 1902 (Am. Phil. Soc. Proc., vol. 41, p. 117). *Harrison beds.*—Fine-grained rather incoherent sss. permeated by great numbers of siliceous tubes arranged vertically. Characterized by *Daemonelix* and other Mio. mammals. Well shown in bluffs of all small streams that head near summit of Pine Ridge in vicinity of Harrison, Nebr. Cover considerable area. Extend well into Wyo.

Are a part of Arikaree fm., and of lower Mio. age, according to H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65–75), and H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, p. 44).

Harrison member (of Pottsville formation).

Pennsylvanian: Southeastern Ohio (Vinton County).

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, pp. 67, 68). *Harrison memb.*, generally an impure iron ore, was named from deposits present in Scioto Co., and was formerly worked for iron smelting at Harrison Furnace. It lies in base of Pottsville fm., but is bedded in the eroded surface of Maxville ls. or, where that is absent, on the Logan strata. Is of variable composition. In places it is a brecciated mass of siliceous fragments cemented by iron compounds. The siliceous material appears to be what was once pieces of Maxville ls. At other places it is a mixture of angular siliceous fragments and well-rounded quartz pebbles, all cemented by iron compounds. Distribution is local in Vinton Co. Thickness 3 in. to 4 ft. 10 in. Underlies Sharon cgl.

Harrison ore bed. (In Pottsville formation.)

See under *Maxville block ore.*

†Harrison series.

Pre-Cambrian: Southern Idaho (Cassia County).

A. L. Anderson, 1931 (Idaho Bur. Mines and Geol. Bull. 14, pp. 24+). *Harrison series.*—Chiefly qtzite, with lesser schist and marble. Descending: (1) White dense vitreous qtzite, in part massive, with ill-defined bedding, and in part distinctly bedded in beds 6 to 18 in. thick, 400 to 500 ft.; (2) qtzite containing much schist and 2 or more marble or ls. members, 2,000 to 3,000 ft.; (3) mainly qtzite; the upper 2,000± ft. slightly micaceous qtzites alternating with numerous thick beds of pure qtzite and a few thin beds of mica schist; the lower 3,000 ft. mainly light-gray to white pure qtzite with thick even bedding, but contains some slightly micaceous members. Total thickness 9,000+ ft. Neither base nor top exposed. Best exposed on flanks of Mount Harrison. Is surely not to be correlated with Belt series, but very likely is older than Belt.

Preoccupied. Replaced by *Albion Range group.*

Harrison Lake formation.

Middle Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, p. 487 and map). *Harrison Lake fm.*—Aggls. and lavas, 9,200 ft. thick, yielding *Cylindroteuthis themis.* Assigned to Middle J. Underlies Echo Island fm. (Middle J.) and uncon. overlies Slollicum series (Triassic). [Mapped on both sides of Harrison Lake.]

†Harrodsburg limestone. (In Meramec group.)

Mississippian: Indiana and northern Kentucky.

T. C. Hopkins and C. E. Siebenthal, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., p. 296). *Harrodsburg ls.*—Lss., 60 to 90 ft. thick, with some sh. interbedded; formerly known as Encrinital ls. Overlies Knobstone group and underlies Bedford oolitic ls. [Spergen ls.].

Correlation with Warsaw ls. (older name) established. (See C. Butts, 1915, Ky. Geol. Surv., 4th ser., 3d Rept., pt. 2.)

P. B. Stockdale, 1929 (Ind. Acad. Sci. Proc., vol. 38, pp. 233–242), divided Harrodsburg ls. into (descending): (1) Upper Harrodsburg ls., 30 to 50 ft.; and (2) Lower Harrodsburg, 25 to 40 ft. of beds divided into (descending) Guthrie Creek memb., 2 to 10 ft.; Leesville ls. memb., 1½ to 8 ft.; and Ramp Creek memb., 16 to 28 ft.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 310–311), suggested redefining Harrodsburg ls. by including his basal Ramp Creek memb. in underlying Borden group. He stated: The complex relationships btw. uppermost Edwardsville (top fm. of Borden group) and overlying Harrodsburg ls. at extreme S. part of State, and uncertainty as to bdy line btw. the two units at many places farther N., suggest that Siebenthal may have been in error in specifically including the "transitional beds" (Ramp Creek memb.) as an integral part of his Harrodsburg fm. This surmise is supported by lithologic contrast btw. Lower and Upper Harrodsburg. Might it not be better to consider Lower and Upper Harrodsburg as two separate fms.; or, perhaps, include Ramp

Creek memb. as a part of the Borden (Edwardsville) and consider Leesville memb. as basal unit of Harrodsburg or as a separate fm.?

Named for Harrodsburg, Monroe Co., Ind.

Harrogate limestone.

Devonian: British Columbia.

F. P. Shepard, 1926 (Jour. Geol., vol. 34, p. 626).

Harrogate formation.

Middle Devonian: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A2, p. 142).

Harshberger limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Somerset County).

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, pp. 222, 223, and pl. 13). *Harshberger ls.*, 5 ft. thick, is quarried by Mr. Harshberger. At Forwardstown, Somerset Co., Pa., it lies 8½ ft. below lower ls. bed of Berlin ls. and rests on 25 ft. of unnamed ss. It is compact, minutely crystalline, spotted with iron pyrites, and of bluish-black color.

Hart limestone member (of Stratford formation).

Pennsylvanian: Central southern Oklahoma (Pontotoc County).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 137–140). *Hart ls. memb.*—A series of alternating lss., shales, and sss. that constitute basal memb. of Stratford fm. In vicinity of Hart the lss. are very prominent, but toward N. and S. some of them thin out while others grade into sh. As a rule arkosic material is not abundant in the lss., but it is always present, and in a few beds constitutes large proportion of the rock. [Regarding age, see *Stratford fm.*]

Named for typical development near village of Hart, W. part of Pontotoc Co.

Hartford limestone.

Pennsylvanian: Western central Kentucky.

C. J. Norwood, 1884 (Ky. Geol. Surv., Repts on western coal field, Ohio Co., p. 174). *Hartford ls.*—Blue shelly ls. 6 ft. thick, lying 15 ft. above coal D.

Apparently named for Hartford, Ohio Co.

†Hartford limestone. (In Shawnee formation.)

Pennsylvanian: Eastern Kansas and northwestern Missouri.

M. Z. Kirk, 1896 (Kans. Univ. Geol. Surv. vol. 1, p. 80). *Hartford ls.*—Ls. which passes under river at Hartford. Separated from underlying Strawn ls. by 60 ft. of sandy sh. and from overlying Wyckoff ls. by 50 ft. of sh.

Same as Topeka ls. (older and better-established name), according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13).

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11). *Hartford (Curzon) ls.* is basal memb. of Topeka ls. fm. [See further description under *Curzon ls.*]

R. C. Moore, Aug. 31, 1936 (Kans. Geol. Surv. Bull. 22, pp. 48, 194–197). Hartford ls. of Kirk is lower memb. of Topeka ls. as now classified. It consists typically of 1 to 3 or 4 beds (1 to 20 ft. thick) of massive or irregularly bedded bluish-gray ls. that weathers brown. Where 2 or more beds of ls. are present they are separated by sh. a few in. to several ft. thick. Thickness of memb. as a whole is 1 to 40 ft. Well exposed below highway bridge at N. edge of Hartford, Coffee Co., Kans.

R. C. Moore, Sept. 4 to 7, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 41), introduced 2 members into Topeka ls. beneath Hartford ls., as explained under *Jones Point sh.* and *Dashner ls.*

This name was discarded by U. S. Geol. Survey in 1912, because then stated to be same as Topeka ls. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Also see 1937 entry under *Topeka ls.*)

Named for exposures at Hartford, Lyon Co., Kans.

Hartford clay.

Name applied by R. F. Flint (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 965–987, 1933) to a late Pleist. clay at and in neighborhood of Hartford, Conn.

Hartgrove limestone member (of Talpa formation).

Permian: Central Texas (Concho County).

W. Kramer, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1579, 1582). A 2-foot bed of dark gray ls. lying 1,000 ft. above Coleman Junction ls. is here named *Hartgrove memb.*, from exposure on Mack Hartgrove's ranch, where it crops out 0.4 mi. S. of and 37 ft. lower than the ground at Eugene Mays well (middle of W. line of Anton Schmidz survey No. 312, about 4.5 mi. SE of Paint Rock). Has been traced across SE. part of Runnels Co. to 11 mi. N. of SE. corner of that Co. Is persistent ledge maker and hence is considered top memb. of Talpa fm.

†Hartland schist.

Lower Cambrian (?): Western Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 96–100, and map). *Hartland (Hoosac) schist.*—In Conn. is southern continuation of large areas of rock on Hoosac Mtn and in adjacent regions of Mass. The rock is everywhere mica schist of definable character, but exhibits great variation in texture, composition, and field appearance. Where least affected by intrusion it is a highly fissile schist. Ranges in color from clear metallic muscovite to black biotite mixed with graphite. Sericite and chlorite often replace biotite. Garnets almost constantly present. No fossils.

Same as Hoosac schist, the older name.

Named for development in Hartland.

Hartland shale member (of Greenhorn limestone).

Upper Cretaceous: Western Kansas.

N. W. Bass, 1926 (Kans. Geol. Surv. Bull. 11, p. 203). *Hartland sh. memb.*—Chalky sh., with a few thin beds of chalky ls. Thickness 28 to 40 ft. A memb. of Greenhorn ls., underlying Jetmore chalk memb. and overlying Lincoln ls. memb.

Named for exposures along Arkansas River from a short distance W. of Hartland, Kearny Co., to Kendall, Hamilton Co.

Hartley augen gneiss.

Pre-Cambrian: Southeastern Pennsylvania and northern Maryland.

E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 43, 44). The Baltimore gneiss has been intruded by a granite that has produced a lit-par-lit injection in upper part of fm. This granite, which has been metamorphosed into a cataclastic granite gneiss, has been called by writers *Hartley augen gneiss*, from its excellent outcrops at Hartley Mill on Long Green Creek, in eastern Baltimore Co., Md.

This fm. was formerly classified by U. S. Geol. Survey as Archean (?), but "Archean system" having been discarded the fm. is now classified as *pre-Camb.*

Hartmann limestone.

Middle Cambrian: Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Hartmann ls.*—Gray mottled ls. in thin beds, with shaly partings; some oolite toward top. Thickness 650 ft. Conformably underlies Bowman ls. and grades into underlying Ophir fm., the bdy being arbitrarily drawn at top of highest sh. bed in this part of section, all of the shales being included in Ophir fm. Named for exposures on W. side of Hartmann Gulch (sometimes called Graveyard Gulch), just N. of Ophir.

Hartridge shale. (In Pottsville group.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1918 (W. Va. Geol. Surv. Rept. Barbour and Upshur Counties, p. 288). *Hartridge black sh.*—Dark-gray to black sh., through which fossiliferous hard black concretions are scattered in large numbers. Thickness 5 to 6 ft. Underlies

Lower Guyandot ss. and overlies Sewell coal. Exposed at Hartridge, Randolph Co.

Hart School bed. (In Moran formation.)

Permian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 179, 180). A ls. bed (2 to 6 ft. thick) in Sedwick ls. memb. of Moran fm. (of Cisco group), occurring 3 to 12 ft. below top of Sedwick memb. Outcrops on road at Hart School, sec. 2969, T. E. and L. survey, 6 mi. N. of Putnam [Callahan Co.]. [See description under *Sedwick ls. memb.* The Moran fm. is now included in Wichita group.]

Hartselle sandstone. (In Chester group.)

Mississippian: Northern, central, and eastern Alabama.

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala. with explanatory chart). Mountain ls. (Chester), 200 to 2,000 ft. thick, divided into 2 contemp. units, Bangor or ls. phase, including *Hartsell ss.*, and Oxmoor or sh. and ss. phase. In northern Ala. lss. prevail, with one or more interbedded sss., the *Hartsell or Lagrange sss.* To S. and SE. of Wills Valley the lss. are replaced by shales and sss. well exposed at Oxmoor. The Mountain ls. underlies Coal Measures and overlies Fort Payne, which is divided into Tuscumbia ls. above and Lauderdale cherty ls. below. [As thus defined *Hartsell ss.* evidently included Hartselle ss. restricted and the older Cypress ss. of present nomenclature, but apparently did not include Gasper fm. and Bethel ss.]

H. McCalley, 1896 (Ala. Geol. Surv. Rept. Tenn. Valley region, Ala.). *Hartselle ss. group*, 150–400 ft. thick, underlies Bangor lss. and overlies Tuscumbia ls. Consists of massive ss., underlain by variable lss. and interchangeable calc. argill. shales (in one place mostly lss., in another place mostly shales), in places 150 ft. thick; at base variable sss. [As thus defined his *Hartselle ss. group* included the sss. now designated *Hartselle ss. restricted, Cypress ss.*, and *Bethel ss.*, together with intervening beds.]

C. Butts, 1910 (U. S. G. S. Bull. 400, on Birmingham dist.). Bangor ls., divided into (descending): (1) Ls., few ft. to 350 ft.; (2) sh., 30 ft.; (3) *Hartselle ss. memb.*, 100 to 200 ft.; (4) sh., 50 ft.; (5) ls., 160 ft. Rests on Fort Payne chert. [As thus defined *Hartselle ss. memb.* evidently applied to the ss. to which it is now applied. This same definition was employed by Butts in U. S. G. S. Birmingham folio, No. 175, 1910, and by E. A. Smith in Ala. Geol. Surv. Bull. 10, 1911. In some subsequent repts, by other writers, the Hartselle ss. was supposed to be same as Cypress ss.]

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14), divided the rocks that had formerly been called Bangor ls. in NW. Ala. into (descending): (1) Pennington fm., 0 to 200 ft.; (2) Bangor ls. restricted, 100 to 700 ft.; (3) *Hartselle ss. restricted*, 0 to 200 ft.; (4) Golconda fm., 0 to 60 ft.; (5) Cypress ss., 0 to 40 ft.; (6) Gasper fm., 75 to 150 ft.; (7) Bethel ss., 0 to 20 ft.; and (8) Ste. Genevieve ls., 0 to 100 ft., which overlies Tuscumbia ls., "generally with slight uncon. in Miss. and Ohio Valleys." Hartselle ss. restricted correlates with Hardinsburg ss. of Miss. Valley. This restricted definition of Hartselle ss. is the present approved definition.

Named for exposures at Hartselle, Morgan Co.

Hartshorne sandstone.

Pennsylvanian (Allegheny): Eastern Oklahoma and western Arkansas coal field.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 436). *Hartshorne ss.*—Brown to light-gray sandrock, 200 ft. thick, underlying McAlester sh. and overlying Sil. in McAlester dist., Okla. Basal fm. of Coal Measures. Hartshorne coal lies above this ss. and is separated from it by a thin but variable bed of sh.

Underlies McAlester sh. (the base of which in Okla. is at top of 1st ss. below *Upper* Hartshorne coal, and the base of which in Ark. is at top of 1st ss. below *Lower* Hartshorne coal) and overlies Atoka fm. The Hartshorne ss. in Ark. is now defined as the first continuous ss. underlying Lower Hartshorne coal. Some repts have included Lower Hartshorne coal in this ss.

Named for exposures near Hartshorne, Pittsburg Co., Okla.

Hartsville limestone.

Silurian (Niagaran): Southeastern Indiana.

J. A. Price, 1900 (Ind. Dept. Geol. and Nat. Res. 24th Ann. Rept., pp. 84–85). *Hartsville (Louisville) ls.*—Sandy ls., 0 to 12 ft. thick, regarded as strat. equiv. of Louisville ls. Overlain by Dev. Corniferous ls. and underlain by Waldron sh. Regarded as topmost fm. of the Niagara in Decatur, Bartholomew, and Shelby Counties.

E. M. Kindle, 1901 (Ind. Dept. Geol. and Nat. Res., 25th Ann. Rept.). Louisville ls., 4 to 35 ft. thick, is "Hartsville bed" of Price.

T. C. Hopkins, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept., p. 39). Hartsville beds included in Jeffersonville ls. (Dev.).

Named for Hartsville, Bartholomew Co.

Hartville formation.

Pennsylvanian and Mississippian: Southeastern Wyoming (Hartville uplift).

W. S. T. Smith and N. H. Darton, 1903 (U. S. G. S. Hartville folio, No. 91). *Hartville fm.*—Massive gray ls., some beds containing chert nodules, with occasional beds of white, gray, buff, and red ss., composes most of fm. In lower part red sh. and gray ls.; at base 50 ft. of red qtzite streaked with white. Total thickness 650 ft. Conformably underlies Opeche fm. and uncon. overlies Guernsey fm. Contains Penn. fossils in upper part and Miss. fossils in lower part. [Mapped over large area at and around Hartville.]

G. E. Condra and E. C. Reed, 1935 (Nebr. Geol. Surv. Paper No. 9), reported results of a detailed lithologic, faunal, and correlation study of Hartville fm., which they divided into 6 unnamed units, the upper one of which they concluded is probably Perm.; the next underlying 4 fossiliferous units are certainly Penn., while the strat. relations of basal unit suggest it is lower Penn.

Hartwell sandstone.

Pennsylvanian: Western Arkansas coal field.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Hartwell ss.*— Ss., 0 to 100 ft. thick, underlying Tomlinson sh. and overlying Belva sh. All included in Sebastian stage. [Is a part of Fort Smith fm.]

Derivation of name not known, but there is a town of that name in Madison Co., NW. Ark.

Hartwell sandstone.

Mississippian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 244). *Hartwell ss.*—Massive, fine-grained, micaceous, olive green, 25 to 30 ft. thick. Lies about 345 ft. below Pocahontas No. 3 coal. Older than Pageton ss. and younger than Ballard Harmon ss. Exposed at Hartwell, McDowell Co., and quarried ½ mi. SE. of Hartwell. Included in Mauch Chunk series.

Hartwell moraine.

Pleistocene (Wisconsin stage): Western Ohio and eastern Indiana. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53. Belongs to Shelbyville morainic system. Named for Hartwell, a few mi. N. of Cincinnati, Ohio.

Hartwick dolomite.

Silurian (Niagaran): Central eastern Iowa.

C. Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 149, 150). *Hartwick terrane.*—Dol., 80 ft. thick, composing next to top fm. of Niagaran series. Overlain by Monticello dol. of Niagaran series, and underlain by Colesburg dol. of Niagaran series. Separated from underlying and overlying fms. by its fauna.

Named for Hartwick, Poweshiek Co.

Harvard *conglomerate lentil* (*of* Worcester phyllite).

Pennsylvanian: Northeastern Massachusetts (Worcester County).

W. O. Crosby, 1876 (Rept. on geol. map of Mass.), referred in several places to a cgl. and argillite in Harvard and Bolton (cgl. on E. and argillite on W.) as *Harvard cgl.*

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers No. 3, with map). *Harvard cgl.* is petrologically a part of the argillite [Worcester phyllite] and probably marks beginning of its deposition.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). *Harvard cgl.* underlies Worcester argillite (phyllite) and overlies Worcester qtzite [Oakdale qtzite].

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, No. 4, pp. 91–271). *Harvard cgl.*, 300 to 400 ft. thick, contains no arkose. Is interbedded with grit and sheared ss. and intimately associated with Worcester phyllite. Apparently thins out to S.

B. K Emerson, 1917 (U. S. G. S. Bull. 597, pp. 61, 66–67, and map). *Harvard cgl. lentil of Worcester phyllite*.—A mass of crushed conglomeratic rock, 500 ft. wide and 1 mi. long, occurs NW. of Harvard village and lies on an isolated block of Worcester phyllite surrounded on all sides by granite. A cgl. mass of similar relations and dimensions forms summit of Vaughn Hill, 3 mi. to SW. The rock is breccia rather than cgl., as component blocks are in general sharply angular. The blocks are as diverse in character as in size. They are mainly qtzite but of several kinds of qtzite. In other specimens the fragments are all sl., but of several kinds of sl. The interstitial matter is fine clay sl. like adjacent argillite.

†Harvard granite.

Late Carboniferous: Massachusetts.

B. K. Emerson, 1889 (Geol. Soc. Am. Bull., vol. 1, p. 560), used, but did not define, this name, which was long ago replaced by him with *Andover granite*.

Harvest Home shale member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 134), proposed *Harvest Home sh. memb.* to replace *lower Meadville sh.* of early repts on NW. Pa. Well exposed along Rock Creek, Greenwood Twp, Crawford Co., especially at Peterson's Falls, on the edge of which is located the Harvest Home Grove, widely known in Crawford Co.

Harvey conglomerate lentil. (In Sewell formation.)

Pennsylvanian: Southern West Virginia.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Harvey cgl. lentil of Sewell fm.*— Massive cgl., 0 to 50 ft. thick, lying about 100 ft. below Nuttall ss. lentil. Named for exposure at village of Harvey [now Bolt P. O.], on headwaters of Marsh Fork of Coal River, Raleigh Co.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties). *Harvey cgl.*—Massive current-bedded medium-grained to coarse grayish-white to yellowish-gray cliff-forming ss. Thickness 0 to 125 ft. Underlies Lower Iaeger sh. and overlies Sandy Huff sh. Named by M. R. Campbell. [This is definition used in subsequent repts of W. Va. Geol. Surv.]

Harveyville shale. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). *Harveyville sh.*, middle memb. of Preston ("Emporia") ls. fm. Consists of greenish, bluish sh., locally a subzone nearly black, argill. to calc., quite fossiliferous, 3 to 4 ft. thick to W., 7 ft. thick to E. Underlies Elmont ls. and overlies Reading ls. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 226). *Harveyville sh.*, which is first defined in this rept, includes beds overlying Reading ls. and underlying Elmont ls. It is mostly bluish or yellowish brown and clayey, but locally contains sandy sh. and thin platy ss., with a coal bed locally above the ss. Thickness 1 to 25± ft. *Identified at many places from Nebr. to Okla. and is undoubtedly continuous across Kans.*

Type loc. near Harveyville, SE. part of Wabaunsee Co., Kans. Good section in sec. 25, T. 15 S., R. 13 E.

Haskell limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Haskell ls.*, new name; underlies Lawrence sh. [restricted] and overlies Stranger ss. and sh. (also new name). Included in Douglas group redefined.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 96). [See under *Douglas fm., Moore, 1932*. On p. 49 the Haskell ls. is described as consisting of 3 ft. of bluish dense even ls.] Named for Haskell Institute, Lawrence.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21). [See 1935 entry under *Stranger fm.*]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 152+). *Haskell ls. memb. of Stranger fm.*—Throughout much of outcrop it is bluish-gray blocky fine-grained ls., occurring as single ledge without sh. partings, and containing banded algae and a few fusulinids and brachiopods. Locally, as at Lawrence, oolitic layers occur at base and top of memb.; the upper oolite furnished types for several pelecypod species of Beede and Rogers. Underlies Robbins sh. [basal part of Lawrence sh. as restricted by R. C. Moore in 1931 and 1932] and overlies Vinland sh. Type loc. on 15th St., NE¼ sec. 5, T. 13 S., R. 20 E., at E. edge of Lawrence.

Haskell sand.

A subsurface sand, 20 ft. thick, of Upper Dev. (Chemung) age, occupying interval btw. 1,550 and 1,570 ft. in Derrick City deep well, McKean Co., NW. Pa., which is Smethport sand of Ashburner, according to C. R. Fettke (Geol. Soc. Am. Bull., vol. 44, No. 3, p. 620, 1933), who spells the name (fig. 2, opp. p. 602, and p. 620) *Haskill;* but Pa. Geol. Surv., 4th ser. Bull. M19, 1933, charts in pocket, spell this name *Haskell.*

Haskew gypsum member (of Blaine formation).

Permian: Northwestern Oklahoma (Harper and Woodward Counties).

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 405–432). *Haskew* is proposed for top gyp. memb. of Blaine fm. Differs from underlying Lovedale, Shimer, and Medicine Lodge gyp. members in several particulars. Does not ordinarily have a dol. bed at base, although a very impure sandy dol. has been observed in a few places. Max. thickness of Haskew memb. in Harper and Woodward Counties, 4 ft. Separated from underlying Lovedale gyp. by 4 ft. of red sh. Clusters of interlocking crystals on surface of this bed are commonly much smaller than those of underlying Lovedale, Shimer, and Medicine Lodge gyp. members, and bed is redder than the other 3. Named for exposures near old store known as Haskew Store, at NE. cor. sec. 2, T. 25 N., R. 19 W.

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437). *Haskew memb.*, not previously recognized, should be accepted.

Haskill sand.

See *Haskell sand.*

Haslam formation.

Upper Cretaceous: Vancouver Island, British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 97).

Hasmark formation.

Upper Cambrian: Central western Montana (Philipsburg region).

F. C. Calkins and W. H. Emmons, 1913 (U. S. G. S. P. P. 78). *Hasmark fm.*—In descending order: (1) Mag. ls., mostly white, 350± ft.; (2) calc. sh., 150 ft.; (3) mag. ls., mostly blue gray, 550± ft. Underlies Red Lion fm. and overlies Silver Hill fm. Named for an abandoned settlement SE. of Philipsburg. The fm. is not very well exposed there, but dearth of geographic names in Philipsburg quad. made it impossible to find one more appropriate.

Hastings series.

Pre-Cambrian: Ontario.

W. E. Logan, 1866 (Canada Geol. Surv. Rept. 1863–66, p. 93, footnote).

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360).

The Hastings dist. includes an area btw. Ottawa and St. Lawrence Rivers SW. of city of Ottawa, extending from Peterborough and Hastings Counties on SW. to Lanark and Renfrew Counties on NE.

Hastings Creek formation.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 185, 1931) to B2 (except summit bed) and B1 of Logan's section of Philipsburg series of Quebec (Lower Ord. and older?). McGerrigle mapped his Hastings Creek fm. (260 ft. thick) in small area in St. Albans quad., NW. Vt. Logan's B1 consisted of white and dove-gray pure lss. with some mag. beds and his B2 consisted of dark lss. with some mag. beds. (See 1931 entry under *Philipsburg series.*)

Hatch shale.

Upper Devonian: West-central New York.

J. M. Clarke and D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, p. 1005 and map). *Hatch shales and flags.*—Light and dark shales with thin flags of blue ss. Thickness 203 ft. Underlie Grimes ss. and overlie Rhinestreet black sh. in Genesee River section. Included in Portage group. Are part of Hall's Gardeau.

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, pp. 199–214). *Hatch sands, flagstones, and sss. with intermingled clay shales.*—Thickness 312 ft. in Naples section. *Hatch flags and sandy shales* 209 ft. thick in Genesee River section. Naples fauna. [Clarke and Luther, 1905 (N. Y. State Mus. Bull. 81), gave thickness of 440 ft. in Watkins and Elmira quads.]

D. D. Luther, 1906 (N. Y. State Mus. Bull. 101). Named for Hatch Hill, at Naples, Ontario Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 76 and chart). *Hatch sh. and flags* recognized from Genesee Valley to Cayuga Co., where they become involved with the Ithaca.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Hatch sh.* underlies Grimes ss. and overlies Rhinestreet sh. All included in Portage group.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 201). *Hatch ss. memb.*—Basal memb. of Enfield facies subgroup of Ithaca-Enfield group of fms. in vicinity of Ithaca, N. Y. Thickness 500 ft. Extends from top of Second *Reticularia levis* zone. Contains *Leiorhynchus globuliforme* zone in upper part. Grades into so-called lower Chemung to E.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352). Hatch underlies Grimes and overlies Rhinestreet. Grimes included in Chemung group and Hatch in Naples group.

Hatchetigbee formation. (In Wilcox group.)

Eocene (lower): Southern Alabama and eastern Mississippi.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 39–43). *Hatchetigbee series.*—All strata btw. base of Buhrstone [Tallahatta fm.] and uppermost of Wood's Bluff fossiliferous beds [called Wood's Bluff or Bashi marl], aggregating about 170 to 175 ft. By far greater part of the beds here included are sandy clays or clayey sands of brownish gray colors, alternating with bands of dark brown or purple color. Top fm. of Lignitic [Wilcox group]. Overlies Wood's Bluff or Bashi series and underlies Buhrstone group.

Is top fm. of Wilcox group, and in Ala. contains deposits of both marine and nonmarine origin, according to C. W. Cooke.

Named for exposures at Hatchetigbee Bluff, on Tombigbee River, in NE. part of Washington Co., Ala.

Hat Creek beds.

Oligocene (middle): Wyoming.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2. pt. 1, p. 11), mentioned "*Hat Creek beds,* Wyo., Reed, Hatcher" as included in White River group.

Hathaway formation.

Upper Pliocene or lower Quaternary (mapped as Pliocene): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 375, 376–378, 384, and map). *Hathaway fm.*—A series of land-laid deposits. Bulk of fm. is rather fine for fangl. Upper 1,800 ft. consists of light bluish-gray ss. containing many streaks of angular pebbles derived from igneous and metamorphic rocks to N. This ss. grades downward into light-gray sh. containing hard calc.

streaks, of which 800 ft. is exposed in small canyon just W. of San Gorgonio River and base not seen. Total thickness unknown. In places overlain, in angular discordance, by a basalt flow. In other places overlain by Deep Canyon fangl. or by Cabezon fangl.; and in still other places by Heights fangl. Is younger than Lion ss. and older than Pipes fangl.

Named for Hathaway Creek, Riverside Co., on and near which it is exposed.

Hathaway oil zone.

Subsurface beds of Plio. and Mio. age, encountered in wells in Santa Fe oil field, Los Angeles Co., Calif., that lie lower than Clarke oil zone.

Hato Puerco tuffs.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 272, N. Y. Acad. Sci.).

Hattiesburg clay.

Miocene (lower and middle): Coastal Plain of Alabama, Mississippi, Louisiana, and eastern Texas.

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90–91). More remote from the Great River [Mississippi], and something farther, the less siliceous the fm. becomes, at Hattiesburg, and in that part of Leaf River from Okatoma to Rogers Creek and on the Chickasawhay above Leakesville, a third phase of the Miocene Grand Gulf group is exhibited, abounding in phytogene remains—almost lignitic. This is the *Hattiesburg phase or fm.* Extends into Ala. and has been traced across Miss.

W. H. Dall, 1903 (Wagner Free Inst. Sci. Trans., Phila., vol. 3, pt. 6, pp. 1541–1620). *Hattiesburg clays* underlie Pascagoula clays and overlie Roberts sand.

G. C. Matson, 1916 (U. S. G. S. P. P. 98). *Hattiesburg clay* consists of massive non-marine blue and gray clays with subordinate amounts of sands and sss. Uncon. underlies Pascagoula clay and conformably overlies Catahoula ss. Forms lower part of Fleming clay of Veatch. Thickness 300–350 ft. in Ala. and La. and 450 ft. max. in Miss.

Named for exposures at Hattiesburg, Forrest Co., Miss.

Hatton tuff lentil (of Stanley shale).

Pennsylvanian (Pottsville): Southwestern Arkansas and southeastern Oklahoma.

H. D. Miser, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 125). Tuff of Carbf. age occurs near base of Stanley sh. in Ouachita Mtn region in Polk Co., Ark., and McCurtain Co., Okla. There are 3, and possibly 4 or 5, beds of it, ranging in thickness from 6 to 85 ft. All of them are very similar in lithologic character. Lowest bed is thickest and most widely distributed. Has been mapped in detail in DeQueen quad., lying mostly in Ark., and to it name *Hatton tuff lentil* has been applied, for reason the best known exposure is in a cut of Kansas City Southern Ry ⅓ mi. S. of Hatton [Polk Co., Ark.]. The tuffs are compact, massive, and tough; generally homogeneous except for presence of numerous chloritic pellets that lie parallel with bedding; of dark gray color with a greenish tinge. None of tuffs have yielded fossils, and their assignment to Miss. is based on relations of Stanley sh. to overlying and underlying rocks, whose age has been determined by fossils.

In DeQueen quad, SW. Ark., lies 500± ft. above base of Stanley sh. Age changed to Penn. in 1934. See under *Stanley sh.*

Hauns' Bridge group.

Upper Devonian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, p. 92). *Haun's Bridge group.*—Greenish gray sandy shales and flags with few thin red beds. Thickness 1,000 to 1,100 ft. Chemung shells from top to bottom, but included in Catskill fm. [probably because of red strata]. Overlies Lackawaxen [Saxton] cgl. and underlies 2,500 ft. of red Catskill sh. Named for 1,000-foot exposure at Hauns' Bridge in Juniata Twp, Huntingdon Co.

These strata form upper part of Chemung fm. as now identified in Huntingdon Co. (See U. S. G. S. Hollidaysburg–Huntingdon folio, No. 227, in press.)

Havana shales.

Cretaceous: Cuba.

J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 539).

See also *Habana fm.*

Havasupai sandstones.

Permian: Northern Arizona (Grand Canyon).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 336). ***Havasupai sss.***—The median ss. section of Aubreyan series, best exposed in rim wall near Bass Camp, W. of El Tovar, Grand Canyon. Thickness 200 ft. Underlies Wompats lss.

Probably named for Havasupai Point, where Coconino ss. is exposed. Appears to be applied to Coconino ss.

Havensville shale. (In Wreford limestone.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 32). ***Havensville sh.***—Middle memb. of Wreford ls. Is essentially an olive-colored argill. sh. with fossiliferous transitional zones at top and bottom. Thickness 5 or 6 ft. in southern Kans.; 15 or 16 ft. SW. of Junction City and SE. of Randolph; and 18 ft. or more at type loc. in cuts on Highway 63 about 2 mi. S. of Havensville, Kans. Overlies Fourmile ls. and underlies Schroyer ls. [R. C. Moore (1936) replaced *Fourmile ls.* with *Threemile ls.*, but Nebr. Geol. Survey continues to use *Fourmile ls.*]

Hawaiiloa volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and Gd. Water Res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). ***Hawaiiloa volcanics.***—Chiefly basalt. Included in lower part of Honolulu volcanic series [q. v.]. Is older than Ulupau tuff. Type loc. Hawaiiloa Hill.

Hawarden shale.

Upper Cretaceous: Northwestern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, p. 148). ***Hawarden terrane.***—Shales, 125 ft. thick, underlying Niobrara terrane and overlying Crill terrane. All included in Coloradan series. [Keyes stated (Iowa Acad. Sci. Proc., vol. 20, p. 200, 1913) that Niobrara terrane in above definition is a bed much higher in section than so-called Niobrara chalk of Iowa as recognized by Meek and Hayden, Calvin, Bain, and others, and that it has recently been traced to typical outcrop of Niobrara ls.]

Probably named for Hawarden, Sioux Co.

Hawke Bay formation.

Hawke Bay quartzite.

Lower Cambrian: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 21).

Hawkeye granite.

Pre-Cambrian: Northern New York (Clinton County).

W. J. Miller, 1919 (Jour. Geol., vol. 27, p. 29; also see Econ. Geol., vol. 14, p. 512). [See under *Lyon Mountain granite.*] Named for exposures just E. of Hawkeye post office [Clinton Co.]. Forms summit of Lyon Mtn.

Hawkins formation.

Carboniferous (?): Central Washington (Mount Stuart and Snoqualmie quadrangles).

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Hawkins fm.*—Volcanic series of flow breccias, tuffs, and amygdaloids; extremely altered; green or purple. Pre-Eocene.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Hawkins fm.* (Carbf.?) makes up rugged peak known as Hawkins Mtn, Mount Stuart quad. Is younger than Easton schist. Assigned to Carbf.(?).

Hawkins limestone.

Cambrian: Southwestern New Mexico (Grant County).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 8). *Hawkins lss.*—Important calc. beds of Mid Cambric age intercalated in basal section of qtzites exposed in Grant Co. Thickness 50 ft. [Derivation of name not given. According to E. Kirk and others Middle Camb. is absent in N. Mex.]

Hawkins Point clays.

Lower Cretaceous; Northeastern Maryland.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 334). There seems to be one horizon in the Albirupean or upper series of Potomac fm. that occupies a considerable breadth at which the purple mottled tenacious clays occur in vast quantities. I have denominated this belt *Hawkins Point clays,* from their occurrence at Hawkins Point, on the lower Patapsco, where they form an extensive cliff 40 ft. high, with a width along the shore of nearly ½ mi. toward Swan Creek [Anne Arundel Co.].

Belongs to Patapsco fm.

Hawley schist.

Ordovician: Western Massachusetts and southeastern Vermont.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Hawley schist,* ankerite chlorite schist, with beds of amphibolite and iron ores. Underlies Goshen schist and overlies Savoy schist.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 163–171 and map, pl. 34). *Hawley schist.*—Sericite and actinolitic chlorite schists with many beds of hornblende schist. Thickness 2,000 ft. (?). Uncon. underlies Goshen schist and overlies Savoy schist. [See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 43–44).]

Named for exposures in Hawley Twp, Mass.

Hawleyville granite gneiss.

Pre-Cambrian(?): Western Connecticut.

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, p. 355), mapped as *Hawleyville granite gneiss* an area of rocks lying NW. of Hawleyville, Conn., but did not mention the town or the fm. name in his text, pp. 354–373.

Hawpatch glacial gravel and sand.

Pleistocene: Southeastern Indiana (Bartholomew County).

M. N. Elrod, 1882 (Ind. Dept. Geol. and Nat. Hist. 11th Ann. Rept., pp. 156–158). *Hawpatch glacial gravel and sand.*—One of most extensive and peculiar beds of gravel in Ind., being 12 mi. long and 3 mi. wide, in Bartholomew Co. Roughly bounded by Flat Rock River on NW. and Haw Creek on SE., and reaching from White River bottoms to Shelby Co. Covered with gravelly black soil.

Hawthorn formation. (Of Alum Bluff group.)

Miocene (lower): Central northern, northern and southern Florida, southern and southeastern Georgia, and South Carolina.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 81–82, 107–112, 157, 158, 326). *Hawthorne beds.*—Beds of phosphatic rock, more or less broken up and inclosed in a younger matrix, overlying Vicksburg ls. at "Devil's Millhopper," near Gainesville, Ga., and occurring as remnants in place on hilltops near Archer, Arredondo, and other places. Includes (descending) phosphatic oolite, soft ss., ferruginous gravel, sand, or ss., and greenish yellow clays. Rests on Nummulitic beds of Vicksburg group. Underlies Altamaha grit. Max. thickness 125 ft. Included in Chattahoochee group.

Later work by G. C. Matson (U. S. G. S. Bull. 604, p. 13, 1915) led him to believe these beds were same as Alum Bluff, the better-established name, and *Hawthorn fm.* was therefore abandoned. Later work by Julia Gardner led her to opinion (1925) that Hawthorn fm. was=only basal part (Chipola fm.) of Alum Bluff group, and the name still remained abandoned. In 1929 (Fla. Geol. Surv. 20th Ann. Rept.), however, C. W. Cooke and S. Mossom revived *Hawthorn fm.* as designation of a lithologic unit (chiefly phosphatic ls. and fullers earth) within Alum Bluff group (of lower and middle Mio. age), and chiefly if not wholly=Chipola fm. (of different lithology) of Alum Bluff group, but which may include a representative of Oak Grove sand. As redefined by Cooke and Mossom the Hawthorn fm. includes the original Hawthorn "beds" of Dall, but excludes the *Cassidulus*-bearing ls. and chert that Matson and Clapp [Fla. Geol. Surv. 2d Ann. Rept., pp. 69–74, 1909] placed in Hawthorn fm. but which is now known to be Tampa. With it are tentatively included Dall's Jacksonville ls. and Manatee River marl, which it has been found impracticable to map separately, although their faunas seem to be younger than that of typical Hawthorn. Dall's Sopchoppy ls., of Chipola age, is also placed in Hawthorn fm. According to T. W. Vaughan and Julia Gardner the †Jacksonville fm. is of upper Mio. age, and younger than any part of Alum Bluff group. The typical Hawthorn fm. is considered by Gardner, Cooke, and Mossom to be of Chipola (lower Mio.) age.

Named for exposures at Hawthorn, Alachua Co., Fla.

†Hawthorne formation.

See *Hawthorn fm.*, the approved spelling.

Hawxby shale.

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr., 6th Ann. Field Conf. Kans. Geol. Soc.). [*Hawxby sh.* shown as underlying Falls City ls. and overlying Aspinwall ls., all included in Admire sh. Derivation of name not stated.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Hawxby sh. fm.*—Light bluish-gray calc. sh. cut by thin-bladed material, 10 ft., underlain by 2½ ft. of bluish-gray and locally red sh. with an argill. subzone. Underlies Falls City ls. fm. and overlies Aspinwall ls. fm.; all included in Admire group. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville ls. to Perm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of Hawxby sh. is Hawxby farm, SE¼ sec. 7, T. 4 N., R. 15 E., Nemaha Co., Nebr., 5± mi. W. of Nemaha.

Haybro formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado (Yampa coal field).

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Haybro fm.*—Sh., ss., and coal beds, with Hayden Gulch ss. memb. (50 ft. thick) at top in part of Yampa field. In W. part of Daton Peak quad. and N. of Yampa River the Haybro is largely ss. and Hayden Gulch memb. can not be separated. Thickness of fm. 600 to 800 ft. The small coal-mining village of Haybro, on Denver & Salt Lake R. R., on Oak Creek, is built on this fm. Is basal fm. of Mesaverde group in Yampa coal field. Overlies Mancos sh. and underlies Milner fm.

Hay Creek formation.

Lower Cretaceous: Northeastern Wyoming and western South Dakota (Black Hills).

W. P. Jenney, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, p. 593, fig. 122, and map). *Hay Creek coal fm.*—In Hay Creek coal field, Crook Co., Wyo., consists of (descending): (1) Massive ss., ocher yellow, weathering yellow brown, underlain by gray and drab clay shales with local thin coals and plant remains, 10 to 20 ft.; (2) coal, mined at Larrabee, Young, and Barrett, 2 to 6 ft.; (3) gray clay sh. and sandy sh. with plant remains, 20 to 35 ft.; (4) soft gray or yellow sss. with carbonized plant remains, 5 to 20 ft. Underlies Barrett shales, without positive evidence of uncon., and uncon. overlies Upper Jurassic Beulah clays [Morrison fm.] in Black Hills. [Presumably named for Hay Creek, Crook Co., Wyo., and Butte Co., S. Dak. In Wyo. these beds are mapped along South Fork of Hay Creek.]

Appears to be same as Lakota fm., better-established name.

Hayden Gulch sandstone member (of Haybro formation).

Upper Cretaceous: Northwestern Colorado (Yampa coal field).

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Hayden Gulch ss. memb. of Haybro fm.*—Massive white ss., 50 ft. thick, forming top memb. of Haybro fm. in part of Yampa coal field. In W. part of Daton Peak quad. and N. of Yampa River the Haybro fm. is largely ss. and Hayden Gulch memb. cannot be separated. Named for exposures in Hayden Gulch.

Hayden Peak latite.

Tertiary: Southern Colorado (Bonanza district, Saguache County).

H. B. Patton, 1916 (Colo. Geol. Surv. Bull. 9, pp. 21–63). *Hayden's Peak latite.*—Fine-grained brownish-gray massive rock, with minute inconspicuous feldspar phenocrysts; quartz in groundmass. Occurs on summit of Hayden's Peak and North Hayden's Peak.

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Hayden Peak latite.*—Local flows, tuffs, and breccias; probably some intrusives. Thickness 1,000 to 1,500 ft. Believed to be in part contemp. with Bonanza latite and in part younger. Rests on Rawley andesite. Includes Hayden Peak latite of Patton and some underlying rocks mapped by Patton as andesite and Bonanza latite. Occurs on summit of Hayden Peak.

Hayes River beds.

Tertiary: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 172–173, 184). *Hayes River beds.*—Slightly consolidated sands and gravels containing lignite beds. Just below mouth of Hayes River, on the Skwentna, they consist of gray and yellow, partially consolidated sed. beds, some soft, some harder. Farther up the Skwentna, nearly opp. mouth of Hayes River, a bluff 100 to 120 ft. high is composed of these beds. Believed to be younger than Kenai beds; and tentatively referred to Neocene.

Hayes River group.

Pre-Cambrian: Manitoba.

J. F. Wright, 1928 (Canada Geol. Surv. Summ. Rept. 1927, pt. B, pp. 63, 64).

Hayfield shale.

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [In table *Bradfordian (Upper Dev.)* of Erie Co., Pa., is divided into (descending): *Hayfield sh.;* Cussewago ss.; Riceville sh.; Venango group, with Le Boeuf ss. (=Panama cgl.) at base. Corry ss. shown uncon. on Hayfield sh.]

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 463, 464). [Repeated 1923 table of subdivisions of Upper Dev. *Bradfordian* in Erie Co., Pa., and expressed opinion that "the Cussewago sand is followed by an increasing thickness of true (non-Bedford) Cussewago sh., which for distinction we will rename *Hayfield sh. (and ls.).*" He also mentioned the thin *Cussewago (Hayfield) ls.* beneath the Hayfield sh.]

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202), applied *Glade ss.* to the ss. underlying *Hayfield sh. memb. of Knapp fm.* in NW. Pa., but did not explain its relations to Cussewago ss. He treated his Hayfield as top memb. of Knapp fm.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 103, 116–119), restricted *Hayfield sh.* to upper part of Hayfield sh. of Chadwick, and named the lower part *Tidioute sh. memb.* He stated that latter sh. is present but meagerly developed at Hayfield type loc. (which he stated is Hayfield Twp, Crawford Co.), and that it rests on Cussewago ss., upon which the Hayfield of Chadwick was defined as resting. Caster renamed Hayfield ls. of Chadwick the *Littles Corner ls.*, and included it in his Hayfield sh. restricted. On p. 103 he stated Hayfield sh. is 25 to 40 ft. thick; on p. 116 he gave thickness of 10 to 60 ft. Caster also (p. 116) used *Hayfield monothem* to include his Hayfield sh. restricted and his (underlying) Tidioute sh. memb., and gave its thickness as 60 ft. He assigned it to Miss. G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 305–354) assigned all of *Bradfordian* to Upper Dev.

Hayfield limestone.

Devonian or Carboniferous: Northwestern Pennsylvania.

See 1925 entry under *Hayfield sh.*

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71), replaced this name with *Littles Corner ls. memb.* "Same as Cussewago ls. of I. C. White."

Hayfield monothem.

See 1934 entry under *Hayfield sh.*

Hay Fork beds.

Miocene: Northwestern California (Trinity County).

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 43–44). [Described deposits near town of Hay Fork, Trinity Co., consisting of sss. and shales, locally associated with coal, and probably extending 10 mi. nearly E. and W., with width of about 1 mi. Contain Tert. fossils and are probably of upper Mio. age. In one place casually alluded to them as *Hay Fork beds.*]

J. S. Diller, 1903 (Am. Jour. Sci., 4th, vol. 15, pp. 342–362). [Described upper Mio. beds of Hay Fork region and throughout text called them *Hay Fork beds.*] "Formed in an estuary near sea level."

Hay Hollow sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

M. I. Goldman and H. M. Robinson, 1920 (U. S. G. S. Bull. 686Y, pp. 362–363). *Hay Hollow ss.*—Slabby ss., generally 1 ft. or less thick, fine-grained, compact, hard, and of rather warm yellow color. At many places contains peculiar winding cylindrical ss. casts an inch in diam., closely interwoven, which cover surfaces of slabs. As it lies 40± ft. below top of Cheshewalla ss., isolated in midst of a thick series of sh., and weathering out in a well-defined line of large broken slabs, it is easily recognized, but care must be taken not to confuse it with a somewhat similar hard slabby bed which lies 10 or 15± ft. below top of Cheshewalla ss. and also forms conspicuous outcrop in midst of sh. around Sundown Hill and around the point W. of mouth of Hay Hollow. This higher bed, however, is orange-colored, rather than yellow, and generally rich in impressions of fossils, especially bivalves, instead of wormlike markings so common on surface of Hay Hollow ss. Named for occurrence along upper part of Hay Hollow in secs. 25 and 36, T. 28 N., R. 11 E.

Haymaker beds.

Upper Devonian: Western New York (Genesee River region).

G. H. Chadwick, 1934 (Geol. Soc. Am., Prel. list of titles and abstracts of papers to be offered at 47th ann. meeting, Rochester, N. Y., Dec. 27–29, 1934, p. 12). [See 1934 entry under *Cadiz beds.*]

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.* Type loc. not stated.]

Haymond formation.

Pennsylvanian (Pottsville): Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex., Bur. Econ. Geol. and Tech. Bull. 44, p. 46). *Haymond fm.*—Sss. and shales with same characteristics as those of Tesnus fm. Thickness 500 ft. Named by Baker. Lies btw. Dimple fm. below and Leonard fm. above. Is top fm. of Penn.

C. L. Baker, 1928 (A. A. P. G. Bull., vol. 12, p. 1114). Validity of Haymond as distinct fm. is uncertain. It appears to be exact lithologic counter-part of the Tesnus. It may be overthrust on the Dimple.

C. Schuchert, 1927 [See 1927 entry under *Tesnus fm.*]

C. L. Baker, 1928 (A. A. P. G. Bull., vol. 12, p. 1114). Validity of Haymond as distinct fm. is still uncertain. Appears to be exact lithologic counterpart of Tesnus. May be overthrust on Dimple.

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). *Haymond fm.* is 1,800+ ft. thick (total unknown). It clearly overlies Dimple fm. and is a valid fm. It grades into overlying Gaptank fm. Few fossils. Correlates with some part of Strawn of central Tex. Lithologically resembles the much older Tesnus fm.

The U. S. Geol. Survey at present classifies this fm. as of Pottsville age. (See U. S. G. S. P. P. 187, in press.)

Named for exposures NW. and SE. of Haymond, Brewster Co.

Haynesville sand.

See *Oakes sand.*

Haynies limestone.

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northwestern Missouri, and northeastern Kansas (?).

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 49, 50). *Haynies ls.*, 8 inches to 1 ft. thick in SE. Nebr., 9 inches in SW. Iowa, 1⅔ ft. in NW. Mo., and 2+ ft. in NE. Kans. Underlies Mission Creek sh. and overlies Larsh sh., all included in Deer Creek ls. Named for outcrop in foot of the bluffs SE. of Haynies Station, Mills Co., Iowa.

G. E. Condra, 1933 (Nebr. Geol. Surv. Paper No. 2), used *Plummer ls.*, in Iowa, for the beds formerly called *Haynies ls.*, and stated (p. 5): The "Haynies ls." memb. of the Deer Creek, according to Condra and Moore, is the Plummer ls. of Okla.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 186). *Haynies memb.* seems exactly to correspond to upper bed of Plummer ls. as originally defined, and it is possible Rock Bluff ls., Larsh sh., and Haynies ls. together are=original Plummer ls. [On p. 187 he stated:] Because sh. btw. Ervine Creek ls. and Rock Bluff ls. in Kans. appears to be exactly=Larsh sh., Haynies ls., and Mission Creek sh. of Nebr. it is here called *Larsh-Mission Creek sh. memb. of Deer Creek ls.* It is 2½ to 7 ft. thick. [He omitted *Haynies ls.* from this 1936 classification for Kans.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Also see 1937 entry under *Topeka ls.* for Condra's latest views.

†Hays limestone member (of Niobrara formation).

Upper Cretaceous: Western Kansas and eastern Colorado.

See explanation under *Fort Hays ls.*

Haystack rhyolite.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 107-109, 153-156). *Haystack rhyolite.*—The rhyolites of Haystack Mtn, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the mapped areas of rhyolite in the State are assigned to Dev.

Haystack gypsum member (of Blaine gypsum).

Permian: Southwestern Oklahoma (Greer County).

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 55). *Haystack gyp.*—Massive gyp., 18 to 25 ft. thick, almost pure white but occasionally grayish, with a few thin bands of gypsiferous ss. Occurs in shales which separate Kiser gyp. below from Cedartop gyp. above. Included in Greer div.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324–341). Haystack gyp. memb. is provisionally considered=Ferguson gyp. memb.

Named for Haystack Creek, Greer Co.

Hayward sandstone member.

Permian: Central northern Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Hayward ss. memb.*—Upper 350 ft. of Garber ss., consisting chiefly of heavy ledges of massive red ss., more or less lenticular, generally cross-bedded, and not uncommonly conglomeratic, interstratified with beds of fissile sh. and sandy sh. Overlies Lucien sh. memb. of Garber ss. and is overlain by Fairmont sh. memb. of Hennessey sh. Named for exposures at Hayward, Garfield Co.

Hazel slate. (In Chilhowee group.)

Cambrian (Lower): Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Hazel sl.*—Chiefly black sl., but contains many thin beds of ss. and cgl. In more eastern areas the rock is always a fine black schist. Thickness 600 to 800 ft. Overlies Thunderhead cgl. and underlies Clingman cgl.

Named for Hazel Creek, Swain Co., N. C.

†Hazel sandstone.

Pre-Cambrian: Western Texas.

E. T. Dumble, 1902 (Tex. Acad. Sci. Trans., vol. 4, pt. 2, No. 6, pp. 1–3). *Hazel ss.*—Red ss., 500 ft. thick, in Diablo Mtns. Uncon. overlies schists and underlies heavy-bedded to flaggy cherty or siliceous lss. of various colors, which are supposed to be Algonkian and are correlated with Texan group of Comstock's Llano section and called Texas marbles.

Regarded as an inseparable part of Millican fm.

Named for Hazel mine, Diablo Mtns, El Paso Co.

Hazelton group.

Jurassic (?): Southeastern Alaska (Hyder region) and British Columbia.

W. W. Leach, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 64). *Hazleton (Porphyrite) group,* Jurassic, B. C. [Hazelton is correct spelling.]

A. F. Buddington, 1929 (U. S. G. S. Bull. 807, pp. 17–22, 59, maps, etc.). *Hazelton group* in Hyder dist., Alaska, consists above of tuffaceous graywacke, sl., argillite, qtzite, and rare ls., and below of greenstone, tuff, volcanic breccia, and sparse sl. Is intruded by Coast Range intrusives, of Jurassic or Cret. age. No fossils found. Beds are assigned to Hazelton group because of lithologic similarity to the fms. of that group to SE. and N. in B. C. and because of similar structural relations to Coast Range intrusives. It has been described by G. Hanson (Canada Geol. Surv. Summ. Rept. 1923, pt. A, pp. 32–36, 1924) as consisting of a lower fm. of volcanic tuff, breccia, and flows of green or gray to purplish andesitic rock, and an upper fm. of argillite, qtzite, and tuffaceous ss. The argillite of upper div. carries Jurassic fossils. Schofield and Hanson (op. cit., pp. 10–13) have divided the rocks on B. C. side of Int. Bdy into (descending) Nass fm., Salmon River fm., and Bear River fm. The lower div. in Hyder dist. is continuous with Bear River fm. of B. C.; a bed resembling Salmon River cgl. was seen at one place; and it is very probable Nass fm. is represented in Hyder dist.

†Hazlet sands.

Upper Cretaceous: New Jersey.

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 315, 329). *Hazlet sands.*—Chiefly sands, highly ferruginous and brown in color in lower portions and often affording indurated crusts. Above the brown sand is frequently a well-developed dark-colored clay very like lower part of underlying Crosswicks clays. Compose upper part of Matawan fm. Conformably overlain by Mount Laurel sands. Named for Hazlet, Monmouth Co.

W. B. Clark, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 435–440). The *Hazlet sands* include Marshalltown sand and clay above and Columbus [Englishtown] sand below, and compose upper part of Matawan fm. [Clark et al., also included Wenonah sand, since they extended the name to base of Mount Laurel sand.]

This name is now considered to be superfluous, and its use has been discontinued.

Hazleton group.

Jurassic (?): British Columbia and southeastern Alaska.

See *Hazelton group*, the correct spelling. Named for town of Hazelton, B. C., which was named for the profusion of hazel bushes in its vicinity.

†Headlight porphyry.

A name that has been applied locally to a granodiorite porphyry, of probably earliest Cret. age, in Trinity Co., Calif.

Headquarters granite.

Pre-Cambrian: Southwestern Oklahoma (Greer County).

C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). Fine-grained brownish-red, often porphyritic intrusive granite of Headquarters Mtn, Greer Co. Older than Reformatory granite and younger than the gabbro.

Headquarters schist.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 627). *Headquarters schist.*—Largely greenish gray, chloritic phyllite or schist, with several beds of metaqtzite, glacial metacgl., metadolomite, and schistose basic pyroclastics. Recrystallized but have not lost their most distinctive characteristics. Thickness 2,800± ft. Conformably underlies Heart graywacke, and overlies Deep Lake metaqtzite, probably conformably. Headquarters Park is located on outcrop. Assigned to early Algonkian.

Healdton sand zone.

A series of subsurface sands, 200 to 400 ft. thick, of early Penn. age, in Healdton field, Carter Co., southern Okla., where they lie at 1,730 ft. depth, the Glenn sand lying at 1,130 ft. and the Ord. at 2,220 ft.

Healing Springs sandstone member (of New Scotland limestone).

Lower Devonian: Central western Virginia.

F. M. Swartz, 1930 (U. S. G. S. P. P. 158C). South of Monterey, Va., the New Scotland ls. becomes highly aren. in its lower half, as at Bolar Springs and Dry Run, and finally changes into a heavy-bedded gray calc. ss., as at Clifton Forge, Gala, and in gap W. of Healing Springs, Bath Co. This ss. composes Healing Springs ss. memb of New Scotland ls. Thickness 8 to 20 ft.

Heart metagraywacke.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 631). *Heart metagraywacke.*—Alternation of gray to olive, smoky metaqtzites and chloritic phyllites, much cross-bedded and fine-textured. Thickness 1,500 ft. Conformably underlies Medicine Peak metaqtzite and conformably overlies Headquarters schist. Heart Lake is located on outcrop. Assigned to early Algonkian.

Heartwellville schist.

Upper Cambrian (?): Southwestern Vermont (Bennington County).

Geo. D. Hubbard, 1924 (14th Rept. Vt. State Geol., pp. 278–283, 291, 293, 315, and map). *Heartwellville schist.*—Mica schist. Grades into underlying Whitingham schist through transition zone 5 to 20 ft. thick. Quartz and sericite, in varying proportions, make up 90 to 95 per cent of the rock. Highly siliceous and highly micaceous layers can occur anywhere in the fm. Garnets of a red almandite type occur all through the fm. Is believed to be of sed. origin. Thickness 300 to 1,200 ft. Is overlain by Readsboro schist, from which it is rather sharply separated but with no evidence of erosion. Identity of Greylock [Ord.] and Heartwellville schists is well established, both by position and by mineral composition, structure, and texture.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this fm. to Upper Camb., but without discussion.

Named for fact that town of Heartwellville, Bennington quad., lies on a large area of the schist.

Heath formation.

Mississippian: Montana.

H. W. Scott, 1935 (Geol. Soc. Am. Proc. 1934, p. 367). [See first entry under *Big Snowy group.*]

H. W. Scott, 1935 (Jour. Geol., vol. 43, pp. 1016–1032). *Heath fm.*—Black, petroliferous shales and sss., primarily black shales, forming upper fm. of Big Snowy group. Thickness may reach 500 ft. In most sections 3 ss. beds occur in upper half. On SE. flank of Big Snowy Mtns these ss. beds have been grouped under name *Van Dusen sand,* which should be considered a memb. at top of Heath fm. On NE. flank of Big Snowy Mtns ss. beds occupying same strat. zone, at top of Heath fm., have been named, by O. W. Freeman, *Tyler sand.* It also should be treated as a memb. of Heath fm. The fm. conformably underlies Amsden fm. and conformably overlies Otter fm. Type section is on N. flank of Big Snowy Mtns, in sec. 6, T. 12 N., R. 20 E. Fossils listed. Are closely related to fauna of Brazer ls. of Idaho and Moorefield fm. of Ark.; and are not older than Warsaw nor younger than Upper Chester. Fauna is now being studied.

Heber limestone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 37). *Heber lss.*—Lss., 250 ft. thick; overlie Park sss.; uncon. below Woodside sh.; compose uppermost fm. of Aubreyan series in Utah. [Derivation of name not stated.]

Hebron gneiss.

Probably Carboniferous: Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 121, 122, 140, 142, and map). *Hebron gneiss.*—Shows great variety in composition and structure. Varies from granitic gneiss to highly fissile schist, and it is only when whole area is considered that term *gneiss* seems appropriate. It forms an irregular band almost completely enclosing the Willimantic gneiss. Crosses Hebron Twp. Is intruded by granite. Grades into Willimantic gneiss on one side and into Scotland and Brimfield schists on the other. The Willimantic gneiss is merely a more injected phase of the Hebron. The Bolton schist grades into Hebron gneiss.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 37 and map). *Hebron gneiss* is believed to be of sed. origin and is correlated with Putman gneiss. Willimantic gneiss is igneous.

†Hebron moraine.

A name that was many years ago applied to a moraine of Pleist. (late Wisconsin) age, from Hebron, Ill. Later work proved that this moraine is only a small part of Lake Mills morainic system, and "Hebron" has been discontinued. (See U. S. G. S. P. P. 34, 1904, p. 63; and P. P. 106, 1918, both by W. C. Alden.)

Hecla sandstone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1884 (Ohio Geol. Surv. vol. 5, pp. 96, 124, 128, 1025, 1026). *Hecla ss.*—Massive ss., in Lower Coal Measures, in interval btw. Upper Clarion coal and Putman Hill ls. in Hanging Rock dist., Jackson Co.

W. Stout, 1916 (Ohio Geol. Surv., 4th ser., Bull. 20), stated that Hecla ss. is same as Clarion ss.

Probably named for Hecla, Lawrence Co.

Hector formation.

Pre-Cambrian: Alberta.

C. D. Walcott, 1910 (Smithsonian Misc. Coll., vol. 53, No. 7, p. 428).

Hectozoic.

A time term applied by E. Hitchcock (Geol. Vt., 1861, vol. 1, p. 19) to Quaternary of present usage.

Hedgehog trachyte.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 109–110, 161–162). *Hedgehog trachyte.*—The mass constituting Hedgehog Mtn, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the trachyte of NE. Me. appears to be included in Dev.

Hedges shale. (Of Pocono group.)

Mississippian: Northeastern West Virginia.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Hedges sh.*—Dark-gray to black carbonaceous sh. containing thin seams of anthracite coal. Thickness 170 ft. Underlies Myers sh. and overlies Purslane ss.; all included in Pocono group. Named for occurrence on Hedges Mtn, Berkeley Co.

Hedwig breccia member (of Esmeralda formation).

Miocene (upper): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Hedwig breccia memb.*—Old talus slopes composed of angular fragments of Paleozoic rocks. Thickness 100 ft. Basal memb. of Esmeralda fm. Underlies Round Rock memb. Outcrops in vicinity of Hedwig claim.

Heebner shale. (In Oread limestone.)

Pennsylvanian: Southeastern Nebraska, eastern Kansas, southwestern Iowa, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 32, 33, 37). *Heebner sh.*, of Oread ls. memb., underlies Plattsmouth ls. and overlies Leavenworth ls. Top part is bluish and argill.; lower part is black, finely bedded, and somewhat carbonaceous. Thickness 5 ft. or more. Named for Heebner Creek and Heebner farm, W. of Nehawka.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). The so-called Heebner sh. of Bull. 1 Nebr. Geol. Surv. is Galesburg sh. memb.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12), continued to use *Heebner sh.* for the sh. underlying Plattsmouth ls. and overlying Leavenworth ls., and R. C. Moore also used it in Kans. in his 1936 classification.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Hefty formation.

Pre-Cambrian: Southern British Columbia and northwestern Montana (Galton Range).

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 2, 114° 30′ to 115°). *Hefty fm.*—Chiefly thick-bedded reddish ss. [Mount Hefty, Mont., is on this map and Hefty fm. is mapped just to W. of it.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 99, 178). *Hefty fm.*—Chiefly heavy-bedded red or reddish-gray ss. and qtzite 775 ft. thick. Underlies, with some abruptness, MacDonald fm. and conformably overlies Altyn fm.

Heidlersburg member (of Gettysburg shale).

Upper Triassic: Southeastern Pennsylvania.

G. W. Stose, 1929 (U. S. G. S. Fairfield-Gettysburg folio, No. 225). Largely red sh. and ss. with some green, gray, and black shales, interbedded with which are many harder gray to white sss. Numerous intrusions of diabase have altered some strata to hard white porcelanite and to white, open-textured sandrock of light weight.

A little of the altered sh. is dark-purplish argillite. Thickness 4,800 ft. Occurs near middle of Gettysburg sh.

Named for exposures in vicinity of Heidlersburg, Adams Co.

Heights fanglomerate.

Quaternary: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 392–393, and map). *Heights fangl.*—Several areas of fangl. are found in this region which were laid down under same conditions as obtain at present day, but they have been uplifted and are undergoing dissection. Banning Heights is floored with such an accumulation, which overlies schists and granite, the Hathaway shales and ss., and the Cabezon fangl. In Hog Canyon, Little San Gorgonio Creek, and Cherry Canyon there is an extensive fangl. at same general elev. as Banning Heights. It is of same sort of material and bears same relationships to surrounding topography. On N. side of range there are several areas of fangl. which are probably of about same age as those described above.

A. O. Woodford and T. F. Harriss, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, pp. 279–288). Heights fangl. of Vaughan is included in our Blackhawk breccia. [See under *Blackhawk breccia*.]

Named for Banning Heights, Riverside Co., which it floors.

Heiskell shale.

Lower Ordovician (Chazyan): Southwestern Virginia and northeastern Tennessee.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). [*Heiskell sh.* is shown in table, in Pearisburg trough as largely contemp. with Pearisburg ls., as underlying Lowville and uncon. overlying Holston, and as=Ottosee sh. and upper part of Tellico ss. Probably named for Heiskell, Knox Co., Tenn., in SE. corner of Briceville quad.]

Helderberg group (also **Helderberg limestone**).

Lower Devonian: New York, eastern Pennsylvania, western Maryland and Virginia, and northern West Virginia.

Helderberg system of Conrad, 1839, included Oriskany ss. at top and Rochester sh. at base.

Helderberg sss. of Conrad, 1839, was defined as resting on Helderberg lss., as underlying the "gray brachiopodous ss." (which is overlain by black sl.), and as containing *Fucoides cauda galli.*

Helderberg lss. of Conrad, 1839, underlie Helderberg sss. and overlie Second Pentamerus ls., which rests on gypseous shales [Salina fm.].

Helderberg ls. group of Mather, 1840, and of James Hall, 1842, and *Helderberg ls. series* of Mather, 1841, extended from base of Marcellus sh. to top of Salina fm.

Helderberg series of E. Emmons, 1842, and his *Helderberg div.* of 1846, extended from base of Marcellus sh. to top of Manlius ls.

Helderberg ls. of E. Emmons, 1842, applied to beds btw. Marcellus sh. and Schoharie grit, or to Onondaga ls. of present terminology.

Helderberg division of Vanuxem, 1842, *Helderberg series* of James Hall, 1843, and *Helderberg div.* of Mather, 1843, and of E. Emmons, 1846, extended from base of Marcellus sh. to top of Niagara group.

Upper Helderberg group of James Hall, 1851, extended from base of Marcellus sh. to top of Oriskany ss. This definition was used by J. D. Dana in several editions of his Textbook of geology, including 1869 ed., and was for many years followed by Hall and some other geologists.

Upper Helderberg group of C. H. Hitchcock, 1866, excluded Esopus grit.

Upper Helderberg ls. of E. Hitchcock, 1867, applied to beds btw. Marcellus sh. and Schoharie grit, or to Onondaga ls. of present usage.

Lower Helderberg group of James Hall, 1851, extended from base of Oriskany ss. to base of "Tentaculite or water ls.," described as resting on Onondaga salt group. In 1859 (also 1874) Hall drew base of his *Lower Helderberg group* at base of Tentaculite [Manlius] ls., which he described as overlying the Waterlime group. This definition nearly corresponds to that of *Helderberg group* as now commonly recognized, except that it included Manlius. It was not, however, immediately adopted, for some geologists for many years continued to include the "Waterlime group."

Great variability in the use of the names "Upper Helderberg group," "Corniferous group," and "Lower Helderberg group" and in the limits assigned to these divisions continued for many years. In 1899 (Sci., n. s., vol. 10, pp. 874–878) J. M. Clarke and C. Schuchert restricted Helderberg, under name *Helderbergian period or group*, to interval btw. base of Oriskany ss. and top of Manlius ls., or to "Lower Helderberg" of previous repts. In their Helderbergian they included at top 250 ft. of beds (called "Kingston beds") above Becraft ls. These beds—now divided into Alsen ls. and Port Ewen ls.—were transferred to Oriskany group in 1903, by C. Schuchert (Am. Geol.). (Clarke and Schuchert's subdivisions of the Helderberg were: Kingston beds, Becraft ls., New Scotland ls., and Coeymans ls.) In 1908 (Sci., n. s., vol. 28, pp. 346–348) G. H. Chadwick also included the Port Ewen in the Oriskanian, stating that the fauna has many affinities with overlying Oriskany lss. and that Dr. [J. M.] Clarke has therefore recommended the transfer of these beds to the Oriskanian, in spite of preponderance of Helderbergian elements. Chadwick also added another fm. to Helderberg group, designating as *Kalkberg ls.* "certain layers heretofore included variously by writers with the beds above [New Scotland] or below" [Coeymans]. Chadwick's subdivisions for N. Y. (Becraft, New Scotland, Kalkberg, and Coeymans) are those commonly accepted today, although A. W. Grabau in 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 468–470) separated from base of Port Ewen ls. 20 to 50 ft. of cherty lss. "containing a modified Becraft fauna," to which he applied the name *Alsen cherty ls.* He stated that these beds are separated from rest of the Port Ewen, in which they had previously been included, by a big hiatus and discon.

The N. Y. State Survey now divides Helderberg group into (descending) Port Ewen ls., Alsen ls., Becraft ls., New Scotland ls., Kalkberg ls., and Coeymans ls. (See W. Goldring, 1931, N. Y. State Mus. Hdb. 10.)

The U. S. Geol. Survey now includes Port Ewen ls. in Oriskany group, to which it belongs, according to C. Butts.

Where the Helderberg deposits are not subdivided they are called *Helderberg ls.*

Named for fact that the deposits form basal part of Helderberg Mtns in Albany Co., N. Y.

†Helderberg division.
†Helderberg sandstones.
†Helderberg series.
†Helderberg system.
See under *Helderberg group.*

Helderbergian.

See under *Helderberg group.* A time term covering interval during which the rocks of Helderberg group were deposited.

Helen iron-formation.

Pre-Cambrian (Keewatin): Western Ontario.

A. P. Coleman and A. B. Willmott, 1902 (Ont. Bur. Mines Rept. 1902, p. 182, and Toronto Univ. Studies, geol. ser., No. 2, p. 11). *Helen iron fm.* Assigned to Huronian.

C. R. Van Hise and C. K. Leith (U. S. G. S. Bull. 360, 1909, and U. S. G. S. Mon. 52, 1911) assigned this fm. to Keewatin, as did C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184).

Helena limestone.

Pre-Cambrian (Belt series): Western central Montana (Belt Mountains).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Helena ls.*—More or less impure bluish-gray and gray ls., in thick layers; 2,400 ft. thick. Underlies Marsh sh. and overlies Empire sh.

Exposed in upper part of city of Helena and on hill slopes to E.

Helenan series.

Name employed by C. [R.] Keyes instead of Helena ls. of other geologists. (See Pan-Am. Geol., vol. 44, 1925, pp. 215, 217.)

†Hellam quartzite.

Lower Cambrian: Southeastern Pennsylvania.

P. Frazer, 1886 (Am. Phil. Soc. Proc., vol. 23, pp. 396, 398–400). *Hellam qtzite, Cambric.*—Same as Potsdam ss. and Formation No. 1. The base of the Paleozoic. A part of it composes Chikis Mtn. Contains *Scolithus linearis.* The *Hellam or Chikis qtzite* is a hard quartzose rock, generally white or gray, tinted by some other color, usually pink, brown, or blue. Is almost always crystalline. In Chester Co. lies uncon. on Archean schists.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 78, 135, 165–166, 199). *Hellam qtzite* is name adopted by Frazer in his York Co. rept. (C_2) because of extensive spread of the fm. over Hellam Twp, where several large quarries work it out, and its characteristic *Scolithus* fossils are abundant. Chiques ss. is not only oldest name for this fm. but is locality of its finest exposure.

See also *Chickies qtzite.*

Hellam conglomerate member (*of Chickies quartzite*).

Lower Cambrian: Southeastern Pennsylvania.

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 360–362). *Hellam cgl. memb. of Chickies qtzite.*—Quartz cgl., grainy qtzite with rounded clear and blue quartz grains, and sl., chlorite schist at base in Hellam Hills, York Co. Thickness 600 ft. in Hellam-Chickies Hills; 150 ft. in Welsh Mtn. Is basal memb. of Chickies qtzite. Rests uncon. on pre-Camb. epidotic amphibolite schist or greenstone and aporhyolite. Named for exposures in midst of Hellam Hills, 3 mi. W. of Chickies Rock.

Hell Creek formation.

Upper Cretaceous: Eastern, northern, and central southern Montana, southwestern North Dakota, and northwestern and northern South Dakota.

B. Brown, 1907 (Am. Mus. Nat. Hist. Bull., vol. 23, art. 33, pp. 829–835). *Hell Creek beds.*—Fossil-bearing, fresh-water deposits of alternating sss. and clays 560 ft. thick in W. half of Dawson Co., Mont. Most constant memb. of series is massive ss. at base, 0 to 160 ft. thick. Probably continuous with the dinosaur-bearing beds of Little Missouri and Grand and Moreau rivers, judging from fauna. *These beds, with the underlying and overlying deposits, are typically* exposed on Hell Creek [Garfield Co.] and nearby tributaries of Missouri River. Assigned to Upper Cret. Separated from overlying Fort Union fm. by 100 ft. of lignite beds, here called *Fort Union* (?). Rests uncon. on Fox Hills fm. Lithologically similar in almost every respect to Ceratops beds of Converse Co., Wyo.

W. T. Thom, Jr., and C. E. Dobbin, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 484–499). *Hell Creek memb. of Lance fm.* as here defined is typically exposed on Hell Creek, Garfield Co., Mont., and is="Hell Creek beds" plus "lignite beds" of Brown (1907), occupying the interval btw. Fox Hills ss. below and the yellow Tullock memb. of the Lance above. In SW. N. Dak. it is overlain by either Ludlow lignitic memb. of the Lance or the contemp. Cannonball marine memb. of the Lance, and it rests on Fox Hills ss. It consists of somber, badland clays, probably accumulated in topset swamps of a great delta, and fluviatile sss., the latter being more numerous and conspicuous toward SW. Remains of a few small mammals have been found in the sss. Dinosaurs (including *Triceratops*) are numerous below the "A" lignite, which marks base of Brown's "lignite beds," but probably have not been found above that horizon. [Mention other fossils.] The Hell Creek and overlying strata are markedly calc. in contrast with the brown memb. of the Fox Hills and older rocks, which are relatively free from lime. In Cedar Creek anticline, Mont., the Hell Creek memb. overlies Colgate ss. memb. of Fox Hills ss.; at mouth of Cannonball River, N. Dak., it rests on Fox Hills ss. [Diagram on p. 484 shows no uncon. above or below Hell Creek memb.]

These rocks are now called *Hell Creek fm.* by U. S. Geol. Survey, and classified as *Upper Cret.*, as explained under *Lance fm.*, last entry.

Heller dacite.

Tertiary (may be upper Miocene): Central Nevada (Tonopah district).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 37+). *Heller dacite.*—Vesicular glassy dacite containing numerous inclusions (sometimes large boulders) of pumiceous material, frequently of later andesite, and occasionally of coarse siliceous granite. Composes Heller Butte, near town of Tonopah. Is older than Brougher dacite. Appears to dip under Fraction dacite breccia and to immediately precede the formation of that breccia. The Heller dacite formed numerous small cones along lines of weakness and was poured forth in relatively limited quantities.

According to T. B. Nolan (personal communication, Jan. 3, 1933) this rock may be contemp. with Esmeralda fm. (upper Mio.).

Hellgate formation.

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deiss, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 679, figs. 2, 3). *Hellgate fm.*—Type section (on N. side of Mount Sentinel, the S. wall of Hellgate Canyon) consists of (descending): (1) Massive, gray-red siliceous qtzite, weathering variegated gray, buff, and lavender, 365 ft.; (2) massive gray and red gray fine to coarse-grained finely banded pure qtzite and sandy qtzite, ripple marked, 280 ft.; (3) massive thick-bedded pink-gray qtzitic ss., weathering buff, 1,160 ft.; (4) massive, gray, fine-grained, siliceous qtzite, ripple-marked, weathering buff, 300 ft.; (5) massive red-gray coarse-grained qtzite, with sandy beds up to 3 ft. in thickness, weathering buff and dull lavender, 95 ft. Conformably underlies McNamara fm. and uncon. (?) overlies Miller Peak fm.; all included in Missoula group.

Hell Gate porphyry.

Pre-Cambrian: Central Colorado (Lake Fork-Ivanhoe region).

J. T. Stark and F. F. Barnes, 1932 (Am. Jour. Sci., 5th, vol. 24, p. 474). Granitic material, which may represent either true intrusion from Silver Plume magma or a porphyroblastic replacement of schist, is well exposed at Hell Gate narrows, 5 mi. W. of the divide on Lake Fork-Ivanhoe section. Similar granitic material alternates with schistose rock for over 10 mi. from the divide in the section down Ivanhoe and Frying Pan creeks. This rock, the origin of which is still in question, has been termed *Hell Gate porphyry.*

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, p. 474, map), assigned this fm. to pre-Camb. "It is believed Hell Gate porphyry merely represents a particular stage or phase of migmatization of Sawatch schist by Silver Plume granite, but because of its distinctive appearance in field it has been mapped separately."

Helms formation.

Mississippian and Devonian (?): Western Texas (Hueco Mountains).

J. W. Beede, 1921 (Univ. Tex. Bull. 1852, pp. 8, 30, 36). *Helms group (Miss.)*.—Yellowish thin-bedded rocks. Local facies vary somewhat from place to place, but main features are almost always present. Locally there are thin sss. in top of Helms group. To N. of Long Canyon nearly the whole series is made up of platy drab to dark-buff lss. (which as a rule weather buff), with, locally, considerable chert in concretions, masses, and layers, and some ss., all separated by thin layers of marl that weathers buff. Below is a covered slope largely composed of clay sh. Fossils in most beds, but rare except locally in uppermost part of section. According to S. Weller is of Chester age. Thickness of fm. 400 to 600 ft. [Gives a detailed section 1± mi. S. of Helms Peak, Huéco Mtns.] Uncon. underlies Magdalena group (Penn.). [Originally included in Hueco ls.]

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 909). *Helms group*, 400 to 700 ft. thick, includes beds of Chester, lower Miss., and Upper Dev. age.

The upper 500 ft. of Helms fm. of Hueco Mtns contains a Chester fauna (G. H. Girty, unpublished rept.); the remainder of fm. is unfossiliferous.

Hemlock greenstone.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Crystal Falls district).

J. M. Clements, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 45–63, pl. 9, opp. p. 84). *Hemlock fm.*—Consists almost wholly of typical volcanic rocks, both basic and acid, with crystalline schists derived from them. Sedimentary rocks play very unimportant role; with one exception they have been formed directly from the volcanics and occur interbedded with them. Thickness 23,000(?) ft. On the whole the Hemlock fm. is younger than Mansfield sl., but some of lower Hemlock beds are contemp. with some of upper Mansfield beds. Is overlain by Upper Huronian. Named for fact Hemlock River flows through the fm. for a number of miles.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 291, 294–296, 300, 323, 507, 607). *Hemlock fm.* (*volcanic*).—Thickness 1,000 to 10,000 ft. Earlier estimated thickness of 23,000 ft. probably illusory. Includes at [pp. 295 and 607 say *near*] top iron-bearing sl. memb., 1 to 1,900 ft. thick, formerly called "Mansfield sl." General strat. position of Hemlock fm. is conformably above Randville dol. and beneath upper Huronian slates, but like most volcanic fms. its relations differ in different parts of dist. Well-bedded cherty slates, iron-bearing lenses, and ls. are interbedded with Hemlock fm. and also both underlie and overlie it. The volcanic rocks are similar in all respects to Keewatin volcanic rocks and to volcanic Clarksburg fm. of Marquette dist. [In chart on p. 598 Hemlock fm. is placed beneath Ajibik qtzite in Crystal Falls dist. and uncon.(?) above Randville dol. Pages 300 and 323 state it is overlain, doubtfully uncon., by upper Huronian in Crystal Falls dist.]

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184) changed name to *Hemlock greenstone*, and stated that it is of Algonkian type.

Hempfield shale member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 141). *Hempfield sh. memb. of Shenango monothem.*—Overlies Shenango ss. memb. and is the *Shenango sh.* of I. C. White's Crawford Co. rept. Is well shown in and about Greenville, Hempfield Twp, Mercer Co.

Hemphill beds.

Pliocene (lower): Texas Panhandle (Hemphill County).

L. C. Reed and O. M. Longnecker, Jr., 1932 (Univ. Tex. Bull. 3231, pp. 16–43, 70–83, map). *Hemphill beds* [also *Hemphill fm.*].—Lower Plio. mammal-bearing beds of Hemphill Co., Tex., consisting chiefly of sands, with lesser amounts of clay, gravel, and caliche. The sands occur throughout the section, while the clays form thin partings. Gravel occurs at base and in upper part. Caliche is confined to uppermost beds. Thickness of fm. 550 ft. Since these beds, according to the fauna, represent a heretofore undescribed fm. of the Lower Plio., the name *Hemphill beds* is here given to them to be applied as a faunal horizon. [Divided into 4 members, which are described in great detail.] Rests uncon. on Perm. (?) red beds.

G. G. Simpson, 1933 (Am. Mus. Nat. Hist. Bull., vol. 67, pp. 98, 99). Clarendon and Goodnight-Hemphill are both distinctly older than Blanco. Hemphill seems to be late Lower Plio., btw. Clarendon and Blanco.

Hempstead gravel member (of Manhasset formation).

Pleistocene: Southeastern New York (Long and adjacent islands) and islands of southern New England (Block, Marthas Vineyard, No Mans Land, and probably Nantucket and Cape Cod).

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Hempstead gravel memb.*—Top memb. of Manhasset fm. Description of Herod gravel memb. applies equally well to Hempstead gravel memb. Rests conformably on Montauk till memb. Overlain by glacial deposits of Wisconsin age. Named for exposures in upper parts of many large gravel pits along W. side of Hempstead Harbor, Long Island. Thickness 0 to 75 ft. Occurs on Long Island and on Plum, Gardiners, and Robins Islands. Time of deposition called *Hempstead substage.*

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Hempstead gravel memb.* present on Marthas Vineyard, Block Island, No Mans Land, and probably on Nantucket Island and Cape Cod.

F. G. Wells, 1935 (Geol. Soc. Am. Proc. 1934, p. 121), regarded Manhasset fm. as of Wisconsin age, as do some other geologists.

Hempstead substage.

The time covered by deposition of *Hempstead gravel memb.*

Henderson granite.

Pre-Cambrian: Western North Carolina and northwestern South Carolina.

A. Keith, 1905 (U. S. G. S. Mount Mitchell folio, No. 124, p. 4). *Henderson granite.*—Composed mainly of orthoclase and plagioclase feldspar, quartz, muscovite, and biotite, enumerated in order of importance. Intrusive into all Archean rocks with which it comes in contact. On E. it extends only short distance beyond Mount Mitchell quad. into adjoining Morganton quad., but toward SW. it increases greatly in width and reaches far into S. C. Assigned to Archean.

Named for extensive areas and exposures in Henderson Co., N. C.

Henderson moraine.

Pleistocene (Wisconsin stage): Central Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Henderson, Shiawassee Co.

Hendricks series.

Hendricks member.

Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).

R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21, p. 155). *Hendricks series.*—Alternating beds of high calcium and low to high mag. lss. or normal dol. Thickness 145+ ft. Underlies Fiborn ls. and overlies Rochester sh.; all included in Niagara. Named for exposures in Hendricks quarry, sec. 1, T. 44 N., R. 9 W., Mackinac Co.

G. M. Ehlers, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 129). *Burnt Bluff fm.* [new name] includes Fiborn ls. and upper part of Hendricks series of R. A. Smith.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 23, 37). *Hendricks memb.*, top memb. of Burnt Bluff fm. Overlies Byron memb. [See 1933 entry under *Burnt Bluff fm.*]

Hendricks sandstone.

Upper Devonian: Northern West Virginia.

D. B. Reger and W. A. Price, 1923 (W. Va. Geol. Surv. Rept. Tucker Co., pp. 103, 240, 241, 245–254). *Hendricks ss.*—Fossiliferous ss., conglomeratic in W., fine-grained in E., lying about 100 ft. below top of Chemung series. Marine fauna. Thickness 6 to 10 ft. Ripple marks on upper surface; pebbles of green sh. at base; much iron oxide.

Named for exposure 1 m. NE. of town of Hendricks, Tucker Co., in Black Fork dist., on point of ridge E. of mouth of Falls Run, in highway leading from town of Hambleton along W. slope of Backbone Mtn and over the mtn to Douglas, in Fairfax dist.

Henley beds.

A name used, but not defined, by F. M. Anderson (Calif. Acad. Sci. Proc., 3d ser., vol. 2, 1902, pp. 1–62) for part of the lower beds of Chico age in S. part of Oregon Basin.

Henley shale member. (In Cuyahoga formation.)

Mississippian: Southern Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 758, 760, 762, 769). *Henley sh. memb.*—Alternating gray and red shales and sss., the red color and the sss. disappearing to E. Thickness 5½ to over 226 ft. Basal memb. of Cuyahoga fm. in Scioto, Pike, and Ross Counties. Underlies Buena Vista ss. memb. ("City Ledge") and overlies Sunbury sh. Is lower part of Buena Vista memb. of Prosser and Cumings.

Named for Henley, Scioto Co.

Hennessey shale.

Permian: Central Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Hennessey sh.*—A series of clay shales, approx. 400 ft. thick, in north-central Okla. underlying Duncan ss., overlying Garber ss. and corresponding to lower part of Harper ss. of Kans. These shales are rarely fissile or laminated, but more commonly blocky, and break with conchoidal fracture. Are characterized by numerous bands or streaks of white or light green color, varying in thickness from a few inches to 4 or more ft. Divided into Bison ss. memb. above and Fairmont sh. memb. below. Included in Enid group. Named for exposures at Hennessey, Kingfisher Co.

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 252–256), proposed to redefine Hennessey and Garber, but J. C. Ross objected. See under *Garber ss.*

Henrietta formation (group in Kansas).

Pennsylvanian: Southern Iowa, western Missouri, and northeastern Kansas.

C. R. Keyes, 1897 (Iowa Acad. Sci. Proc., vol. 4, pp. 23–24, 25). *Henrietta ls.*—Several ls. beds separated by shales; 75 ft. thick. Underlies Pleasanton shales and overlies Cherokee shales. *Includes Mystic coal.* Middle fm. of Des Moines stage in Iowa, Mo., and eastern Kans. Includes Pawnee ls. memb. at top, Marmaton fm. in middle, and Fort Scott ls. memb. at base in eastern Kans.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). *Henrietta fm.* as here defined is divided in Mo. into (descending) Pawnee ls. memb., Labette sh. memb., and Fort Scott ls. memb. The Lexington (Mystic) coal and the 6 ft. of sh. separating it from Fort Scott ls. are here transferred to Cherokee sh.

This 1915 definition of *Henrietta fm.* was followed generally until 1931, when R. C. Moore (Kans. Geol. Soc. 5th Ann. Field Conf. chart) dropped the name from the Kans. classification, treating its subdivisions as fms. in his Okmulgee group (which he later replaced by Marmaton group and Cherokee group). The 1933 (57th Bien.) and 1935 (58th Bien.) repts of Mo. Bur. Geol. and Mines, however, continued to use Henrietta as defined by Hinds and Greene.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 57–58). At present there seems to be little good reason to continue use of *Henrietta*. The Marmaton group includes *Henrietta fm.* and lower part of Pleasanton sh. [both of which he dropped from Kans. classification].

Named for Henrietta escarpment, near Henrietta, Johnson Co., Mo.

Henrietta diorite porphyry.

Tertiary: Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 325). [Age not given. Assigned to Tert. by M. L. Lee (Econ. Geol., vol. 7, 1912, p. 328).]

Henry sand.

A subsurface sand lying at 1,850 to 1,900 ft. depth in Lawrence Co., Ill.

Henryan series.

A term employed by C. [R.] Keyes to cover †Henrys Fork group of early repts on Colo. and Utah.

Henryhouse shale.

Silurian (Niagaran): Central southern Oklahoma.

C. A. Reeds, 1911 (Am. Jour. Sci., 4th, vol. 32, pp. 256–268). *Henryhouse sh.*—Along Chimneyhill Creek is bluish to yellowish, thin to moderately thick-bedded earthy ls. and intercalated sh. beds in lower 180 ft., and white marly beds in upper 43 ft. In type area alternating yellowish shales, shaly lss., and bands of reddish ls. occur. Thickness 0 to 223 ft.; average 90 ft. Originally included in middle of Hunton fm. Underlies Haragan sh. and overlies Chimneyhill ls. Contains Niagaran fossils.

Named for Henryhouse Creek, Carter Co., which crosses the outcrop about 3 mi. E. of Woodford.

†Henrys Fork group.

Upper Cretaceous and Upper Jurassic: Northeastern Utah (Uinta Mountains) and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 50, 153). *Henry's Fork group.*—Sss., bad-land rocks, cgls., and shales, with carbonaceous shales and lignitic coal. Thickness 500 ft. Underlies Sulphur Creek group and overlies Flaming Gorge group. Type loc. is S. side of Henry's Fork. [Powell's map shows the fm. exposed along lower end of Henrys Fork, in Uinta Co., Utah, at and above where it unites with Green River.]

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Henrys Fork group of Powell as=Frontier, Aspen, Bear River, and upper part of Beckwith fm. of present terminology of SW. Wyo. In Uinta Mtns it appears to correspond approx. to Dakota (?) fm.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, p. 36). "Henrys Fork group" of Gilbert in Henry Mtns included part of Morrison fm. (Upper Jurassic) and an overlying ss. here called *Dakota (?) ss.*

Hensell sand. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Central Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 141–144, 152). *Hensell sand.*—In descending order: (1) Marly mag. ls., 40 ft.; (2) siliceous ls. underlain by calc. sand, 55 ft.; (3) yellow calc. sand, 15 ft.; (4) cgl., 25 ft.; (5) red sand, 3 ft.; (6) friable yellow sand, 5 ft. Total thickness 143 ft. Included in Travis Peak fm. Underlies upper memb. of Travis Peak fm., which consists of 40 ft. of cgl. and calc. ss. alternating with aren. lss. Overlies Cow Creek beds. Southern equiv. of Bluff Dale sands.

Named for Mr. Hensell's place, at Travis Peak post office, Burnet Co.

Henshaw formation.

Pennsylvanian: Northwestern Kentucky (Shawneetown quadrangle).

Wallace Lee, 1916 (Ky. Geol. Surv., Geol. of Ky. part of Shawneetown quad.). *Henshaw fm.*—Shales, sss., and coals, 175 ft. thick, underlain by 25 ft. of ss. called "Dixon ss." in previous repts. Replaces *Dixon fm.* of previous repts (preoccupied). Is topmost fm. of Penn. in this area. Overlies McLeansboro fm.

Named for Henshaw, Union Co.

Henson tuff. (In Silverton volcanic series.)

Miocene: Southwestern Colorado (Ouray region).

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153). *Henson tuff.*—Pyroclastic fm.; chiefly well-bedded fine-grained greenish- or brownish-gray sandy andesitic tuffs; no calc. shales or ls. layers, in which respect it differs from Burns tuff. Thickness 75–600 ft. Is uppermost fm. of Silverton [volcanic] series. In Silverton folio upper part was put in Potosi [volcanic] series and lower part in underlying pyroxene andesite. No fossils.

Named for exposures on Henson Creek, Ouray quad.

Heppel formation.

Middle Devonian: Quebec.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 83).

Herat shale member (of Ochre Mountain limestone).

Mississippian (upper): Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Herat sh. memb. of Ochre Mtn ls.*—Thin and poorly exposed horizon of black sh. interbedded with ss., lying 1,700± ft. above base of western facies of Ochre Mtn ls. Named for exposures near Herat claims, Gold Hill quad.

See also U. S. G. S. P. P. 177, 1934.

Herbert conglomerate.

Pennsylvanian (early Pottsville): Southeastern Tennessee (Bledsoe, White, Van Buren, Hamilton, and Cumberland Counties).

W. A. Nelson, 1925 (Tenn. Dept. Ed., Div. Geol. Bull. 33A, pp. 49–50, and under county descriptions). Basal memb. of Bonair ss. Consists of 40 to 150 ft. of soft, light-yellow ss., coarse grained and in places conglomeratic. Underlies Eastland sh. lentil of Bonair ss., and rests on Whitwell sh. Best measurement was taken on Glade Creek just N. of where old road from Herbert, Bledsoe Co., to Sparta crosses this stream.

†Herculean shale member. (In Monterey group.)

Miocene: Central western California (San Pablo region).

C. E. Weaver, 1909 (Calif. Univ. Pub., Bull. Dept. Geol., vol. 5, p. 251). *Herculean sh. memb. of Monterey fm.*, underlies Quercan ss. in San Pablo region. [Derivation of name not stated.]

Replaced by *Hercules sh. memb.*

Hercules shale member (of Briones sandstone).

Miocene (upper): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Hercules sh. memb.*—Bituminous sh., 500 ft. thick, forming a memb. of Briones ss. Named for Hercules Station, on San Pablo Bay.

Hercules limestone.

Miners' local name for an ore-bearing ls., 0 to 4 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 90 ft. below Rambler ls. and 150 ft. above St. Patrick ls. Exposed in Hercules claim. (See U. S. G. S. P. P. 173, 1932.)

Herendeen limestone.

Lower Cretaceous: Southwestern Alaska (Alaska Peninsula).

W. W. Atwood, 1911 (U. S. G. S. Bull. 467, pp. 25, 39, etc.). *Herendeen ls.*—Aren. ls., 800 ft. thick, light-gray, locally cross-bedded. Exposed from Herendeen Bay to Port Moller. Underlies Chignik fm. (Upper Cret.) and overlies Staniukovich sh. Contains Lower Cret. fauna.

Herington limestone. (In Sumner group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

J. W. Beede, 1909 (Kans. Acad. Sci. Trans., vol. 21, pt. 2, p. 253). *Herington ls.*—Variable lss., including, in upper part, soft geodiferous, flaggy layers; also harder layers, more massive, very fossiliferous, and of buff shade; and to S. coarser ls. Thickness 12 to 15 ft. Overlies Enterprise shales and underlies Pearl shales. All included in Marion stage.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, in cooperation with U. S. Geol. Survey). "Marion fm." abandoned and *Herington ls.* elevated to rank of a fm. in Sumner group. Overlies Enterprise sh., probably with slight uncon., and underlies Wellington fm. (redefined to include †Pearl sh. at base). [This is present approved definition of U. S. Geol. Survey.]

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), discarded Enterprise; revived Pearl sh. (restricted) for beds overlying Herington ls.; greatly restricted Wellington fm.; applied *Paddock sh.* to beds immediately underlying Herington ls.; and treated Herington as top memb. of his Nolans ls. (new). These changes have not yet been considered by U. S. Geol. Survey for its publications.

See Kans.-Nebr. Perm. chart compiled by M. G. Wilmarth, 1936.
Named for Herington, Dickinson Co., Kans.

Herkimer sandstone.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Herkimer ss.*—This name is derived from Herkimer Co., and is here applied to Upper Clinton "gray band" of Eaton, which stretches conspicuously across southern part of this county with a max. thickness of 70 or 80 ft. at type loc. on Steeles Creek, 5 mi. SW. of Herkimer village. Fossils listed. We believe the Herkimer is only a ss. phase of the Phoenix [sh.]. Overlies Vanhornsville ss. and underlies Donnelly iron ore. [Is a part of Clinton fm.]

Herkimer limestone.

Middle Cambrian: Central northern Utah (Tintic district).

W. Lindgren and G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Herkimer ls.*—Mottled shaly ls., consisting of bluish-black, dense, carbonaceous ls. mottled by thin discontinuous layers or blotches of yellowish-brown material rich in iron and clay. Thickness 225 to 235 ft. Underlies Bluebird ls. and overlies Dagmar ls. Named for Herkimer shaft, E. of Quartzite Ridge.

Herman Creek lava.

Pleistocene: Southwestern Washington and central northern Oregon.

R. W. Chaney, 1918 (Jour. Geol., vol. 26, No. 7, pp. 577–592), described rocks of gorge of Columbia River, Oreg. and Wash., and applied *Herman Creek lava (andesitic basalt)* to rocks overlying so-called Satsop fm. and underlying gravels and river terraces of recent origin. He repeated this section in Univ. Chicago Cont. Walker Mus., vol. 2, No. 5, 1920. Herman Creek is in Hood River Co., Oreg.

Hermansville limestone.

Lower Ordovician: Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Hermansville ls.*—Coarse-grained ss. with abundant calc. cement alternating with pure dol. or oolitic beds. Thickness 100 ft. max. Of Chazy and Beekmantown age. Overlies Lake Superior ss. Is youngest fm. in Menominee dist.

R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14, geol. ser. 11, p. 22). The Calciferous or Lower Mag. ss. (200 to 250 ft. thick in wells along Green Bay), or perhaps only lower part of it, is represented by *Hermansville ls.*

Named for exposures near Hermansville, Menominee Co.

Hermit shale. (Of Aubrey group.)

Permian: Northern Arizona, southern Utah, and southeastern Nevada.

L. F. Noble, 1922 (U. S. G. S. P. P. 131B, pp. 26, 28, 64+). *Hermit sh.*—Deep brick-red sandy shales and fine-grained friable sss., 267 to 317 ft. thick at Hermit Basin, the type loc. Uncon. overlie Supai fm. as herein redefined, but formerly included in Supai fm. under the designations "sh. of Supai fm." and "upper Supai sh." The beds are separated from Supai fm. because of uncon. at their base and fact that they contain plants and other fossils of Perm. age; the underlying Supai fm. as here redefined being considered of Penn. age, but possibly of Perm. age in its upper part. Lithologically the Hermit sh. resembles many beds of sandy sh. in the Supai, but, unlike the Supai, it contains no massive hard layers of cross-bedded ss., and the more sandy beds in the Hermit are prevailingly reddish, not buff, as they are in the Supai. Thin platy lamination is most prominent structural characteristic of Hermit sh. Thickness varies from possibly less than 75 ft. in region about Tanner Canyon to 500+ft. W. of Bass Canyon. Underlies Coconino ss.

Hermitage formation.

Middle Ordovician (Trenton): West-central Tennessee and southern Kentucky.

C. W. Hayes and E. O. Ulrich, 1903 (U. S. G. S. Columbia folio, No. 95, p. 1). *Hermitage fm.*—Even-bedded, alternating thin layers of argill. or siliceous blue ls. and gray or bluish sh. in lower third, and heavier-bedded siliceous subgranular ls., more or less strongly phosphatic, in middle and upper parts. Thickness 40 to 70 ft. Of early Trenton age. Uncon. overlies Carters ls. and underlies Bigby ls.

Named for occurrence at Hermitage Station, Davidson Co.

Hermon type.

Name applied by A. F. Buddington (N. Y. State Mus. Bull. 281, 1929, pp. 52–81) to a porphyritic granite in NW. Adirondacks (Lewis and Jefferson Counties) intrusive into Grenville series. Derivation of name not stated. Age relations to nonporphyritic Alexandria type of granite not determined.

Hermosa formation.

Pennsylvanian: Southwestern Colorado, southeastern Utah, northeastern Arizona, and northwestern New Mexico.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60, p. 8). From section displayed in Animas Valley and at Rico we can assume presence of other sed. fms. below Dolores fm. (oldest exposed) in La Plata dome. These embrace *Rico* and *Hermosa* (Carbf.), the *Ouray* (Dev.), and the Ignacio (Camb.), all in apparent structural conformity.

W. Cross and A. C. Spencer, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 48). *Hermosa fm.*—The upper part is a complex of shales with occasional lss.; middle part is many bands of massive dark-gray ls., often highly fossiliferous, alternating with sss. and cgls.; lower part is greenish-gray sss. and shales, the latter sometimes nearly black. Thickness 1,800 ft. Underlies Rico fm. and overlies Dev. ls. and qtzite. Named for Hermosa Creek, Colo.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120), applied *Molas fm. to 75 ft. of Penn. strata* which intervene btw. Hermosa fm. and Ouray ls. and which are absent in area where Hermosa fm. was first defined.

In SE. Utah and parts of SW. Colo. the intrusive Paradox fm. intervenes below Hermosa fm. and is believed by J. B. Reeside, Jr., and A. A. Baker to be younger than Molas ls.

R. Roth, 1934 (A. A. P. G. Bull., vol. 18, No. 7, p. 945). Since Spencer gave no specific type loc. for *Hermosa fm.*, the type section has been selected as in secs. 26 and 35, T. 37 N., R. 9 W., La Plata Co., Colo., for following reasons: (1) It is easy of access, as main highway btw. Durango and Silverton passes through the area; (2) total thickness (2,146 ft.) is approx. same as max. given by Spencer for the Hermosa; (3) the section is in area considered typical of the Hermosa by Spencer and is well within the area mapped as Hermosa by Colo. Geol. Surv. Fauna of typical Hermosa is of Cherokee age.

Herndon oil sand.

Name proposed by A. F. Crider (A. A. P. G. Structure symposium, vol. 2, 1929, p. 181) for reddish sharp quartz sand, forming oldest producing horizon in Pine Island oil field, Caddo Parish, La. Lies in Trinity group (of Comanche age), 193 ft. below Dixie oil horizon. Named for Texas Co.'s Herndon No. A6 well, which first produced from this sand.

Hernshaw sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 155). *Hernshaw ss.*—Massive, medium-grained, micaceous and grayish brown. Thickness 20 to 50 ft. Underlies Little Chilton coal and overlies Hernshaw coal. Named for Hernshaw, Kanawha Co.

Herod gravel member (of Manhasset formation).

Pleistocene: Southeastern New York (Long and Fishers Islands) and islands of southeastern New England (Marthas Vineyard, Block Island, and probably Cape Cod).

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367–390). *Herod gravel.*—Sandy gravels, with good proportion of pebbles, mainly of granitic rocks, 30 to 100 ft. thick. Uncon. underlies Montauk drift and conformably overlies Jacob sand. Correlated with Illinoian stage of Mississippi Valley.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467–469). *Herod gravel* (glacial) occurs at nearly all points from Long Island to Boston.

F. G. Clapp, 1908 (Geol. Soc. Am. Bull., vol. 18, table opp. p. 512). *Herod gravel* is Lower Manhasset and beds overlying Montauk till are Upper Manhasset.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Herod gravel memb.*, basal memb. of Manhasset fm. In some places prevailingly sandy, in others chiefly gravel; in places the lithologic change is abrupt vertically and horizontally; in general more sand toward base and more gravel toward top; in its more normal phases the deposit consists of an alternation of thin layers of sand and gravel, the whole having a gravelly aspect. Underlies Montauk till memb. of Manhasset fm. and overlies Jacob sand. Time of deposition called *Herod substage.* Correlated with beginning of Illinoian stage of Mississippi Valley.

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Herod gravel memb.*—Basal memb. of Manhasset fm.; glacial sand and gravels; 0 to 100 ft. thick. Conformably overlies Jacob sand and conformably underlies Montauk till memb. of Manhasset fm. Present on Marthas Vineyard, Block Island, and probably on Cape Cod.

F. G. Wells, 1935 (Geol. Soc. Am. Proc. 1934, p. 121), regarded Manhasset fm. as of Wisconsin age.

Herod substage.

The time covered by deposition of *Herod gravel memb.*

Herrin limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern and southwestern Illinois (Saline County).

G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, p. 262). The ls. cap rock of Herrin No. 6 coal, which I shall call the *Herrin ls.*, since it is so commonly associated with Herrin coal, is an impure, earthy dark-gray, dirty-looking ls. that breaks with a splintery fracture. Where exposed along streams it spalls off in angular fragments showing little structure. Contains fossils.

A. H. Bell, C. Ball, and L. McCabe, 1931 (Ill. Geol. Surv. Press Bull. 19), show 2½ ft. of sh. btw. Herrin ls. memb. and Herrin coal in parts of Perry Co., and give thickness of Herrin ls. as 4½ to 6 ft.

Herschel quartzite.

Mesozoic (Lower Cretaceous ?): Southeastern Arizona (Tombstone district).

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Herschel qtzite.*—Dense fine-grained qtzite, 270 ft. thick. Underlies White lime and overlies Lucky Cuss ls. in Tombstone dist.

F. L. Ransome, 1920 (U. S. G. S. Bull. 710D). Herschell qtzite of Church is Mesozoic, probably Comanche (Lower Cret.).

Hersey red shale member (of Pembroke formation).

Silurian (late): Southeastern Maine.

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, pp. 6–7). *Hersey red sh. memb.*—Chiefly purplish red fossiliferous sh.; includes some gray sh. like that of Leighton memb. Thickness 2,700 ft. Top memb. of Pembroke fm. Separated from older Leighton gray sh. memb. by rhyolite tuff. Named for exposures on Hersey Neck, Pembroke Twp, Washington Co.

Hertha limestone. (In Kansas City group, Kansas.)

Hertha limestone member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

G. I. Adams, 1899 (Kans. Acad. Sci. Trans., vol. 16, pp. 58, 59). *Hertha ls.*—Ls. composing lower memb. of Erie fm. and forming escarpment extending W. from Hertha [Neosho Co., Kans.], crossing Labette Creek S. of Galesburg and following its W. bluff for considerable distance, terminating in mounds W. of Altamont. Overlain by Mound Valley ls.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, pp. 34, 35). *Hertha ls.* is here introduced for the lss. succeeding Upper Pleasanton shales (Dudley sh.) as exposed in vicinity of Hertha. Haworth (1898) says this series of beds is probably a continuation of Bethany Falls ls., a term first used by Broadhead (1872) for the fm. at Bethany, Harrison Co., Mo., a distant locality. Should this correlation be established, *Bethany* would displace *Hertha*. Underlies Galesburg sh. Thickness 10 to 20 ft. Thins out in hills NW. of Altamont. Fossils listed.

G. I. Adams, 1904 (U. S. G. S. Bull. 238). *Hertha ls.* overlies Dudley sh. and underlies Ladore sh., which is separated from Galesburg sh. by Mound Valley ls. [Bethany Falls ls.].

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13). *Hertha ls. memb.*—Basal memb. of Kansas City fm. and of Missouri group. Underlies Ladore sh. memb. and overlies Pleasanton fm. Galesburg sh. memb. rests on Bethany Falls ls., which lies on Ladore sh.

For many succeeding years the definition of *Hertha ls.* was for the ls. overlying Dudley sh. and underlying Ladore sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97), stated that "so-called Hertha ls. at Hertha is really Bethany Falls ls." (which has priority), and introduced *Sniabar ls.* for upper of the lss. called *Hertha* by Hinds and Greene, and *Schubert Creek ls.* for lower ls. called *Hertha* by Hinds and Greene.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 24). J. M. Jewett (Kans. Acad. Sci. Trans., vol. 36, 1933, p. 134) rightly concluded the ls. at Hertha to which Adams in 1903 applied name *Hertha* is Bethany Falls ls. In 1904 (U. S. G. S. Bull, 238, pp. 14 and 16) Adams published maps of area immediately N. of Hertha in which first ls. below the Bethany Falls (=Mound Valley ls.) was indicated as Hertha. This lower ls. is the 6-foot ls. cropping out at Hertha, and not the one shown as Hertha in previous publication. The reason for this confusing change in mapping was not given in text. The early Kans. Surv. followed this second usage of Adams, so that, excepting original definition, the name *Hertha* has been consistently applied to lower ls. of Bronson group [of Newell, not Bronson group of R. C. Moore, 1935, which includes 150 ft. of underlying beds called *Bronson fm.* by Moore]. It was discovered by F. C. Greene, R. C. Moore, and me, in special field investigation of Hertha problem, that lower ls. cropping out at Hertha is continuous across E. Kans., and (contrary to Jewett's 1933 conclusion) is in part=the ls. at Kansas City that has in past been called *Hertha*. It does not seem advisable to suppress *Hertha* on ground it is synonym of Bethany Falls. In Adams' final usage and subsequent work it appears there has been consistent application of *Hertha* to one ls. unit, the lower of the Bronson or "triple system" of early writers. I propose here to retain *Hertha* in formational sense, for the ls. cropping out at Hertha, and for its immediate correlatives. In tracing the Hertha southward from Kans. [Hertha?] it was discovered by Greene, Moore, and me that the unit is added to above, so that over much of E. Kans. it is divisible into 2 members, of unlike lithology, commonly separated by some sh. The upper memb. was thought to be Jewett's Schubert Creek ls., and the lower one, so well developed in NE. Kans. and adjacent parts of Mo., is here termed *Sniabar ls.*, from exposures along Sniabar Creek in SE. part of Jackson Co., NW. Mo.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 79, 80). It is agreed the beds called *Hertha* by Hinds and Greene at Kansas City are same as Hertha ls. at type loc. The names *Elm Branch* [*sh.*], *Sniabar* [*ls.*], *Tennison Creek* [*sh.*], and *Schubert Creek* [*ls.*] are not required and will not be recognized. Critzer ls. may prove useful, but is not here recognized. *Hertha ls.* is considered to comprise first important ls. unit, locally divided by sh. into 2 or more beds, below Middle Creek ls. memb.

of Swope ls. Thickness of sh. interval btw. top of Hertha and base of Middle Creek (or, in S., where Middle Creek disappears, the base of the Bethany Falls) ranges from 2 to 50 ft. or more. The Hertha is basal fm. of Bronson group and rests conformably on Bourbon fm. Black fissile sh. immediately underlies it near Hertha and to S. Thickness of Hertha 4 ft. to locally 30 ft. in N. part of Bourbon Co., where upper and lower members are separated by 15 ft. of sh. The Hertha extends from south-central Iowa to Labette Co., Kans., but is not known to reach Okla. line. Definition and description given by Adams in 1903 and his strat. section in his 1904 paper agree in indicating that rock he intended to name Hertha is the one exposed just E. of Hertha.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Hess thin-bedded limestone member (of Leonard formation).

Permian: Western Texas (Marathon region).

J. A. Udden, 1917 (Univ. Tex. Bull. 1753, p. 43, pl. 3). *Hess fm.*—Lss., mostly thin bedded, but also contain several layers 5 to 10 ft. thick; a good part of ls. is oolitic; some sss. and shales, mostly in lower 400 ft.; ls. cgl. 10 to 40 ft. thick at base. Color of shales and lss. mostly light gray. Thickness 2,150 ft. Extension of the Hess W. from Leonard Mtn is uncertain. It may be present in lower part of Leonard Mtn. Uncon. overlies Wolfcamp and Gaptank fms., from which it is distinguished by small development of argill. and sandy material and by absence of conglomeratic material, except in basal cgl. Distinguished from overlying Leonard fm. by having well-defined bedding planes. Greatest development in old Hess ranch, Glass Mtns.

See also under *Leonard fm.*

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 57–69). *Hess fm.* has not been well understood because of its great lateral variation in lithology and thickness. In his section on Leonard Mtn Udden provisionally placed in Leonard fm. massive lss. regarded by us as Hess, though he recognized the possibility that the Hess might be present there. The type sections of the two fms. therefore overlap. The contact is now placed at the natural line of subdivision btw. siliceous shales above and massive lss. below. In E. part of Glass Mtns the Hess is a great mass of ls., prevailingly thin bedded and dolomitic, 2,130 ft. thick. To E. the lss. are partly replaced by varicolored marls and shales. In W. part of Glass Mtns the fm. is less than 100 ft. thick in places, and consists of massive light-gray pure ls. Because of these differences the fm. can be divided into an eastern and a western facies, with div. line lying on Hess ranch E. of Leonard Mtn. Contact btw. Hess and Leonard fms. is here interpreted as conformable, but many puzzling features remain to be explained. Contact is well exposed SW. from Leonard Mtn to Dugout Mtn, where the Leonard is 900 to 1,800 ft. thick and the Hess only a few hundred ft. thick. It is also well exposed NE. from Wood ranch, where Leonard is 250 ft. thick and Hess more than 2,000 ft. thick. In neither area is there any evidence of erosion. Faunas of Hess and Leonard fms. are similar, but there are certain characteristic elements in each not shared by the other, though both are of same facies. Although max. thickness of each fm. appears to be mutually inclusive of the other, the distinctive quality of the two faunas seems to argue against an intergradational relationship. The westward thinning of the Hess is result of an overlap on uplifted Wolfcamp beds and not the result of pre-Leonard erosion or the intergradation of Hess and Leonard facies.

P. B. King, 1934 (Geol. Soc. Am. Bull. vol. 45, pp. 730–732). The Hess fm. of previous repts is contemp. with and grades into lower part of Leonard fm. It is therefore here designated *Hess thin-bedded ls. memb. of Leonard fm.*

Hesse quartzite. (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Hesse ss.*—Fine white massive ss., formed of round quartz grains. Thickness more than 500 ft. Overlies Murray sh. Underlies Apison sh. [In parts of NE. Tenn. is overlain by Shady dol.]

Named for Hesse Creek, Blount Co., Tenn.

Heumader shale. (In Oread limestone.)

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). *Heumader sh. memb.*—Thin sh. near top of Oread ls., underlying Kereford ls. memb. and overlying Plattsmouth ls. memb. [On p. 52 it is described as consisting of 2 ft. of dark-bluish sh. with thin yellow streaks.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 48, 167–168). The few ft. of sh. that lies btw. base of Kereford ls., where that memb. is present, and top of Plattsmouth ls. may be termed *Heumader sh.* and classed as a memb. of Oread fm. The sh. is clayey to sandy and usually appears dark gray. Thickness almost 0–10 ft. Where Kereford ls. is absent the Heumader and possibly shaly equivalents of the Kereford are not differentiated. Although strat. continuity with units classified as parts of Oread fm. is recognized, the sh. next above the Plattsmouth is then included with Kanwaka sh. Type loc., Heumader quarry, bluffs of Missouri River just N. of St. Joseph, Mo.

Heuvelton sandstone.

Upper Cambrian: Northern New York (St. Lawrence Valley).

G. H. Chadwick, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 289–291). *Heuvelton* ("*Twenty-foot*") *ss.*—Name introduced with Prof. Cushing's consent, for the heavy white ss., recognized independently by him and by writer, which from its resistant nature has proved most valuable stratum in Canton quad. for solution of strat. problems. Is characterized by *Scolithus canadensis* and by large gastropods suggestive of Ord. age, but it seems conformable to underlying Theresa mixed beds or fm. as restricted by Ulrich. Assigned to Ord. (?). Is uncon. overlain by Bucks Bridge mixed beds or fm., which is approx.=Tribes Hill.

H. P. Cushing, 1916 (N. Y. State Mus. Bull. 191). There is some evidence that still another fm. will have to be separated from upper part of the Theresa, including: (1) What we have mapped as *Heuvelton ss. lentil of Theresa fm.*; (2) the beds btw. this ss. and base of [overlying] Tribes Hill; and (3) the 30 ft. more or less of sandy beds just under this ss. But evidence is not yet decisive, and lithologically the beds are much like those of the Theresa, with which they form a convenient lithologic unit. [In places in this rept Cushing applied *Heuvelton div.* to the 3 beds enumerated above.]

G. H. Chadwick, 1920 (N. Y. State Mus. Bull. 217, 218). *Heuvelton white ss.*—White vitreous ss., 0 to 25 (?) ft. thick, often with decided platy structure, much ripple marking, and minor cross-bedding. Age uncertain; probably Ozarkian. Seems linked stratigraphically with Theresa (Upper Camb.) below, though its few fossils suggest a later age. This is "20-foot ss." of Prof. Cushing, which according to him is shown by its relations farther W. to be merely a lentil in the Theresa, though on our meridian it constitutes apparent summit of that fm. [But he in several places called it *Heuvelton fm.*, and mapped it separately from Theresa.] No marked strat. break with underlying Theresa mixed beds. Uncon. [discon. on another page] overlain by Bucks Bridge mixed beds.

Probably named for Heuvelton, St. Lawrence Co., NW. N. Y., in Potsdam region.

Hewett's Branch sandstone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1884 (Ohio Geol. Surv. vol. 5, p. 116). *Hewett's Branch ss.*, 25 ft. thick at Carbondale, Athens Co. Underlain by Upper Freeport ls. and separated from overlying Upper Freeport coal by 6 feet of clay and sh.

Hewitt sand.

A subsurface sand, of early Penn. age, in Hewitt pool, Carter Co., central southern Okla.

Hewittville calcilutites (or beds).

Lower Ordovician (Beekmantown): Northern New York (Canton quad.).

G. H. Chadwick, 1920 (N. Y. State Mus. Bull. 217, 218, p. 33). *Hewittville calcilutites* in columnar section; *Hewittville beds* in heading.—Upper 8 to 9 ft. of Bucks Bridge mixed beds or fm. Consist of rather argill., light (smoky) gray, firm and compact dull limy mudstones (calcilutites or exceedingly fine calcarenites); weather vivid tones. Cap Bucks Bridge fm. on W. bank of Raquette River just below concrete dam of lower mills at Hewittville. Elsewhere these beds fail to appear, either because concealed beneath ledges of discon. overlying Ogdensburg fm., or because discontinuous through erosion or lateral change. Questionable whether they belong in Bucks Bridge fm., but since no break is evident at supposed contact it has not seemed wise to separate them until they can be traced farther E. Underlain by sandy and siliceous dol. of rather flaggy structure and highly fucoidal as it weathers.

Hiawatha member (of Wasatch formation).

Eocene (lower): Southwestern Wyoming and northwestern Colorado.

W. T. Nightingale, 1930 (A. A. P. G. Bull., vol. 14, No. 8, pp. 1019–1040). In this paper *Hiawatha memb.* is assigned to Wasatch sediments lying below Tipton tongue fm., of Green River age, in Vermilion Creek gas area. Gray shales constitute predominating part of memb., although there is also a minor amount of green to pink sh. and considerable lignite and dark carbonaceous sh., particularly in highest 1,000 ft. A few interbedded layers of gray to buff ss. are important as known and possible reservoirs for gas and perhaps oil. The sss. are lenticular and range from a few inches to 20 or 30 ft. in a few hundred ft. Thickness of memb. 4,100± ft. The gas-producing sands occur from 2,450 to 4,100 ft. below Tipton tongue, and range from 3 to 45 ft. in thickness. In general the Hiawatha beds are partly fluviatile and partly lacustrine. Named for development on Hiawatha and West Hiawatha domes, Twps 12 N., Rs. 100 and 101 W., Moffat Co., Colo.

W. T. Nightingale, 1935 (A. A. P. G. Bull., June). *Hiawatha memb. of Wasatch fm.* is partly fresh water, partly fluviatile, and partly lacustrine. Thickness 4,054 ft.

Hickman group.

Pleistocene: Southwestern corner of Kentucky.

R. H. Loughridge, 1888 (Ky. Geol. Surv. Rept. Jackson's Purchase Region, pp. 37–41). *Hickman group.*—Thick buff-colored clays with siliceous claystone at top. Believed to be older than Lignitic group. Included in Eocene. [Later studies by E. W. Berry showed these deposits are Pleist. Loughridge's map of Jackson Purchase region is dated 1885, and shows *Hickman* beneath Lignitic.]

Named for bluffs of Mississippi River at Hickman, Fulton Co. and to S.

Hickman sand.

A subsurface sand in Burbank oil field, Okla.

Hickory sandstone.

Upper Cambrian: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxi, 285). *Hickory series.*—Massive ss. above, coarse cgl. below. One very characteristic and persistent division is a massive white to buff fine pebbly ss., almost qtzite, near top. Thickness 150 to 250 ft. Uncon. overlies Eparchean group and uncon. underlies Riley series. [Later field work showed †Riley series included Hickory ss. Top of Hickory ss. was therefore defined by S. Paige (U. S. G. S. Llano-Burnet folio, No. 183, 1912) as top of highest dominantly sandy beds. Thickness 350 ft.]

Overlies Llano series uncon. and underlies Cap Mtn fm.

Named for Hickory Creek, Llano Co.

Hickory shale.

An abbreviated form of *Hickory Creek sh.* (Penn., Kans.-Nebr.) used by some writers.

Hickory sand.

Drillers' term for an oil sand in NW. Pa. that is said to lie at about same horizon as Snee or Blue Monday sand.

Hickory Creek shale.

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 97). [See under *Merriam ls.* On p. 46 *Hickory Creek sh.* is stated to be ½ to 1 ft. thick.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 69, 71–72). Plattsburg ls. divided into 3 members (descending): Spring Hill ls. memb., ***Hickory Creek sh. memb.***, and Merriam ls. memb. The Hickory Creek memb. consists of 1± ft. of black carbonaceous sh., which to S. becomes gray or yellowish and argill. Locally absent, and ½ mi. E. of De Soto thickens to 20 ft. In some instances, as at S. edge of sec. 29, T. 13 S., R. 23 E., the sh. is overlain and underlain by a peculiar ochery, shaly ls. or calc. sh. In such case, for convenience, the yellowish shaly layer is considered the div. btw. the upper and lower Plattsburg. Named for stream near Peoria, Franklin Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Hicks formation.

Upper Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., 5th, vol. 20, No. 17, Oct. 19, pp. 421–432). *Hicks fm.*—Greater part consists of dolomite similar to those of underlying Lamb dol., but the fm. also contains lenticular beds of ss., fossiliferous ls., and in one place sh. Contains early Upper Camb. fossils. Thickness 600 to 1,200 ft. Variation in thickness believed to indicate uncon. with overlying Chokecherry dol., of Lower Ord. age. Named for exposures in Hicks Gulch, in North Pass Canyon, Gold Hill dist.

See also U. S. G. S. P. P. 177, 1934.

Hidden Treasure limestone.

Mississippian (lower): Central northern Utah (Ophir district).

F. M. Wichman, 1920 (Eng. and Min. Jour., vol. 110, No. 12, p. 563). Overlying Gardner dol., but with no distinct bdy separating them, lies what is called in Ophir the *Hidden Treasure ls.* It might be considered as upper part of the Gardner, but on account of its value as an ore-bearing medium, it is advisable to give it a distinct name. It forms summit of Ophir Hill, where all that remains of it is 75 to 100 ft. It consists of coarsely crystalline, rather soft light-gray to brownish ls., with interbedded layers of thin dark-colored ls. similar to that in the Gardner, and at least one bed of dense carbonaceous sh. Fossils abundant.

S. G. Olmstead, 1921 (Econ. Geol., vol. 16, pp. 443, 452, 453). The Upper Pine Canyon ls. in Ophir dist. is locally known as *Hidden Treasure ls.* It consists of 290 ft. of rather pure ls. showing many fossils and some chert nodules. The Lower Pine Canyon ls. is locally known as *Chicago.* It consists of 390 ft. of rather dark-gray blocky ls., characterized by bands of dark chert 1 to 2 in. in thickness, spaced from 1 to several ft. apart.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, p. 145). The Hidden Treasure, Chicago, and Sacramento mines are all in Madison ls. The *Hidden Treasure* ore shoots were in general in upper beds of the Madison. The *Chicago* and *Sacramento* ore bodies showed practically no tendency to be limited to a single strat. horizon but passed up and down through the section as they were followed, although both were in Madison ls. throughout.

Higham grit.

Triassic (?): Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492). *Higham grit.*—Basal memb. of Nugget ss. in Fort Hall Ind. Res. Thickness 500 ft. Underlies Deadman ls. memb. of Nugget.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 41). *Higham grit memb.*—Coarse white to pinkish gritty or conglomeratic ss., the component particles of which are coarse and subangular. Locally is almost qtzite. Thickness 500± ft. Basal memb. of Nugget ss. in Fort Hall Ind. Res. Underlies Deadman ls. memb. of Nugget and conformably overlies Ankareh ss. [later named *Timothy ss.*]. Named for Higham's Peak, sec. 23, T. 3 S., R. 37 E., the highest summit in NE. part of the reservation, which is composed of this rock.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713, pp. 29, 50), (1) treated Higham grit as a distinct fm.; (2) restricted Nugget ss. to upper part ("main ss. memb.") of Nugget ss. as recognized by him in previous repts; (3) introduced *Timothy ss.* to replace *Ankareh ss.* as used by him in previous repts on SE. Idaho; and (4) reported the Higham as resting uncon. on Timothy ss. This is present generally accepted definition of Higham grit.

†High Bluff blue sands.

Upper Cretaceous (Gulf series) : Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 75–77, 188). *High Bluff blue sands.*—Fossiliferous dark-blue fine micaceous sandy marls, containing same fossils as overlying Washington greensands, but are more massive and contain more glauconite and lime. Thickness 125 ft. Overlie Big Deciper calc. sands. Absent in places. Named for exposures in High Bluff of Ouachita River, 1½ mi. NE. of Arkadelphia, Clark Co., where they compose basal 50 ft. of section and where they are conformably overlain by Washington greensands.

C. H. Dane, 1929 (Ark. Geol. Surv. Bull. 1, pp. 46, 115). [See under †*Washington greensand.*]

†High Bluff greensand.

Upper Cretaceous (Gulf series) : Southwestern Arkansas.

See explanation under †*Washington greensand.*

Named for exposures in High Bluff of Ouachita River, 1½ mi. NE. of Arkadelphia, Clark Co.

High Bridge gneiss.

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116–120). [On his "Section across New York [Manhattan] Island along southern shore of Spuyten-Duyvel Creek and Harlem River" *High Bridge gneiss* is shown upturned to E. of King's Bridge ls. According to U. S. G. S. New York City folio Highbridge is located on Fordham gneiss.]

Highbridge limestone.

Lower and Middle Ordovician: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 2). *Highbridge ls.*—White ls. grading downward into gray ls. and calc. sh.; thickness 200 ft. Underlies Lexington ls. Includes Chazy and Birdseye lss. of early Ky. repts.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 8–23), divided Highbridge ls. of Campbell into (descending) Tyrone, Oregon, and Campnelson substages.

A. F. Foerste, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 377–385), proposed restricting *Highbridge ls.* to Oregon and Campnelson beds, of Chazy age, excluding Tyrone, because of its Black River age. This proposed restriction, however, was not accepted by Miller, who up to 1925 (Ky. Geol. Surv., ser. 6, vol. 21, pp. 126–142) continued to include the Tyrone in Highbridge ls. This is also the U. S. Geol. Survey definition.

Named for exposures at Highbridge, Jessamine Co.

High Bridge granite.

See *Mellen or High Bridge granite.*

High Falls shale (in New York).

High Falls formation (in New Jersey).

Silurian (Salina) : Eastern New York (Ulster and Orange Counties) and northern New Jersey.

C. A. Hartnagel, 1905 (N. Y. State Mus. Bull. 80, pp. 342–357). *High Falls shales.*—Red shales, well shown on farm of Patrick Winn at High Falls [Ulster Co.]. Basal memb. of Salina beds in eastern N. Y. Resemble Vernon sh. Underlie Binnewater qtzites and overlie Shawangunk grit and cgl.

In 1907 (N. Y. State Mus. Bull. 107) Hartnagel gave thickness of *High Falls sh.* at Cornwall as 119 ft., and stated that it graded into overlying Binnewater and rested on Shawangunk without break. Also that the High Falls and Binnewater are=Longwood shales of Darton.

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146), described *High Falls sh.* as consisting of 67 to 100 ft. of greenish to red argill. to sandy sh., "exposures often brilliant red."

C. Schuchert, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 540–543), reported great break btw. *High Falls sh.* and Shawangunk cgl. and probable break btw. Binnewater and High Falls fms., and gave thickness of the High Falls in Binnewater-High Falls region as 80 to 90 ft.

In northern N. J. (NW. part of Franklin Furnace quad.) the *High Falls fm.*, as it is there called, consists at base of hard red quartzitic ss. intercalated with some green or gray sss. and softer red shales, which become more abundant in upper part of fm., and it is more than 400 ft. thick. Its thickness in Delaware Water Gap is estimated at 2,300 ft. In N. J., as in N. Y., it rests on Shawangunk cgl.

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 657). It has been shown [pp. 622–660] *Bloomsburg red beds* can be followed continuously from type loc. in NE. Pa. southward into Md. and eastward through central and eastern Pa. to Delaware Water Gap, where it was called *Clinton* by Chance and *High Falls* by Stose. It is continuous with Medina-Longwood red ss. of N. J. and High Falls red beds of Hartnagel in SE. N. Y. It is manifest it is same fm. throughout this entire area and should have one name to avoid confusion. The term *Bloomsburg* has priority.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 342). *High Falls shales* are pyritic red shales, 80 to 90 ft. thick, overlying Shawangunk in Kingston-Port Jervis section. The red shales above the Shawangunk in Orange Co., N. Y., and in N. J. are called *Longwood shales*. They are in part or wholly=High Falls sh. and perhaps Binnewater ss.

Highgate slate.

Upper Cambrian (?): Northwestern Vermont (Franklin County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 114–115). *Highgate sl.*—Mainly dark sl., in places black; usually banded. Banding in most places regular, sharp, and clear. The dark and light layers are evenly spaced and from ⅛ to ¼ in. thick. Interbedded with the sl. are many thin seams of fossiliferous blue ls. 1 or 2 in. thick. One-third mi. NW. of Highgate Center these layers thicken and outcrop in the R. R. cut as a strongly banded ls. mass 35 ft. thick. These are probably highest beds in the fm. near Highgate. In lower part at Highgate Falls the light bands consist of fine sandy sh. or ss. seams; there are several beds of tough gray dol., 1 ft. or more thick, that weathers rusty brown; and about 40 ft. above base there is a zone, nearly 6 ft. thick, of sl. filled with small pebbles of ls. up to 4 in. across. Thickness at Highgate Falls at least 300 ft. Contains Upper Camb. fossils. Extends from Canada into town of Milton, a distance of 25 mi. Principal development is in Highgate Twp [St. Albans and Enosburg Falls quads], where it forms broad area. Fine section exposed at Highgate Falls, where it overlies Milton dol. Nothing is known of overlying fms. in this region, but doubtless later Upper Camb. fms. were deposited on Highgate sl.

P. E. Raymond, 1924 (Boston Soc. Nat. Hist., vol. 37, No. 4). So far as can be judged from trilobites at present known, *Highgate fm.* would be termed Ord., rather than Camb., but would be placed about on border btw. the two.

B. F. Howell, 1929 (16th Rept. Vt. State Geol., p. 263). Keith in 1923 [rept cited above] tentatively included in his Highgate sl. the *Paradoxides* beds (Middle Camb.), to which writer in 1926 restricted the name *St. Albans*. *Highgate sh.* as here used is restricted to the Upper Camb. sh. overlying Mill River cgl. (probably Upper Camb.), which in turn rests (almost certainly with uncon.) on St. Albans sh. The name *Mill River cgl.* is proposed by writer, after consultation with Keith.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 377). In St. Albans region of NW. Vt. the Corliss cgl. (of Beekmantown age) rests uncon. on Highgate sl., and the Highgate rests on Mill River cgl. (Upper Camb.), which in earlier repts was called by me *Milton dol.* and (later) "Missisquoi fm." The Mill River cgl. rests uncon. on St. Albans sl.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 353–381), assigned *Highgate sl.* to Upper Camb., although Raymond (1924) and McGerrigle (1931) suggested it might be Ord.

C. Schuchert, 1936 (letter dated Feb. 12). I have recently, with help of Prof. Raymond, referred whole of Highgate (formerly Upper Camb.) to oldest Ord., correlating it with *Ceratopyge* fauna of Sweden.

Highgate Springs series.

Middle and Lower Ordovician: Southern Quebec and northwestern Vermont (Franklin County).

W. E. Logan, 1863 (Geol. Surv. Canada, pp. 273–275, 855–859), described the rocks of Highgate Springs region, but did not definitely name them.

H. W. McGerrigle, 1931 (17th Rept. Vt. State Geol., pp. 181–184). The fms. composing *Highgate Springs series* are Chazy, Lowville, Black River, and Trenton in age. Logan and others believed Utica fm. also was present, but it is probable these "Utica" beds are a shaly upper part of the Trenton. Most complete exposure of the series is at Highgate Springs [St. Albans quad.], Vt., where all fms. mentioned above are shown. [Geographic distribution described and fm. mapped in NW. Vt.] Is younger than Philipsburg series.

Highland gneiss.

Pre-Cambrian: Southeastern New York (Highlands of the Hudson).

D. S. Martin, 1888 (geol. map of N. Y. City and vicinity). ***Highland gneiss*** (*Laurentian*). [Oldest fm. shown. Placed beneath ***Atlantic or Manhattan*** *gneiss* (*age disputed*).]

J. M. Clarke, 1908 (N. Y. State Mus. 60th Ann. Rept., vol. 1, pp. 11–12). Oldest fm. of Highlands of the Hudson is a gneiss, provisionally designated ***Highland gneiss***, and probably=Fordham gneiss of New York City dist. It is essentially a series of metamorphosed ancient sediments, chiefly siliceous, now appearing as granite gneisses, qtzite schists, mica schists with occasional interbedded lss. and serpentinous beds, the whole abundantly interjected with sheets, stringers, and dikes, of igneous rocks of many varieties and different dates. Assigned to pre-Cambric.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, pp. 22, 28). The pre-Camb. ***Highlands gneiss***, Inwood ls., and Manhattan schist and their associated intrusives compose almost all of West Point quad. The ***Highlands gneiss***, which makes about 70 percent of total area, is considered to be age equiv. of Grenville gneiss and associated series of Adirondacks and Canada. The Poughquag qtzite is clearly uncon. on ***Highland gneisses***. [In table on p. 140 the gneiss in West Point quad. is called ***Fordham gneiss***, and it is assigned to "older Grenville."]

Highland morainic system.

Pleistocene (Wisconsin stage): Northeastern Minnesota and northwestern Wisconsin.

A. H. Elftman, 1898 (Am. Geol., vol. 21, pp. 90–109, 175–188). The moraine immediately N. of Lake Superior is named *Highland moraine*, for Highland Station, Lake Co., Minn.

F. Leverett, 1928 (U. S. G. S. P. P. 154). *Highland morainic system.*—The major part of this morainic system was years ago mapped by Elftman as ***Highland moraine***. It is here divided into the following moraines (descending order of age): Nickerson morainic system (including Fond du Lac, Thomson, Cloquet, and Draco moraines) and Kerrick morainic system (including Cromwell and Wright moraines).

Highland formation.

Upper Paleozoic (?): British Columbia.

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 87).

Highland Boy limestone member (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 41, map, sections). ***Highland Boy ls. memb. of Bingham qtzite.***—White or light-colored marbles, with considerable silica, both in form of sand grains and chert, and in places beds of mottled blue and white marble. Much of the chert is secondary but some of it is original. Believed to be derived from blue ls. Thickness 0 to 400± ft. Six areas of this ls. occur within short distances of Highland Boy mine. May possibly be=Jordan ls. memb., but seems to lie above Commercial ls. Is lower than Yampa ls. lentil.

Highland Church sandstone member (of Forest Grove formation).

Mississippian: Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). ***Highland Church ss. memb.***—Massive cliff-forming ss., 25 ft. thick, forming top memb. of Forest Grove fm. Forms typical cliffs about Highland Church, E. of Tishomingo City, Miss. Lower part of Forest Grove fm. consists of 90 ft. of sh. and ss.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details regarding this memb.

Highland Croft magma series.

Upper Ordovician (?): Northwestern New Hampshire (Ammonoosuc River region) and White Mountains.

M. Billings, 1934 (Sci., vol. 79, No. 2038, Jan. 19, pp. 55-56). Four major periods of intrusive igneous activity have been recognized in central N. H.: The *Highlandcroft, Oliverian, New Hampshire,* and *White Mtn petrogenic cycles.* The *Highlandcroft cycle* includes diorite, quartz diorite, granodiorite, and granite. They are younger than Partridge sl. and older than Clough cgl.; are definitely pre-Sil., and probably late Ord. The *Oliverian rocks* are largely biotite granite; younger than Lower Dev. but older than major period of orogeny. The *New Hampshire magma series* consists of diorite, quartz diorite, granodiorite, trondhjemite, and granite, younger than Lower Dev. and essentially contemp. with the great period of folding. Youngest of all is *White Mtn ("alkaline") magma series,* which is younger than Lower Dev. and later than the period of orogeny. Thus 3 of the igneous series are younger than Lower Dev., and to them belong 90 percent of the igneous rocks of central N. H. The other 10 percent (the Highlandcroft group) is pre-Sil., probably late Ord. but possibly older. On 1932 geol. map of U. S. only the *White Mtn magma series* is shown as Paleozoic; all others being included in pre-Camb. In other words, Paleozoic intrusives are much more abundant than map shows. [Billings mapped *New Hampshire magma series* and *Highland Croft magma series* over parts of Littleton and Moosilauke quads in Am. Jour. Sci., 5th, vol. 28, Dec. 1934, p. 414.]

M. Billings, 1935 (personal communication April 26). *Highland Croft* was chosen from a large farm about 1½ mi. W.-NW. of Littleton.

See also *Highlandcroft granodiorite.*

Highlandcroft granodiorite.

Upper Ordovician (?): Northwestern New Hampshire (Littleton quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., p. 25 and map of Littleton quad.). *Highlandcroft granodiorite* is proposed for a granodiorite (chiefly greenish gray) and associated intrusives which are younger than Albee, Ammonoosuc, and Partridge fms. and older than Clough, Fitch, and Littleton fms. The large estate called "Highlandcroft," on St. Johnsbury road 1½ mi. W.-NW. of Littleton, is located on largest body of this rock in Littleton and Moosilauke quads. Is probably late Ord. [*Highlandcroft magma series* is used as a center heading and *Highlandcroft granodiorite* as a side heading. The names appear to be synonymous.]

M. Billings, 1935 (letter dated Aug. 27). Lahee's Fitch Hill granite gneiss is precisely the same as our Highlandcroft granodiorite. It belongs to Highlandcroft magma series. In other words, Highlandcroft is used both for a whole magma series and also in a restricted sense for a granodiorite within the series.

Highland Peak limestone.

Middle Cambrian: Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Engrs. Trans., No. 1647, p. 6) and 1932 (U. S. G. S. P. P. 171). *Highland Peak ls.*—Light-gray to dark-gray or black ls., fine-grained to medium coarse-grained, with many dolomitic beds. Thickness 3,000± ft. Conformably overlies Chisholm sh. and conformably underlies Mendha ls. Named for Highland Peak, in Highland Range, in whose W. slope the fm. is best shown. Composes main part of Bristol-Highland Range from S. edge of Highland quad. N. to about 2½ mi. S. of Bristol Pass. No recognizable fossils but overlying Mendha ls. has been identified as basal Upper Camb., and underlying Chisholm sh. is Middle Camb., so Highland Peak ls. appears to comprise major part of Middle Camb.

High Park lake beds.

Tertiary (late Miocene or Pliocene): Eastern Colorado (Pikes Peak region).

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *High Park lake beds.*—Remnants of a series of local sss. and cgls. lying either on granite or on a thin rhyolite flow, the cgls. characterized by pebbles of extremely hard Algonkian qtzite, granite, and gneiss. No fossils; but beds appear to be older than adjacent volcanic breccia, which in many places rests on Florissant lake beds. Is older than Alnwick lake beds. Named for High Park.

†High Point sandstone.

Upper Devonian: West-central New York.

J. M. Clarke, 1885 (N. Y. State Geol. Rept. for 1884, p. 22 and map; also U. S. G. S. Bull. 16). *High Point Chemung.*—A richly fossiliferous layer of calciferous ss. outcropping on summit of High Point, in Naples, the highest mtn. in Ontario Co. Is youngest Dev. strata in this dist. Thickness 5 to 7 ft. Overlies Lower Chemung (Portage) sss. Fauna is Chemung.

According to J. M. Clarke and D. D. Luther, 1902 (N. Y. State Mus. Bull. 52, pp. 616–631), the High Point ss. carries a Chemung fauna, but corresponds in time to Portage ss., which carries a Naples fauna. In 1904 (N. Y. State Mus. Bull. 63) J. M. Clarke and D. D. Luther named the beds beneath High Point ss. the *Westhill sss.* and the beds above it the *Prattsburg ss. and sh.;* and described High Point ss. as follows: Consists of 100 ft. of light-gray sss. in layers 3 inches to 4 ft. thick, separated by thin beds of hard blue sh., some layers compact and calc., but larger portion laminated and somewhat shaly; contains lenticular beds of impure ls.; sss. are thinner and softer to E.; from 50 to 75 ft. exposed at High Point, Ontario Co.; about 50 ft. below top is "High Point firestone" of calc. ss. and cgl., 7 ft. thick; the High Point ss. is continuous with Portage sss. of Genesee Valley, which carry a Naples fauna, but the High Point and overlying Prattsburg sh. were included in Chemung because of their faunas.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 84). *High Point ss.* is recognized as far E. as Chemung Co.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 402), included *High Point ss.* in Portage group, placed it above West Hill flags, and stated it is same as Nunda ss.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2), restricted Chemung but included this ss. in Chemung, placing it below Prattsburg ss. and above Westhill.

The U. S. Geol. Survey has discarded this name, in favor of Nunda ss.

†High Point firestone.

Calc. ss. and cgl., 7 ft. thick, lying about 50 ft. below top of †High Point ss., of N. Y.

High Rock sandstone.

Pennsylvanian: Southwestern Indiana (Daviess County).

G. H. Ashley, 1899 (Ind. Dept. Geol. and Nat. Res. 23d Ann. Rept., 1898, p. 113) casually applied *High Rock ss.* to the massive coarse-grained ss., 65 ft. thick, in Daviess Co., "that culminates at High Rock and extends into Greene Co." He stated that in early repts it was miscorrelated with Mansfield ss.

High Rock sandstone.

Pennsylvanian: Southeastern Kentucky (Magoffin County).

I. B. Browning and P. G. Russell, 1919 (Ky. Geol. Surv., 4th ser., vol. 5, pt. 2, p. 15). *High Rock ss.*—Massive soft coarse-grained white to brownish-white ss. 30 to 50 ft. thick, underlying Fugate coal and overlying Flag coal rider in Magoffin Co. Included in Pottsville. Is persistent enough to be recognized as a distinct fm. Named High Rock ss. because found on several high points exposed in cliffs called "High Rocks" by natives. Is easily confused with Puncheon Creek ss., but is older.

High Tower granite.

Probably Cambrian: Northwestern Georgia (Tate quadrangle).

W. S. Bayley, 1928 (Ga. Geol. Surv. Bull. 43, p. 37, map). *High Tower granite.*—Light-gray or white gneissoid biotite granite. One area of it is in W. part of Tate quad. and the other in SE. corner, where it is best developed around Hightower, Forsyth Co. Younger than Carolina gneiss (Archean), but probably not older than Salem Church granite of W. part of quad. and is probably Camb. The Salem Church granite intrudes Hiwassee schist and Great Smoky fm.

Hightower sands.

Drillers' name *Hightower shallow sand* applies to a sand of Chester (Miss.) age in Ind. that has been correlated with Hardinsburg ss.; and *Hightower deep sand* to a lower sand of Chester age that has been correlated with Mooretown ss. of Cumings.

Highwood syenite.

Eocene (?): Central northern Montana (Fort Benton quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Highwood syenite.*—Light-colored coarsely granular feldspathic rocks of Highwood Peak and neighboring laccoliths. Southern part of Highwood Peak is composed of a very typical syenite.

Hignite formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 33, 43, and pl. XLA). *Hignite fm.*—Shales, sss., and coals, 460 ft. thick, lying btw. top of Red Spring coal above and base of Hignite coal below in Cumberland Gap coal field. Underlies Bryson fm. and overlies Catron fm.

Later studies by D. White show Hignite fm. is of late Pottsville age and is represented in time interval of Kanawha fm.

Named for Hignite Creek, Bell Co., Ky.

Hilbig zone.

Eocene (lower): Central Texas.

C. B. Claypool, 1933 (The Wilcox group of central Tex., Abstract of thesis, Univ. Ill.). *Hilbig marine zone* in Rockdale fm. of Wilcox group has been defined in southern Bastrop Co. and traced southward into Guadalupe Co. There is a slight discon. at base of the marine zone. It is considered probable equiv. of Pendleton marine zone of La. [Type loc. not stated.]

Hill sand horizon.

Lower Cretaceous: Northeastern Texas (Cass County) and northwestern Louisiana (Caddo County).

J. S. Ivy, 1936 (Oil and Gas Jour., vol. 34, No. 48, April, p. 72). *Hill sand horizon*, 35 ft. thick, in Glen Rose fm., lies 223 ft. above Dees horizon in Rodessa field, and 80 ft. above *Caddo Levee Board horizon.* Latter horizon consists of 88 ft. of oolitic lss., with some sh. and sand, and lies 55 ft. above Dees sand horizon.

Hillabee chlorite schist.

Post-Carboniferous (?): Eastern Alabama.

W. M. Brewer, 1896 (Ala. Geol. Surv. Bull. 5, pp. 84, 89, 92). *Hillabee (Iwana) green schist belt.*—A belt of light-green, highly pyritiferous altered eruptive rock paralleling "Talladega" sl. proper of Talladega Mtns, on SE. edge, and apparently maintaining its continuity along the line of strike, from Coosa River, near mouth of Weogufka Creek, toward NE. into Cleburne Co. This rock is distinguishable from "Talladega" slates by large percentage of unaltered pyrites it carries, as well as by its massive structure, hardness, and toughness.

E. A. Smith, 1896 (Ala. Geol. Surv. Bull. 5, pp. 118–125). *Hillabee, Iwana, or Millerville green schists.*—Green schists, probably an altered eruptive rock. Occur along SE. border of main mtn belt of Talladega slates in almost continuous outcrops. The names are those of localities where the rocks show in typical form. The highly schistose and slaty varieties may be seen about Hillabee or Millerville, Clay Co. In places the Hillabee schists hold a large percentage of pyrite in crystals disseminated through a siliceous rock. All agree in thinking the schists are result of alteration of some basic eruptive rock. For present, therefore, we have grouped them together under the name *Hillabee*, from locality where they are exposed in typical fashion.

G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 38). *Hillabee chlorite schist.*—A metamorphosed basic intrusive, in places massive. Occupies position btw. Ashland mica schist and Talladega sl. Is same as Hillabee green schist as mapped by E. A. Smith in Ala. Geol. Surv. Bull. 5. Tentatively classified as post-Carbf. (?).

Named for exposures at Hillabee, on Hillabee Creek, Clay Co.

Hill Creek beds (member of Millsap Lake formation).

Pennsylvanian: North-central Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept. by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See under *Millsap Lake fm.*) Type loc. not stated.

Hilliard formation.

Upper Cretaceous (Montana and Colorado): Southwestern Wyoming (Uinta and Lincoln Counties).

W. C. Knight, 1902 (Eng. and Min. Jour., vol. 73, p. 721). *Hilliard fm.*—Almost entirely sh., varying from drab to gray, with a few bands of ss. Exposed from Kemmerer W. to Ham's Hill and also 1 mi. N. of Hilliard. Thickness 5,000 ft. Well developed near Hilliard. Overlies Frontier fm. and underlies Laramie group.

W. C. Knight, 1903 (Geol. Soc. Am. Bull., vol. 13, pp. 542–544). Hilliard is located on *Hilliard fm.* I cite as typical section the sh. beds W. of Kemmerer and extending as far as E. portal of Oregon Short Line tunnel. Overlies Frontier fm. and underlies Laramie.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Hilliard fm.*—Gray to black sandy shales and shaly sss., not known to contain coal of economic importance. Weathers into region of low relief. Thickness 5,500 (?) to 6,800 ft. Several thick lenses of white ss., containing *Inoceramus exogyroides*, occur 3,000 to 3,800 ft. above base of fm. W. of Frontier. Overlies Frontier fm. and underlies Adaville fm.

Hillman limestone.

Pennsylvanian: Northeastern Pennsylvania (Luzerne County).

C. A. Ashburner, 1886 (2d Pa. Geol. Surv. Ann. Rept. 1885). *Hillman ls.*—Tough, siliceous ls., 2 to 3 ft. thick, exposed in cut of Lehigh Valley R. R. SW. of Hillman Colliery breaker. Lies 10 ft. above Hillman or H coal and 37 ft. below Bowkley or I coal.

†Hill Quarry beds.

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

E. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 370–387). *Hill Quarry beds.*—Alternating beds of ls. and sh., 125 to 150 ft. thick. Form topmost div. of Cincinnati beds proper (middle fm. of Cincinnati group). Lie stratigraphically below Lebanon beds (topmost fm. of Cincinnati group), and are underlain by Eden sh. Constitute highest stratum found in Cincinnati hills.

Not a geographic name. Replaced by *Maysville group.*

Named for hill quarries at Cincinnati, Ohio.

Hillsboro sandstone.

Silurian (?): Southwestern Ohio.

E. Orton, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 271, 301, 306–7). *Hillsboro ss.*—Very fine-grained, purely siliceous ss., of white to yellowish or brown color, 0 to 30 ft. thick, forming top fm. of Niagara group near Hillsboro and at a few other localities in Highland Co. Overlies Cedarville or Guelph ls. and underlies Helderberg ls. (Greenfield stone).

J. E. Carman and E. O. Schillhahn, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 169). A restudy of *Hillsboro ss.* of Highland Co. has shown that certain exposures formerly interpreted as ss. layers interbedded in Greenfield and Niagaran dolomites, are really masses of ss. completely enclosed in the dolomites not more than 30 ft. below Sil.-Dev. discon., which here cuts across Greenfield and Niagaran dolomites. The other exposures are of ss. resting on either the Greenfield or the Niagaran at horizon of the discon. The Hillsboro is interpreted as including 2 types of deposits of same age: (1) Discontinuous sand laid down on post-Sil. erosion surface; (2) sand washed down into existing cavities beneath this erosion surface. The Hillsboro is younger than the erosion interval which came after the fm. of Greenfield dol. (late Sil.) and older than Ohio sh. (Upper Dev.), which in Highland Co. lies next above the Sil.-Dev. discon. It is in same hiatus as Sylvania ss. (early Dev.) in NW. Ohio.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 137–138). *Hillsboro ss.* may represent basal deposits of Lower Dev. and may be of about same age [Helderberg, Lower Dev.] as Sylvania ss. of northern Ohio.

Hillsborough series.

Carboniferous: New Brunswick.

W. J. Wright, 1922 (Canada Geol. Surv. Mem. 129, pp. 7, 18). [Assigned to Carbf., but G. W. H. Norman, 1932 (Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 171), assigned it to Miss.]

Hillsdale limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 451, 487). *Hillsdale ls.*—Blue, hard, and massive at top, with streaks of sandy sh. toward base; calc. portions contain abundant black, nodular chert, weathering gray. Marine fossils. Thickness 50 to 150 ft. Underlies Sinks Grove ls. and overlies Maccrady series [fm.]. Is basal memb. of Greenbrier series [ls.]. Type loc. in Monroe Co., in road just E. of Hillsdale, on W. limb of Hillsdale anticline. Also observed in Greenbrier and Mercer Counties, and northward to Marlinton, Pocahontas Co., W. Va., also in Giles Co., Va., and through SW. Va. and into Ky., where it corresponds to St. Louis ls. of Butts.

Hilton shale member (of Portage formation).

Upper Devonian: Southwestern Virginia and northeastern Tennessee.

J. H. Swartz, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 436–448). *Hilton sh. memb. of Portage fm.*—Black sh. or argillite, with, in places, some interbedded gray-black sh. Thickness 12 to 50 ft. Is top memb. of Portage fm. in SW. Va. and Rutledge-Rogersville-Sneedville-Klondyke region of NE. Tenn. [Named for exposures at or near Hilton, Scott Co., Va.]

Hinche formation.

Pliocene: Haiti.

W. P. Woodring, 1922 (Haiti Geol. Surv. Stratig. and structure of central plain, p. 10).

Hinchman sandstone.

Upper Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Hinchman tuff* consists of 500 ft. of greenish or gray sandrock, composed in many places of lapilli. Overlies Bicknell ss.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Hinchman ss.* consists of 500 to 1,000 ft. of coarse tuffaceous ss. and cgl. of andesitic material, with some shaly beds. Uncon. overlain by Foreman fm. and grades into underlying Bicknell ss.

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81; vol. 44, No. 5, pp. 895–903), included Bicknell ss. in *Hinchman arkose*, as he called the fm.

Named for exposures at Curtice Cliff, in lower part of Hinchman Ravine, Plumas Co.

Hinchman tuff. See *Hinchman sandstone.*

Hinckley sandstone.

Pre-Cambrian (Keweenawan): Southeastern Minnesota.

N. H. Winchell, 1886 (Minn. Geol. Nat. Hist. Surv. 14th Ann. Rept., pp. 336–337). *Hinckley sandrock* (*Potsdam?*), is separated from overlying Dresbach sandrock by shales [which he both included in and excluded from his St. Croix, and which he in 1888 named *Dresbach sh.*].

Warren Upham, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2, pp. 639, 645, and map, pl. 55). *Hinckley ss.*—The ss. quarried at Hinckley is hard and compact medium-grained ss. of light-buff color, nearly level in stratification. This ss. occurs in bluffs of Kettle River. Overlies [so-called] Potsdam ss.

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 16). *Hinckley ss.*—White sss. and cgls., varying to red, interbedded with much red sh. Thickness 1,000 ft.

N. H. Winchell, 1901 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 6, Atlas, map of Minn.). *Hinckley ss.* underlies Dresbach and passes down into Potsdam red ss. [so-called]. [Mapped on atlas sheets of Carlton and McLeod Counties (where it is 381 ft. thick), also Pine County.]

C. P. Berkey, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 233, pl. opp. 237). *Potsdam or Hinckley sss.* of Minn., 0 to 1,000 ft. thick, underlie Dresbach sh. and rest uncon. on pre-Camb.

F. F. Grout and E. K. Soper, 1914 (Minn. Geol. Surv. Bull. 11). The red clastic series, 2,000 ft. thick, known in wells in E. and SE. Minn., is probably of same age as red sss. and shales outcropping from Lake Superior SW. to Mora, locally called *Hinckley ss.*

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, pp. 699–713). The red clastic series of Minn. consists of *Hinckley ss.* and underlying unnamed shales and sss. The *Hinckley ss.* is a thick coarse red to brown ss., which often contains much partl.' weathered feldspar, together with mica, magnetite, and traces of other minerals. It may be either massive or shaly, and sometimes shows marks of shallow-water deposition. It immediately underlies St. Croix series, and can be recognized over wide areas, even in records of deep wells of southern Minn. Fossils found in cuttings of Waconia well about 40 ft. below base of Hinckley ss. resemble those of Middle Camb. of Mont., Wyo., Utah, and Idaho, and whole deposit may b̓ Camb., but it is also considered=Keweenawan lavas.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 35–36). There are 2 areas in Minn. in which rocks occur that have been classified as *Hinckley ss.* The NE. area, in which occur beds that have been correlated with Bayfield group of the Upper Keweenawan, includes the exposures on St. Louis River at Fond du Lac and to S. around Hinckley, Minn. Correlation of these beds with upper part of main body of Red Clastic series to S. is accepted by all geologists who have worked in region. In eastern and southeastern area, where lowest Upper Camb. and Red Clastic beds are known only from well logs, the term *Hinckley* was applied to a ss. that occurs below the Eau Claire shales. Are these 2 sss. of same age and both properly called Hinckley? The Mount Simon of Wis. [Upper Camb.] and the Hinckley of adjacent parts of Minn. can be correlated with confidence. There appears to be evidence that the Hinckley of NE. Minn., including that at Hinckley, is older than the beds Stauffer called *Hinckley* in southern Minn. We suggest that *Hinckley* as applied to the beds below Eau Claire shales in E. and SE. Minn. be discarded and that *Mount Simon* be used to designate these beds. If Hinckley is to be retained at all it must apply to the rocks exposed near Hinckley, Minn., which are correlated, by all geologists who have worked in region, with upper part of Red Clastic series and are probably of Upper Keweenawan age. If later work should prove that the Hinckley of southern Minn. and Mount Simon ss. of Wis. are same as type Hinckley, then *Hinckley*, which has priority, should replace *Mount Simon*.

G. I. Atwater and G. M. Clement, 1934 (Geol. Soc. Am. Proc. 1933, p. 384). The ss. that outcrops at Hinckley and at Sandstone, Minn., is correlated with Orienta ss. of Bayfield group of Upper Keweenawan of Wis. This correlation was suggested by Thwaites in 1912. The Hinckley represents upper horizons of pre-St. Croixan red clastic series that are encountered in deep wells in SE. Minn. and NE. and central Iowa. The term *Hinckley* as used by Minn. Geol. Survey in deep wells in SE. Minn. is a definitely younger ss.—the Mount Simon ss. of Wis. It is therefore suggested *Hinckley* be restricted to pre-Mount Simon beds that crop out at Hinckley and elsewhere in NE. Minn. The term *Mount Simon* should be applied to the ss. beneath Eau Claire sh. that is now called *Hinckley* by Minn. Survey.

G. I. Atwater and G. M. Clement, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1684–1685). The sss. that crop out in central eastern Minn. at Hinckley, Pine Co., and along Kettle River are of upper Keweenawan age and correlate with Amnicon fm. of Oronto group and Orienta fm. of Bayfield group in Wis. Younger Keweenawan beds occur in center of Lake Superior geosyncline in NW. Wis. The Mount Simon ss., which forms base of Upper Camb. in Wis. and Minn., is much younger than Hinckley ss. and the overlying Keweenawan sss., and is separated from them by a great structural and erosional uncon. The name *Hinckley* should therefore be restricted to the ss. that crops out at Hinckley and along Kettle River, and *Mount Simon* should be applied to the ss. that underlies Eau Claire memb. of Dresbach fm. in Wis. and Minn. and overlies Red Clastic series (upper Keweenawan) in Minn.

Hindostan whetstone.

Pennsylvanian: Southwestern Indiana (Orange and Martin Counties).

Name was used by D. D. Owen as early at least as 1839 (2d Rept. Geol. Surv. Ind., pp. 8, 10) but not in stratigraphic sense.

E. T. Cox, 1871 and 1876 (Ind. Geol. Surv. 2d Ann. Rept., pp. 81, 105; 7th Ann. Rept., pp. 6–8). *Hindostan whetstone.*—Whetstone, 20 ft. thick, in 2½-ft. layers, with sh. btw., occurring in middle of Millstone grit. Overlain by 4 ft. of shaly bluish ss., succeeded above by 70 ft. of massive ss. and cgl. Underlain by thin bed of black bituminous sh., succeeded below by thin beds of coal and clay and 38 ft. of ss.

E. M. Kindle, 1896 (Ind. Dept. Geol. and Nat. Res. 20th Ann. Rept.). *Hindostan whetstone* is economically the most important part of Mansfield ss.

Named for village in Martin Co., which was once county seat but has been extinct since 1870.

Hindsville limestone member (of Batesville sandstone).

Mississippian: Northern Arkansas (Eureka Springs and Yellville regions).

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Hindsville ls. memb. of Batesville ss.*—Dark-gray ls. interbedded with some ss. Thickness 1½ to 50 ft. In all previous repts on northern Ark. has been included in underlying Boone ls., but is here included in Batesville ss. on paleontologic and lithologic grounds, and because of marked uncon. at its base. Named for exposure near Hindsville, Eureka Springs quad.

Hinsdale gneiss.

Pre-Cambrian: Western Massachusetts and Connecticut.

B. K. Emerson in 1892 used *Hinsdale gneiss* on U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 18, 20, 24–25). *Hinsdale gneiss.*—A group of gray biotite gneisses, generally quite coarse and with jet-black biotite in distinct elongate patches, granitoid and yet well foliated. Underlies Hinsdale ls. and is oldest fm. in Berkshire Hills and Connecticut Valley. [See also B. K. Emerson, U. S. G. S. Bull. 597, 1917.]

Named for occurrence at Hinsdale, Berkshire Co., Mass.

†Hinsdale limestone.

Pre-Cambrian: Western Massachusetts.

B. K. Emerson in 1892 used *Hinsdale ls.* on U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 18, 24–26). *Hinsdale ls.*—Coarse white to pink, highly crystalline ls. with coccolite or chondrodite so abundantly and evenly scattered through mass that it deserves name *coccolite ls.* or *chondrodite ls.* Exposed 50 ft. W. of Hinsdale Station, where 25 ft. is shown. Overlies Hinsdale gneiss and is older than East Lee gneiss. [In U. S. G. S. Bull. 159, 1899, B. K. Emerson gave thickness 600+ ft.]

Replaced by *Coles Brook ls.*

Hinsdale formation.

Tertiary? (Pliocene?): Southwestern Colorado and northwestern New Mexico.

W. Cross, 1911 (U. S. G. S. Bull. 478, pp. 22, 29, map). *Hinsdale volcanic series.*—In portions of San Cristobal and Uncompahgre quads., and presumably in others not yet examined, a succession of volcanic eruptions later than Potosi volcanic series took place, producing a series of lavas differing notably from the products of earlier eruptions. Potosi volcanic series was much eroded before these later lava flows were extruded. So far as known they closed the long sequence of lavas in San Juan region. They range from a rhyolite very rich in quartz and alkali feldspar but poor in calcic feldspar and in all ferromagnesian minerals to a normal olivine plagioclase basalt. Between these two extremes are several types of lavas possessing some characteristics distinguishing them from earlier lavas. Named for important occurrences in Hinsdale Co. The most extensive deposits of these lavas thus far discovered are on divide btw. Lake Fork and Cebolla Creek, directly E. of Lake City. The section exposed is nearly 1,200 ft. thick. It is too early to sharply define limits of Hinsdale volcanic series.

E. S. Larsen, 1923 (U. S. G. S. P. P. 131G, table opp. p. 184; also Bull. 718). *Hinsdale volcanic series* is later than Fisher quartz latite (Mio.) and Creede fm. (0 to 2,000 ft. thick, and also of Mio. age). Latter fm. rests uncon. on Potosi volcanic series in Creede dist.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Hinsdale volcanic series* is of Tert. (?) (Plio. ?) age. [Map shows, in San Juan Mtns, some post-Hinsdale volcanics.] Between the Hinsdale and the Mio. Potosi volcanic series there were outspread the Fisher quartz latite (Mio.) and the Los Pinos and contemp. gravels, of Tert. (?) (Plio. ?) age.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Hinsdale fm.*, and redefined it so as to include, under the name *Los Pinos memb.*, the gravels and sands originally treated as a distinct fm., under the name *Los Pinos gravel*.

Hinsdale sandstone.

Upper Devonian: Southwestern New York (Cattaraugus County) and northwestern Pennsylvania.

G. H. Chadwick, Oct., 1933 (Pan-Am. Geol., vol. 60, pp. 200, 203). *Hinsdale ss.* is suggested for the "quarry sss." composing basal course of Chadakoin fm. of Olean region.

G. H. Ashley and J. D. Sisler, 1933 (Pa. Topog. and Geol. Surv., 4th ser., Bull. M19, pp. 13–14). According to Chadwick, *Hinsdale* ("*Quarry*") *shaly ss.*, 20 ft. thick, underlies Chadakoin sh. and flags and overlies Girard (=Volusia), and is included in Chemung group of NW. Pa.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.* Names of beds underlying and overlying Hinsdale ss. changed, and Hinsdale excluded from Chadakoin fm.]

G. H. Chadwick, Feb. 28, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 326, 350). Near Olean and along Genesee River the *Hinsdale ss.* overlies Volusia beds and underlies Chadakoin beds.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 860, 862). In eastern Cattaraugus Co. the base of the Chadakoin, there called "pink rock" by drillers, contains the *Hinsdale sss.*

G. H. Chadwick, 1936 (letter dated Jan. 2). Type loc. of *Hinsdale* is Ed Hull quarry, high on the hill face E. of Scott Corners and about 1 mi. N. of Hinsdale village [Cattaraugus Co., N. Y.], which is in sight from it.

Hinshaw sandstone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 280). *Hinshaw sss.*—Sss., 100 ft. thick, composing a middle fm. in Laramian series of Utah and Colo. Overlain by 1,200 ft. of unnamed shales and underlain by 1,000 ft. of unnamed shales. [Name used in tables only. Derivation of name not stated. On p. 280 is shown as older than "Navajo sh." and younger than "Picturecliff sss."]

Hinton division.

Lower Ordovician or Upper Cambrian: Central Texas.

T. B. Comstock, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 301–306). *Hinton div.*—Consists of (descending): (1) Sponge bed. of slabby structure, 15 to 20 ft.; (2) sandy calc. shales or slabby dolomites, 25 to 30 ft.; (3) fossiliferous horizon with solid pavement of large sponges, 10 ft.; (4) calc. shaly beds 0 to 20 ft.; (5) tough, commonly dull-gray to brownish crystalline dolomites weathering gray; (6) 15 ft. of pink, white, or mottled red and white ls. with crystalline facets agreeing well with typical Birdseye ls. of N. Y.; (7) transition set of siliceous lss. of variable thickness and somewhat indefinite composition. Lower div. of San Saba series. Underlies Deep Creek div. and overlies Hoover div. of Leon series.

Named for Hinton Creek, San Saba Co.

Hinton formation.

Mississippian: Southern West Virginia and southwestern Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 487). *Hinton fm.*—Heterogeneous mass of variegated shales, sss. of varying character, and impure lss., ranging in thickness from 1,050 to 1,100 ft. Lowest bed is heavy ss., which is prominent feature along railroad from Hinton to Sandstone. Is lowest group of rocks exposed in that portion of New River gorge which lies below Hinton. [Later repts by Campbell state it overlies Bluefield sh.] Underlies Princeton cgl. Is=Greenbrier sh. of Rogers.

The 1928 prel. ed. of Va. Geol. Surv. geol. map of Va. redefined Bluefield sh. and Hinton fm., by restricting Bluefield to the prevailingly calc. beds and transferring to overlying Hinton fm. about 200 ft. of shaly or sandy beds included in Bluefield as defined.

Named for Hinton, Summers Co., W. Va.

Hinton group.

A name that has been applied in some repts to Hinton fm. (Miss.).

†Hinton limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

C. E. Krebs, 1916 (W. Va. Geol. Surv. Rept. Raleigh Co. and western portions of Mercer and Summers Counties, pp. 75, 76, 88). *Hinton ls.*—Massive ls., upper part full of marine fossils. At Hinton, Summers Co., it is 35 ft. thick and top lies 1,060 ft. below top of Mauch Chunk series. Is 55 ft. thick 2 mi. SW. of Hinton, and top lies 340 ft. below top of Mauch Chunk.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 347). Because of conflict with Hinton group [fm.] replaced by *Avis ls.*

Hinton (Upper) limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western parts of Mercer and Summers Counties, p. 167). *Upper Hinton ls.*—Hard gray ls., 25 ft. thick, lying 295 ft. below top of Mauch Chunk in section ½ mi. SW. of Meadow Creek, Richmond dist.

Hinton sandstone.

Mississippian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western parts of Mercer and Summers Counties, p. 77). *Hinton ss.*—Dark brown, 90 ft. thick. Included in Mauch Chunk series, its top lying 415 ft. below Hinton ls. (marine, and 35 ft. thick) at Hinton, Summers Co.

†Hippurites limestone.

Paleontologic name applied by R. T. Hill in 1887 (Am. Jour. Sci., 3d, vol. 33, p. 298) to the rocks in Tex. that were later named *Edwards ls.*

Hitka formation.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 334, 338).

Hitz limestone member (of Saluda limestone).

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

A. F. Foerste, 1903 (Am. Geol., vol. 31, p. 347). In repts of Ind. Survey the beds at top of Ord. section at Madison are referred to as *Murchisonia hammelli* beds, or as the gastropod layer. Since the most varied fauna so far obtained from this horizon was collected in West Madison, along brow of Hitz hill, on W. side of Madison branch of Panhandle Railroad, the bed may also be called *Hitz bed.* [Some repts have excluded it from the Saluda.]

Adopted as a memb. of Saluda ls. because originally included in Saluda. In Jefferson Co., Ky., is 5 ft. thick and almost pure blue ls. According to E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 433), the Hitz ls. belongs to Whitewater fm. and not to Saluda. (See under *Saluda ls.* for explanation of relations of Saluda to Whitewater.)

Named for Hitz Hill, near Madison, Jefferson Co., Ind. Extends from near Floydsburg, Oldham Co., Ky., to southern bdy of Ripley Co., Ind.

Hiwassee slate.

Lower Cambrian: Western North Carolina, northeastern Tennessee, and northern Georgia.

A. Keith, 1904 (U. S. G. S. Asheville folio, No. 116, p. 5 and columnar section). *Hiwassee sl.*—In this region the fm. consists almost entirely of bluish-gray or bluish-black sl., which weathers to greenish, yellowish gray, and yellow. The slates are interstratified at intervals with lenticular layers of blue or dove-colored ls. North and NE. of Hot Springs many of the sl. beds are somewhat sandy, a little coarser-grained, and marked with light-gray siliceous bands of sed. origin. On other side of French Broad River the rocks are finer-grained and more uniform. In many NW. outcrops the slaty character is less pronounced and some layers are almost unaltered shales. A noticeable constituent in some beds is mica in fine scales—an original deposit and not a secondary growth. Bulk of material composing the slates is argill. To this is added here and there the micaceous and sandy material. West of Allen Stand the deposits of sand were enough to make distinct layers 8 to 10 ft. thick, which locally developed into fine cgls. In vicinity of Pigeon River and Crabtree Bald the rocks are so metamorphosed that they consist almost entirely of schists, of several varieties, with interbedded layers of graywacke. Most of the schists are dark gray or black, varied here and there with lighter gray bands. Thickness 700 to 1,500 ft. Overlies Snowbird fm. and underlies Cochran cgl.

In some areas Hiwassee sl. underlies Great Smoky cgl., which is regarded as=Cochran cgl.

Named for exposures on Hiwassee River, Polk Co., Tenn., which has cut a fine section through the fm.

Hobart Hill andesite.

Devonian (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 113, 169. 172–173). *Hobart Hill andesites.*—Hornblende andesite forming Hobart Hill, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the andesite of NE. Me. appears to be assigned to Dev.

Hobo Gulch formation.

Middle Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 436). *Hobo Gulch fm.* [on map], *Hobo Gulch shaly ls.* [in strat. table], *Hobo Gulch lime-sh.* [in text heading].—Shaly ls., including characteristic ls. flags. Corresponds in position to Pilgrim ls. Consists of (descending): 35 ft. of "crinkled ls." (banded cherty ls.); 100 ft. of nearly black ls.; 18 ft. of sh., with no marked characteristics, that may=Park sh. Overlies Starmount ls. and underlies Cemetery ls. Forms a well-marked group of strata seen in railroad cuts near the tailing dams and in Queen Gulch. [Hobo Gulch is a NE. tributary of Queen Gulch, according to Weed's map, but this fm. is not mapped in vicinity of Hobo Gulch.]

Hoboken serpentine.

See under *Staten Island serpentine.*

Hobson Lake series.

Pre-Cambrian (?): British Columbia.

J. F. Walker, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, pp. 283, 284).

Hochelagan formation.

Pleistocene: New York and adjacent parts of Canada and Vermont.

J. B. Woodworth, 1905 (N. Y. State Mus. Bull. 84, pp. 206–222, and map). *Hochelagan fm.* proposed to replace *Champlain* (preoccupied) as a name for the late Pleist. marine deposits of northern N. Y., Canada, and Vt. The best studied section of these marine fossiliferous beds is that of Montreal, the ancient site of which city was occupied by the Indian settlement of Hochelaga. It is therefore proposed to call the deposits of this marine invasion the *Hochelagan fm.* and the subepoch or stage of their time of deposition as the *Hochelagan,* a phase which follows the Wisconsin, with its late lacustrine stages contemp. with the departing ice sheet.

Hocking Valley conglomerate facies.

Mississippian: Central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 669, 678). *Hocking Valley cgl. facies of Cuyahoga fm.*—Mostly cgls. and coarse sss., with some sh. Thickness 600 to 625 ft. Includes (descending) Berne memb., 1' to 20 ft.; Black Hand memb., 100 to 150 ft.; Fairfield memb., 200 to 330 ft.; Lithopolis memb., 118 to 200 ft. Underlies Byer memb. of Logan fm. and overlies Sunbury sh. Occurs in Hocking Valley, Fairfield and Hocking Counties.

Includes Cuyahoga fm. and lower part of Black Hand fm.

Hockley Mound sand member (of Willis sand).

Tertiary? (Pliocene?): Southeastern Texas and southern Louisiana.

J. Doering, 1935 (A. A. P. G. Bull., vol. 19, No. 5, pp. 655, 656, 660–665). *Hockley Mound sand memb.*—Uppermost memb. of Willis fm. in SE. Tex., SW. La., and SE. La. Light-colored fine-grained soft sand. Thickness few ft. to 20 to 25 ft. in SE. Tex., SW. La., and SE. La. Named for Hockley Mound, on Willis Plain, 4 mi. SW. of Hockley, Harris Co., Tex. Rests on Willis ferruginous sand memb. of Willis fm. Overlapped uncon. by Lissie fm. and locally by the [later] Beaumont and Recent.

Hodges shale member (of Bloomington formation).

Middle Cambrian: Northeastern Utah and southeastern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 406, 407). *Hodges sh. memb.*—Drab clay sh., 350 ft. thick, forming basal memb. of Bloomington fm. in northern Utah.

Named for exposures in Hodges Canyon, Rich Co., NE. Utah.

Hodges sand.

A subsurface sand, of Penn. age, in Frye field, Shackelford Co., north-central Tex., lying at 500 ft. depth.

Hodge's Hill sandstones.

Tertiary (Oligocene?): West Indies (Antigua).

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 498).

Hoffman limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties) and northern West Virginia.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Hoffman ls.*—Underlies Middle Hoffman coal and overlies Lower Hoffman coal; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 67, pl. 6). *Hoffman ls.*, of variable thickness, occurs at number of places in Georges Creek valley beneath Middle Hoffman coal, and is named for its relation to that bed.

Hoffman sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Hoffman ss.*—Underlies Lonaconing coal and overlies Upper Hoffman coal; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 68, pl. 6). *Hoffman ss.*—Found at various localities in Georges Creek Valley above Upper Hoffman coal. Thickness 20 to 30 ft. Named for occurrence in Hoffman Drainage Tunnel.

†Hogback sandstone.

Upper Cretaceous: Southwestern Wyoming.

J. W. Powell, 1876 (Geol. of eastern part of Uinta Mtns, pp. 40, 48, 155), applied the descriptive terms *Middle Hogback ss.* and *Upper Hogback ss.* to 2 sss. in upper part of his Point of Rocks group (which is=Adaville fm. and upper part of underlying Hilliard fm.). These sss. are probably in Adaville fm.

Hogback schist.

Pre-Cambrian: Central southern Maine (Waldo County).

E. H. Perkins and E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 9, pp. 204–228). *Hogback schist.*—Principally quartz-mica schist, very highly metamorphosed. Of sed. origin. Appears to be more highly metamorphosed than the other fms. This may be due to greater age and previous metamorphism or to a difference in original composition of sediments. Lies to E. of Branch Pond gneiss. Forms long ridge known as Hogback Mtn, including Frye Mtn range, in town of Knox [Waldo Co.]. Probably pre-Camb.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as pre-Camb.

Hog Creek shale member (of Caddo Creek formation).

Pennsylvanian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 397). *Home Creek bed.*—Slightly aren. and slightly fossiliferous bluish clay or sandy clay, with some ss. and conglomeratic ss., in places in massive beds. Thickness thin to 70 ft. Memb. of Canyon div. Overlies 60 ft. of cherty ls. and underlies Home Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 36; Univ. Tex. Bull. 2132, pp. 117+). *Hog Creek sh. memb.*—Sandy sh. forming basal memb. of Caddo Creek fm. (of Canyon group). To N. grades into thick cross-bedded ss. at top. Underlies Home Creek ls. memb. Rests on Ranger ls. memb. of Brad fm.

Named for Hog Creek, Brown Co., Colorado River region.

Hog Mountain sandstone. (In Mineral Wells formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). *Hog Mtn ss.* underlies East Mtn sh. [restricted] and lies higher than Brazos River ss., all members of Mineral Wells fm. [This ss. lies within East Mtn sh. as originally defined.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 106). Hog Mtn ss. of Plummer included in Mineral Wells fm. as here restricted.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 31+). *Hog Mtn ss. lentil.*—A reddish-buff medium-grained thick-bedded ss. lying in lower part of East Mtn sh. memb. of Mineral Wells fm., and typically exposed on top of Hog Mtn, 3 mi. SE. of Mineral Wells.

Hogshooter limestone.

Pennsylvanian: Northeastern, central northern and central Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, p. 12). Drum ls. splits near Kans. line, and lower memb., which Ohern calls the *Hogshooter,* disappears some 20 mi. N. of Tulsa.

In 1925 the beds overlying Hogshooter ls. were named *Nellie Bly fm.* The Hogshooter rests on Coffeyville fm. In central Okla. it becomes a memb. of Francis fm. Its thickness is 5 to 19 ft.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 91). Winterset ls. extends to southern Okla. and is exact synonym of *Hogshooter ls.,* which should be dropped.

Named for Hogshooter Creek, Washington Co.

Hogshooter sand.

Pennsylvanian (?): Northeastern Oklahoma (Washington County).

W. R. Berger, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 189–194). *Hogshooter gas sand.*—Channel deposit, 0 to 168 ft. thick. Producing horizon in Hogshooter field, Washington Co. Lies directly on Boone. Varies greatly in thickness and pinches out only a short distance to E. and W. of long axis of the field. Has been determined by several hundred well records to be a continuous body of sand in a N.-S. direction, but very narrow and lenticular in opposite direction. Main body of Hogshooter gas sand is interpreted as having been deposited in the channel of the principal stream flowing southward through the pre-Cherokee valley. The narrow and comparatively thin eastward and westward extensions of Hogshooter sand are believed to be deposits made by tributary streams in lower part of their courses. Similar deposits are known at the surface in central and northern Mo., where 2 main channels have been mapped as the Warrensburg and Moberly channels.

Hoh formation.

Tertiary (Miocene and Oligocene?): Northwestern Washington.

C. E. Weaver, 1915 (Am. Inst. Min. Engrs. Bull. 103, pp. 1424–1427). *Hoh fm.*—Dark-gray shales and sandy micaceous shales with subordinate gray medium-grained sss. which are gritty in places; occasional bands of cgl. Thickness 10,000 ft. Only fm. in Wash. that contains oil. Assigned to Jurassic (?); may be Cret., Jurassic, or older. Overlain uncon. by upper Mio.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13, p. 278). *Hoh fm.*, 10,000+ ft. thick, occurs on W. side of Olympic Mtns, along W. coast of Olympic Peninsula, in Jefferson and Clallam Counties. Excellent exposures along coast btw. mouth of Hoh River and Hoh Head. Is only fm. exposed along Queets, Hoh, and Soleduck Rivers for 20 mi. from ocean. In Quillayute area is uncon. overlain by upper Mio. deposits. Possibly Jurassic. Certainly pre-Mio. and probably pre-Eocene.

R. H. Palmer, 1927 (Jour. Geol., vol. 35, pp. 276–278; A. A. P. G. Bull., vol. 11, No. 12, p. 1324). *Hoh fm.* covers more than half of Olympic Peninsula. Its strat. position has been so uncertain that either the entire fm. or members of it have been tentatively placed in Cret., pre-Cret., Jura, Trias, and even Carbf. During 1926 a locality was found on the coast 1 mi. N. of Hoh River, where strat. relationships of at least 3 of its members are well exposed. These are (descending): (1) Massive and bedded ss., technically arkosic graywacke, with many cgl. lenses, 2,000± ft., Lower Mio. fossils; uncon. on (2) soft, thinly bedded light-gray ss., 150 to 200 ft., which may be either pre-Temblor Mio. or Olig.; (3) gray sh. with a few sandy and cgl. lenses, 1,000 ft. exposed. There is evidence No. 3 of above section is oldest Hoh memb. exposed anywhere along coast of Olympic Peninsula. No fossils were found in it that are definite age markers, and it may be either pre-Temblor Mio. or Olig. The Hoh fm. underlies Quillayute fm.

Hoing sandstone.

Silurian: Central eastern Iowa.

W. H. Norton, 1928 (Iowa Geol. Surv. vol. 33, pp. 30–31, 431). *Hoing ss.*—Sandy beds (chert, ls., and quartz sand) at base of Sil. Thickness in wells 6–50 ft. Overlies Maquoketa sh. In Des Moines well in Greenwood Park the beds are 22 ft. thick and are separated from Maquoketa sh. by 55 ft. of ls. Believed to correspond to typical Hoing sand of western Ill.

M. A. Stainbrook, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 259, 260). True Hoing sand of Ill., which is Dev., does not occur in Iowa. According to M. Weller (letter) the Hoing sand of Ill. is underlain by upper Davenport memb. (the top of Wapsipinicon) and overlaps older beds of the Wapsipinicon, and underlies Cedar Valley ls. "Writer believes the ls. beneath Hoing sand is lower Davenport, instead of upper Davenport. Independence sh. has same strat. relations as Hoing sand of Ill. but can not be said definitely to be equiv. until fauna, if any, of latter is known."

Hoing sand.

A subsurface unit in Colmar-Plymouth field, McDonough Co., central western Ill., which has been classified as late Ord., as Sil., and as Dev. (Hamilton?). L. E. Workman says (Trans. Ill. State Acad. Sci., vol. 26, No. 3, p. 107, March 1934) it is Dev., and that it consists of ss. and sandy dol. Encountered at 417 ft. depth on J. Hoing farm, near Colmar, McDonough Co. (See Ill. State Geol. Surv. Bull. 23, pp. 51–53, 1917; Bull. 31, pp. 8–55, 1915; Bull. 40, p. 73, 1919.) T. E. Savage, 1922 (Ill. Geol. Surv. Bull. 38, p. 268), stated it was probably derived from deeply weathered residual material that was developed on surface of Maquoketa sh. during long period of land conditions that prevailed in the region btw. end of Maquoketa and beginning of Niagaran time, and that it appears not to have been laid down over extensive area, because many wells pass from Niagaran ls. directly into Maquoketa sh.

See also under *Hoing ss.*, 1935 entry.

Hoko formation.

Pliocene (?): Northwestern Washington.

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22, p. 202). *Hoko fm.*—A series of cgls., 300± ft. thick, occupying territory from Hoko River in its lower course E. to Clallam Bay. Rests uncon. on upturned and eroded sss. and shales of Clallam fm. The boulders contain Mio. fossils. The fm. is certainly pre-Pleist., so that evidence places it in Plio. [Relations to Quinault fm. and his Raft River fm. not explained.]

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 604). The Hoko River Plio., so called, of Reagan is an area of Monterey ss. and cgl. uncon. on Astoria series.

Holbrook sandstone.

Lower Triassic: Eastern Arizona (Holbrook region).

D. Hager, 1922 (Mg. and Oil Bull., vol. 8, Nos. 1, 2, 3, Jan., Feb., Mar., pp. 26, 33–34, 73, 81–94). *Holbrook ss.*—Thinly cross-bedded sss. with a few sh. intercalations; the ss. dark gray on fresh fracture and contains black specks and mudstone pellets; all weathers dark red and changes laterally to massive cross-bedded ss. Top memb. of Moenkopie fm. in Holbrook area. Exposed in form of cliffs just N. of railroad btw. Winslow and Holbrook. Uncon. underlies Shinarump cgl. and lies on red gypsiferous shales of the Moenkopie.

†Holden group.

Pennsylvanian: Northwestern Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. Rept. on Iron Ores, pt. 2, pp. 169, 194). *Holden group.*—Shales, lss., and sss, 59 ft. thick, including beds Nos. 55 to 64 of detailed section of lower Coal Measures from Sedalia to Kansas City. Underlies Mound group and overlies Lexington group.

Is lower part of Pleasanton fm.

Named for exposures at Holden, Johnson Co.

Holdenville shale.

Pennsylvanian: Central and central southern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Holdenville sh.*—Blue and yellow clay sh., with thin siliceous lss. and sss., 260 ft. thick. Underlies Seminole cgl. and overlies Wewoka fm.

Named for Holdenville, Hughes Co., which is located on the sh.

Holderness formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado (Yampa coal field).

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Holderness fm.*—N. of Yampa River mostly friable ss. 200± ft. thick, but S. of that stream thickens rapidly to W. to 900 ft. and includes beds of massive ss., sh., and coal. Is thickest in Holderness Gulch, Daton Peak quad. Is top fm. of Mesaverde group in Yampa coal field. Underlies Lewis sh. and overlies Twentymile ss.

Holdrege formation.

Pleistocene (Nebraskan): Southern Nebraska.

A. L. Lugn and G. E. Condra, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 190). *Holdrege fm.* (*Nebraskan*).—Lowermost gravel-sand deposit in southern Nebr., 50 to 100+ ft. thick. Conformably underlies Fullerton fm. (Aftonian).

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 326, 342–344). *Holdrege fm.*—Largely fluvial inwash-outwash deposits of sand and gravel, generally coarse near base and finer toward top. Thickness 0 to 120± ft. Is = Nebraskan till and David City fm., both of Nebraskan age. Not known to outcrop in Platte River valley or south-central Nebr. May be exposed at some places along Republican Valley. Is certainly exposed at several places in Niobrara Valley. Is known almost entirely from well logs. Underlies Fullerton fm. and rests uncon. on Tert. or Cret. Occurs more or less continuously over area of 15,000± sq. mi. Named for the Trees deep test for oil and gas near Holdrege, Phelps Co.

Hole-in-the-Wall member.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Hole-in-the-Wall memb.*—Basal memb. of Boulder Pass fm. Consists of (descending): (1) Metargillite, medium-bedded, finely banded, green, with large ripple marks in upper part and *Collenia* in lower part, 16 ft.; (2) metargillite, qtzite, and minor cgl. beds, main mass being of red to buff sandy metargillites, mud-cracked, ripple-marked, and in spots cross-bedded, well exposed on slope above Granite Park chalet, 300 to 350 ft.; (3) argillite, green to buff, finely banded, grading down into gray-buff argill. ls., mud-cracked and ripple-marked, 75 ft. Overlies Siyeh fm., and underlies Purcell lava. [Derivation of name not stated but probably Hole-in-the-Wall Falls, Flathead Co.]

†Holiknuk series.

Upper Cretaceous: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 159–161, 182). *Holiknuk series.*—Alternating beds of ss., argill. or siliceous ls., sh., and arkose; cgl. at base containing pebbles apparently derived from uncon. underlying Tachatna series. Some plants and invertebrates. Referred to Cret. Essentially contemp. with Kolmakoff series. [Apparently named for Holiknuk River.]

G. C. Martin, 1926 (U. S. G. S. Bull. 776, chart opp. p. 474), referred these rocks to Upper Cret. and discarded the name. He stated that they are W. continuation of part of Spurr's Kolmakoff series.

Holland sandstone.

Lower Devonian: Northwestern Ohio.

E. Orton, 1888 (Ohio Geol. Surv. vol. 6, p. 20) and 1890 (Ohio Geol. Surv. 3d Organization, 1st Ann. Rept., p. 24). *Monclova or Holland ss.* occupies same position in series as Sylvania ss.

Named for Holland, Lucas Co.

Holland sand.

A subsurface sand occurring btw. Big lime and Oswego lime in vicinity of Ochelata, N. E. Okla., and correlated with Labette sh. (Penn.).

Holland Patent.

Upper Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Holland Patent* introduced for upper Utica or zone of *Climacograptus pygmaeus* in Mohawk Valley.

Hollenberg limestone. (In Sumner group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., pp. 63–66). Only a few ft. of basal part of Pearl sh. is exposed in Nebr., but a short distance S. of State line, as btw. Hollenberg and Hanover, Washington Co., Kans., its lower sh. and a ls. capping this sh. are well shown, from which we have traced them southward to near Okla. line. A second ls., 18 to 20 ft. above the Hollenberg bed, outcrops at some places. The lower sh. memb. of Pearl sh. is 38 to 40 ft. thick in northern Kans. and about 50 ft. farther S. in Kans. The *Hollenberg ls.* (named for exposures along the Little Blue 3½ mi. SE. of Hollenberg) is very persistent and a good horizon marker, 3 to 4 ft. thick. It is a gray fossiliferous zone which forms large yellowish flat blocks. In places it is filled with Foraminifera, ostracodes, and 3 genera of small gastropods.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), restricted *Pearl sh.* to beds beneath this ls., applied *Newbern sh.* to the beds overlying this ls., and treated the ls. and his Newbern sh. as lower part of Donegal ls. (new).

Holliday shale.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38). *Holliday shales.*—Shales, 900 ft. thick, composing Pintoan series, the basal div. of Cambric section in Utah. [Derivation of name not stated.]

Hollis quartzite.

Pre-Cambrian: Eastern Alabama (Lee County).

G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 33–34). *Hollis qtzite.*—Qtzite, in places having nature of quartz schists, exposed at and near Hollis, Lee Co., and 10 mi. to SW. No fossils. Infolded in Archean rocks. Tentatively assigned to Algonkian.

In view of fact that "Archean system" and "Algonkian system" have been discarded, this fm. is now classified by U. S. Geol. Survey as *pre-Camb.*

Hollow dolomite. (Buried.)

Silurian (Niagaran): Central Kansas (Harvey County).

L. A. Johnston, 1935 (Tulsa Geol. Soc. Digest, 1934, pp. 12–17, pl. 1). *Hollow dol.*—Highly crystalline porous dol. containing many large vugs, some of which are due to chemical solution of fossils. Upper part usually sandy and sometimes has phosphatic inclusions. Recrystallization has destroyed most fossils. Occasionally the lower part of this zone is cherty and in such places fossils are more easily found. This is major producing zone of Hollow field and can be traced throughout the basin where the Siluro-Dev. group is present. Thickness 0–40 ft. Few fossils. Microfossils resemble those of Hopkinton of southern Ill. and lower Hunton of Okla. According to Laudon is lithologically similar to Niagaran of northern Miss. Valley. Differs lithologically from the uncon. overlying Ediger ls. In 4 wells overlies a coarsely crystalline pink and white crinoidal ls., 10 ft. thick, resembling Chimneyhill of Okla. Was named by F. A. Bush, unpublished paper delivered before Tulsa Strat. Soc. in 1933, in which *Ediger ls.* also was proposed.

Holly Creek clay.

Lower Cretaceous (Comanche series): Southwestern Arkansas.

H. C. Vanderpool, 1928 (A. A. P. G. Bull., vol. 12, pp. 1079–1080). *Holly Creek clay.*—Series of nonfossiliferous aren. rocks, 0 to 300 ft. thick, consisting of red clays, thin sand beds, and gravel lenses. One gravel lentil in particular has been named Ultima Thule lentil. It occurs locally just above Dierks ls. lentil. Southward from outcrop this red series thins within a short distance, and is represented in La. by lss. which form part of Glen Rose ls. It seems desirable that this series of beds, occurring btw. two such well-defined marine zones, should have a distinct name. The name *Holly Creek* is therefore proposed, because of excellent exposures near Little Holly and Holly Creeks, SE. of Dierks, Howard Co., Ark. The beds grade into underlying Dierks ls. lentil and are overlain by DeQueen ls.

Holly Springs sand. (In Wilcox group.)

Eocene (lower): Mississippi and western Tennessee and Kentucky.

E. N. Lowe, 1913 (Miss. Geol. Surv. Bull. 10, pp. 23–25). The middle div. of Wilcox fm. might appropriately be called *Holly Springs sands.* Thickness perhaps 350 ft. Is prevailingly sands, coarse-grained, cross-bedded, white to yellow, red, or purple; micaceous; become grayish or greenish beneath the surface. Typically developed at and for several mi. E. of Holly Springs [Marshall Co., NE. Miss.]. Underlies Grenada beds and overlies Ackerman beds, the lowest div. of the Wilcox.

In present usage of names the Wilcox is treated as a group and Holly Springs sand as middle fm. of that group.

Holmesville shale. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 43). *Holmesville sh.*—Basal memb. of Doyle fm. Type loc. 1½ mi. W. and ½ mi. N. of Holmesville, Gage Co., Nebr., where it consists of (descending): (1) Gray, red and gray, argill. sh., 10 or 11 ft.; (2) blocky ls., 1 ft.; (3) gray sh., 7 ft. The ls. persists for a considerable distance into Kans. Thickness 20± ft. in

Nebr., increasing to 35 ft. in parts of Butler Co., Kans. Underlies Towanda ls. and overlies Fort Riley ls.

Holmesville moraine.

Pleistocene: Northeastern Ohio. Named for Holmesville. (See G. G. Cole, Sci., vol. 47, p. 469, 1918, and G. W. White, Jour. Geol., vol. 40, pp. 246–247, 256, 1932.)

Holocene.

A term that has been applied to post-Pleist. deposits designated as Recent series by U. S. Geol. Survey and most other geologists, and also applied to Tert. deposits. For former use see B. Smith, N. Y. State Mus. Bull. 300, 1935; for latter use see J. B. Perry, Boston Soc. Nat. Hist. Proc., vol. 15, 1872, p. 55. The term was adopted by Portuguese Committee of 1885 Int. Geol. Congress, but has seldom been used in United States.

Holston marble. (Also **Holston limestone.**) (In Blount group.)

Lower Ordovician (Chazy): Eastern Tennessee, western North Carolina, and western Virginia.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, map). *Holston marble.*—[Described on map legend as: "Lentils of variegated marbles of many colors in blue and gray ls." The name does not appear in columnar section or in text of this folio, but marble beds in Chickamauga ls. are briefly described.]

A. Keith, 1901 (U. S. G. S. Maynardville folio, No. 75, p. 3). *Holston marble.*—In lower part of Chickamauga fm. are many beds of more or less coarsely crystalline marble. These do not appear NW. of Clinch syncline, except in a most local way. In that syncline and southward, however, marble is usually well developed in all areas of the fm. On account of distinctive appearance and economic importance is mapped under name of Holston marble. Is 600 to 650 ft. thick near Clinch Mtn and thins in all directions from that area. The position of the marble beds in the ls. varies much from place to place. Usually there is considerable thickness of blue and gray ls. below the marble; N. of Clinch Mtn, however, and on S. side of Black Oak Ridge, the marble beds are thicker and rest on Knox dol. Varies considerably in color from red, brown, gray, and pink, most of rock, however, being dark bluish gray and variegated reddish brown or chocolate. Is lentil in Chickamauga ls.

Later repts define Holston marble as underlying Athens sh. and uncon. overlying Lenoir ls. Ulrich (1929) stated that in places in E. Tenn. and SW. Va. his newly proposed *Whitesburg ls.* intervenes btw. Athens sh. and Holston marble. The Holston is now in most areas treated as a distinct fm. in Blount group, instead of as a memb. of Chickamauga ls., which is being rapidly split up into smaller units, as more detailed work is done.

Named for exposures on Holston River, Knox Co., Tenn.

Holt shale. (In Topeka limestone.)

Pennsylvanian: Northwestern Missouri, southeastern Nebraska, northeastern Kansas, and southwestern Iowa.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). *Holt sh.*—A thin but persistent bed of sh. in Topeka ls. memb. of Shawnee fm. Is bluish and argill. above and black and fissile in middle and lower parts. Thickness in Nebr. 1–2½ ft.; in Iowa 1⅝ ft.; in Kans. 2½ ft.; at Forest City, Mo., 2⅓ ft. Underlies Coal Creek ls. bed and overlies Dubois ls. bed, all included in Topeka ls. Named for good exposures in Holt Co., Mo., just below Forest City and NW. of Oregon.

Holt moraine.

Pleistocene (Wisconsin stage): Northwestern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 117–118). Village of Holt, Marshall Co., stands on this moraine.

Holtsclaw sandstone. (In Osage group.)

Mississippian: Western and northern Kentucky and southern Indiana.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, p. 151). *Holtsclaw ss.*—Bluish-gray or buffish, loosely cemented soft fine-grained thick-, to massive-bedded ss., 15 to 25 ft. thick in Jefferson Co., Ky. Top fm. of Osage group. Underlies Warsaw ls. and overlies Rosewood sh. Is "Knob" ss. of early repts. Contains Keokuk fossils.

E. R. Cumings, 1922. [See under *Rosewood sh.*]

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 54, 124), abandoned this name. See summary of book cited, under *Carwood fm.* and *Rosewood sh.*

Named for Holtsclaw Hill, Jefferson Co., Ky.

Holy Cross schist.

Pre-Cambrian: Central Colorado (Sawatch Range).

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, pp. 466–479, map). *Sawatch and Holy Cross schists.*—[Mapped separately, but described together, as follows:] Foliated rocks, ranging from dense black biotite or hornblende schists, through banded injection gneisses, to granitoid rocks with only faint traces or "ghosts" of schist remnants, are by far the most abundant rocks of Sawatch Range. These various types of foliates are everywhere gradational one into another, the type depending upon extent to which the original metamorphosed sediments have been invaded and replaced by granitic juices, stringers, and sills of Pikes Peak or Silver Plume massives. In extreme cases all traces of schistosity have been removed, resulting in a thoroughly granitoid rock. All outcrops that retain any evidence of original schistose character have been mapped as schist. The Sawatch and Holy Cross schists are separated more on basis of field appearance than on any difference in origin or composition. The Holy Cross schist is universally and intimately injected by stringers and sills of brilliant pink pegmatite, and is distinct in appearance from Sawatch schist, in which the pegmatite is commonly white or gray. Not known on what the difference of color is based, since Silver Plume massive is apparently responsible for injection of both types of schist. Are pre-Camb. and may belong to Idaho Springs fm. [The *Mountain of the Holy Cross* occurs in midst of mass mapped as *Holy Cross schist and migmatite*. The other schist seems to have been named for Sawatch Range.]

Holyoke formation.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette district).

M. E. Wadsworth, 1890 and 1891 (Lake Superior along the south shore, by Julian Ralph, pp. 77–99; 1st ed., 1890; 2d ed., 1891). *Holyoke fm.*—Cgls., qtzites, and schists of Cascade, Republic, Holyoke, and elsewhere in Marquette dist. Overlies Republic fm. and uncon. underlies Potsdam ss.

M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, pp. 63–66). *Holyoke fm.*—Qtzite with cgl. at base. Uncon. underlies Negaunee fm. and uncon. overlies Mesnard fm., which is believed to be uncon. on Republic fm., but which may be same as Republic fm. [On later pages of this vol. Holyoke fm. is defined as resting uncon. on Republic fm. and as including at base a cgl. they called *Holyoke cgl.*] Named for occurrence at Holyoke, in Cascade range.

J. M. Clements, 1899 (U. S. G. S. Mon. 36, p. 20). Upper Marquette series is Wadsworth's Holyoke fm.

See also C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, pp. 145–149).

Holyoke diabase. (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 451–456). The sheet of *Holyoke diabase* came up through a fissure in Chicopee sh. and flowed westward out over Longmeadow brownstone and Sugarloaf arkose. Greatly thickens to W.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). [See 1898 entry under *Longmeadow ss.*] Is "main sheet" of Percival. Thickness 350 to 400 ft. Is older than Hampden diabase.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 92, 94, 97, 265–271). After Talcott diabase had been deeply covered, the accumulation of sediment was again interrupted by an eruption of lava through a fissure on the earth's crust, which opened along bottom of the basin. The lava flowed E. and W. on bottom of the bay, and solidified into a sheet which may have been 2 or 3 mi. wide and about 400 ft. thick in its thickest central part. This is the "main sheet" and is called *Holyoke diabase.* This sheet was covered with sand and mud layers to a considerable thickness when Hampden diabase ("posterior bed") outflowed. At N. the same buff arkose that underlies Holyoke diabase also rests on it. The diabase continues to rest on Sugarloaf arkose to Holyoke, and from there to S. line of State it rests on Longmeadow ss. and Chicopee sh. The "Deerfield" diabase is a sheet of Holyoke diabase. The Holyoke is a fm. in Newark group. Named for occurrence in Mount Holyoke Range. Mass.

Holyoke conglomerate.

Pre-Cambrian (middle Huronion): Northwestern Michigan (Marquette district).

See 1893 item under *Holyoke fm.*

Holzmark sand.

A subsurface sand in Fayette ss. (Eocene) of Pettus dist., Tex. (See A. A. P. G. Bull., vol. 15, No. 7, pp. 780, 781, 1931.)

Home Creek limestone member (of Caddo Creek formation).

Pennsylvanian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 398). *Home Creek bed.*—Ls., 25 to 50 ft. thick, friable in upper part, massive blue beds in lower part, and some clay and ss.; one clay bed 10 to 30 ft. thick to N. Is memb. of Canyon div. Overlies Hog Creek bed and underlies Bluff Creek bed.

C. S. Ross, 1921 (U. S. G. S. Bull. 726G, p. 306). *Home Creek ls. memb. of Canyon fm.*—Is 40 ft. thick in Lacasa area. Consists of 3 lss. separated by shales. Is top memb. of Canyon fm. Replaces Plummer's "Eastland" ls., which name is preoccupied. Town of Caddo, Stephens Co., is built on this ls.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 36; Univ. Tex. Bull. 2132, pp. 118+). *Home Creek ls.,* a series of thin lss. 10 to 50 ft. thick, forming top memb. of Caddo Creek fm. from Llano Mtns NE. into Young Co.; but to NE. of Finis, Jack Co., it can not be traced with certainty, because it changes laterally into calc. sands. Overlies Hog Creek sh. memb. in both Colorado River and Brazos River valleys.

Named for Home Creek, Coleman Co.

Homer limestone member (of Wayan formation).

Cretaceous (Lower ?): Southeastern Idaho.

G. R. Mansfield, 1921 (Geol. Soc. Am. Bull., vol. 32, pp. 249–266), referred 4 times (and showed its distribution on geol. map) to *Homer ls. memb.* of Wayan fm., Lower Cret. (?), SE. Idaho, but did not define it. In Jour. Geol., vol. 29, 1921, pp. 458, 459, Mansfield casually referred twice to same unit, and also mapped it.

G. R. Mansfield, 1927 (U. S. G. S. P. P. 152, p. 107). *Homer ls. memb. of Wayan fm.*—Occurs in NE. part of Cranes Flat quad. and extends into adjacent regions N. and E. Its strat. position is not known definitely. Ordinarily the surface underlain by it is strewn with white pieces of rock, which by their arrangement on the slopes suggest the attitude of the beds. Locally, as on slope NE. of Sugarloaf Mtn, the ls. forms massive ledges. At this place some of upper beds are dull gray, coarsely crystalline, and crowded with poorly preserved fossils [listed].

Named for exposures in valley of Homer Creek, Cranes Flat quad.

Homer limestone member (of Holdenville shale).

Pennsylvanian: Central southern Oklahoma (Pontotoc County).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 104–105). [Name was also used by Morgan, but not defined, in Okla. Geol. Surv. Circ. No. 12, pl., p. 9, 1923.] *Homer ls. memb.*—Dark-gray or almost black ls.; constituting a reef of *Chaetetes* in NE. part of Stonewall quad. To S. Fusulinas appear in the ls., become abundant, and the ls. finally changes to almost a pure *Fusulina* ls. Is in lower part of Holdenville fm., 17 to 70 ft. below Sasakwa ls. memb.

Named for exposures ½ mi. W. of Homer School, in sec. 25, T. 4 N., R. 6 E., Stonewall quad.

Homestake limestone.

Carboniferous: Southwestern Utah (Iron Springs region).

C. K. Leith and E. C. Harder, 1908 (U. S. G. S. Bull. 338, p. 24). *Homestake ls.*—Carbf. ls., 50 to 500 ft. thick, uncon. underlying Pinto ss. (Upper Cret.). [Mapped at and around Homestake mine, Iron Springs quad.]

Homestake formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, with maps). *Homestake fm.*—Cummingtonite and chloritic schists, with contorted quartz stringers; in places dolomitic. Outcrops usually red and massive, the red color due to iron oxide. Greater part of fm. is cummingtonite schist. Original fm. was a siliceous, ferruginous, dolomitic ls., somewhat banded and in places well preserved. Underlies Ellison fm. Thickness 70 ft. Believed to be of Keewatin age.

Derivation of name not stated, but probably is Homestake mine, Lead dist.

Homewood sandstone member (of Pottsville formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 67). *Upper Homewood ss.*—Top memb. of Beaver River group. Is a massive yellowish white conglomeratic ss., 75 to 155 ft. thick. Is separated from overlying Brookville coal by 4 ft. of fire clay. Is 155 ft. thick at Homewood Station, Beaver Co., Pa., where it cuts out overlying Clarion coal group up to a higher horizon than Ferriferous (Vanport) ls. Lies 20 to 80 ft. above Connoquenessing (*Lower Homewood*) ss. [The Upper Homewood ss. of above rept has for many years been called *Homewood ss. memb. of Pottsville fm.*, the use of *Lower Homewood* for the Connoquenessing ss. having been discontinued.]

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 308–316). *Piedmont (Upper Homewood)* ss. underlies Brookville coal and is separated from underlying Mount Savage coal by 20 to 80 ft. of sh.

Homewood (Lower) sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western parts of Mercer and Summers Counties, p. 56). *Lower Homewood ss.*—Underlies Stockton A coal and overlies Stockton coal. Thickness 48 ft. 4 in.

†Hominy formation.

Pennsylvanian and Permian: Central-northern Oklahoma.

C. N. Gould, 1905 (U. S. G. S. W. S. P. 148, map). [In this rept an area in NE. Okla. is mapped as *Hominy fm.*, but text does not mention the name. Page 32 of rept, however, states that: The fms. exposed in Hominy dist. include the southern extension into Okla. of Pottawatomie, Douglas, Shawnee, Wabaunsee, Cottonwood, and Neosho fms. of Kansas geologists, and have a thickness of over 1,500 ft. In 1906 (U. S. G. S. Bull. 298, p. 252) M. L. Fuller and S. Sanford published a description of a well near Cleveland, Pawnee Co., Okla., which contains the following statement: The rocks outcropping for 25 mi. W. and E. and 40 mi. N. have been grouped together as *Hominy fm.* (*Penn.*), including Pottawatomie, Douglas, Shawnee, Wabaunsee, Cottonwood and Neosho fms. of Kansas geologists, and have a thickness of over 1,500 ft.]

Named for Hominy, Osage Co.

Hominy sand.

Lower (?) Ordovician: Central northern Oklahoma (Osage County) and eastern Oklahoma (Tulsa and Okmulgee Counties).

L. H. White, 1926 (Okla. Geol. Surv. Bull. 40B, pp. 8, 13–14). *"Burgen" ss.* (*"Hominy" sand*).—The "Burgen" ss. was first called "Hominy" sand because it was thought to be principal source of deep production around town of Hominy, Osage Co. Since that time, however, it has developed that most of that production was probably coming from the underlying "Siliceous" ls. The "Burgen" ss. uncon. overlies Arbuckle ls. ("Siliceous lime") and underlies Tyner fm.

R. W. Clark, 1926 (Okla. Geol. Surv. Bull. 40F). The *Hominy sand* lies at depth of 2,880 ft. in sec. 19, T. 14 N., R. 13 E., and at 3,548 ft. in sec. 33, T. 13 N., R. 11 E.

F. C. Edson, 1927 (A. A. P. G. Bull., vol. 11, p. 969). *"Hominy" ss.* underlies Tyner fm. and uncon. overlies Siliceous ls.

W. F. Cloud, 1930 (Okla. Geol. Surv. Bull. 40RR). *Burgen ("Hominy") sand* is 10–75 ft. thick in Tulsa Co. It lies on weathered surface of Arbuckle ls., and consists of hard massive ss., light gray to yellowish brown.

Hominy lime.

A subsurface ls., of Penn. age, in central northern Okla. that is supposed to correlate with Lecompton ls. memb. of Pawhuska fm. and to be same as †Pawhuska lime.

Honaker limestone. (In Virginia, **Honaker dolomite.**)

Middle Cambrian: Southwestern Virginia, northeastern Tennessee, and western North Carolina.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44, p. 2). *Honaker ls.*—Varies in character from blue flaggy ls. to dark impure ls. and massive gray dol. Thickness 900 to 1,000 ft. Overlies Russell fm. and underlies Nolichucky sh. West of this quad. the Honaker ls. is subdivided by a small band of calc. sh. (Rogersville sh.) into two distinct lss., the upper of which has been named Maryville and the lower Rutledge ls. In passing eastward the Rogersville sh. becomes more and more calc. until, on W. edge of this quad. the three blend into a single ls. with about same thickness as the aggregate farther W.

Named for exposures at Honaker, Russell Co., Va.

Honaker sand.

A subsurface sand in southern San Juan Co., SE. Utah, that lies in Hermosa fm. (Penn.). Is reported to occur just below water level at foot of Honaker Trail.

Hondo sandstone member (of Chupadera formation).

Permian: Southeastern New Mexico (Pecos Valley region).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Chupadera fm.* of Pecos Valley region here divided into (descending): (1) *San Andres ls. memb.* (replaces Picacho ls. of Fiedler and Nye); (2) *Hondo ss. memb.*, and (3) Yeso memb. The Hondo ss. consists of coarse white quartz grains, variably streaked yellowish to brownish red and cemented by iron and lime. In places it is cross-bedded, and iron concretions and nodules are abundant in upper part. Thickness usually 50± ft. Has been commonly referred to in the field as "Glorieta ss.," but it has never been definitely shown that this ss. is wholly or in part the ss. of Glorieta Mesa. Crops out near bottom of valley of the Hondo and its tributaries. Of great value in subsurface correlation. [The adoption of *Hondo ss. memb.* involves a slight redefinition of both San Andres ls. and Yeso as originally defined and heretofore used.]

Honerine limestone.

Miners' local name for an ore-bearing ls., 8 to 12 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 40 ft. below Maverick ls. of miners and 10 ft. above their Little Honerine ls. Exposed in Honerine claim. (See U. S. G. S. P. P. 173, 1932.)

Honesdale sandstone group. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 66–68, 132, 140). *Honesdale ss. group.*—Underlies Cherry Ridge group and overlies Montrose red sh. At Honesdale, Wayne Co., is easily divisible into (descending): *Honesdale white ss.*, 25 ft.; *Honesdale red ss.*, 40 ft.; *Honesdale gray ss.*, 25 to 50 ft. At Montrose, Susquehanna Co., this group of rocks forms the high bank near Fair Grounds, but no division can be made. *Montrose sss.* is a term I have freely employed in my township repts, uncertain how much of the section in hilltops around Montrose (over the red sh.) ought to be restricted to Honesdale ss. group. Vanuxem in

1844 applied term *Montrose ss.* (*Oneonta*) to distinguish one div. of his Catskill, but seems to have looked upon it as lowest div. of the fm., whereas I find 500 ft. of Catskill measures still beneath drainage level at Montrose. [On pp. 132 and 140 he says Honesdale ss. series of Wayne Co. is same as Montrose series of Susquehanna Co.]

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6). *Honesdale ss. group* is 500 ft. thick near W. line of Monroe Co. and 987 ft. thick on Lehigh River. [Another rept gave thickness of 987 ft.]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 581–584, 606), described geographic distribution and fossils of nonmarine *Honesdale ss.*, as he called it, and replaced *Montrose red sh.* of White with *Damascus red sh.*, the name *Montrose* being preoccupied in N. Y. He stated: *Honesdale ss.* underlies Cherry Ridge red beds, overlies Damascus red sh., and passes into marine beds to west.

Honey Creek limestone.

Upper Cambrian: Central southern Oklahoma (Arbuckle and Wichita Mountains).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 624, 642, 661, 666, pl. 27). *Honey Creek ls. memb. of Reagan ss.*—Certain thin lss. originally included in basal part of Arbuckle ls. but now transferred to underlying Reagan fm. Is calc. upper part of the Reagan. [Thickness and type loc. not stated.]

H. D. Miser, 1926 (Okla. geol. map), followed Taff's original definitions of Arbuckle ls. and Reagan ss. and included this ls. in Arbuckle ls.

E. O. Ulrich, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 742+). The beds formerly called by writer Honey Creek ls. memb. of Reagan ss. are here raised to rank of fm. and called *Honey Creek fm.* Named for Honey Creek, a tributary of Washita River which rises in Arbuckle Mtns and flows northeastward around W. end of East Timbered Hills. Along Honey Creek, on S. side of East Timbered Hills, in sec. 1, T. 2 S., R. 1 E., Okla., the upper part of *Honey Creek fm.* consists of 44 ft. of thin-bedded argill. and shaly ls., often yellow, with some cgl., probably intraformational, (the *Ptychaspis* zone), which is absent ¼ mi. E. of Honey Creek. The *lower part* consists of 80 ft. of uneven plates of crystalline ls., many of them very fossiliferous, separated by clayey and more or less glauconitic seams, with grains of glauconite scattered through the lss. Trilobites of *Pterocephalia* zone are abundant in lower 20 ft., and *Eoorthis* zone next above; also a layer with crinoid fragments near base and another or two in upper third. In this section the Honey Creek is uncon. overlain by Royer fm., the intervening Fort Sill fm. being absent, and is separated from underlying Reagan ss. by a hiatus corresponding to Cap Mtn fm. of [central] Texas. In Wichita Mtns the fm. is 250 ft. thick.

The U. S. Geol. Survey has adopted *Honey Creek ls.* (Upper Camb.) as a distinct fm., for the thin sandy lss. that form basal part of Arbuckle ls. as defined by Taff in Wichita Mtns, Okla., but in Arbuckle Mtns, Okla., older lss. come in below the Honey Creek. The latter is 124 ft. thick at type loc. It does not include the 60 ft. of calc. sss. which Taff treated as top memb. of Reagan ss. (See C. L. Dake and J. Bridge, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 725–741.)

C. E. Decker, 1933. (See under *Timbered Hills group.*)

Honna formation.

Cretaceous: British Columbia.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 44).

Honolulu volcanic series.

Pleistocene (middle? and late) and Recent (?): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). Most of *Honolulu volcanic series* lies at or near city of Honolulu. It rests with great erosional uncon. on Koolau volcanic series, of Tert. and possibly early Pleist. age. It has been subdivided into the following mapped subdivisions:

Recent or latest Pleist. lavas and pyroclastics:

Basalts and pyro-explosion deposits of Tantalus and Sugar Loaf:

Tantalus basalt.	Sugar Loaf basalt.	Contemporaneous pyro-explosion deposits. Locally called "black sand."	Occur at Honolulu

Basalts and pyroclastics of Koko fissure:
- Kaupo basalt.
- Kaohikaipu volcanics.
- Koko volcanics. (Overlie Kalama volcanics.):
  - tuff.
  - basalt.
- Kalama volcanics.
- Manana tuff.

Recession of sea to present level.

Do not occur near Honolulu. — Contemporaneous

Late and middle (?) Pleist. lavas and pyroclastics. (Probably all post-middle Pleist.):

Lavas and pyroclastics of Waipio (60±-foot) stand of the sea and Wamainalo (+25-foot) stand of the sea:
- Punchbowl volcanics:
  - basalt.
  - tuff.
- Castle volcanics.
- Kamanaiki basalt.
- Black Point basalt. (Overlies Diamond Head tuff.)
- Mauumae volcanics.
- Kaimuki volcanics. (Rest on Diamond Head tuff.)
- Diamond Head tuff.
- Training School volcanics.
- Maunawili volcanics.
- Ainoni volcanics.
- Salt Lake tuff. | Makalapa tuff. (From different vents.)

Relatively contemporaneous, but erupted from different vents. Occur at and near Honolulu.

Halt of sea at 40-foot (?) level, known as Waialae stand.

Lavas and pyroclastics of Kaena (+95-foot) and Laie (+70-foot) stands of the sea:
- Kaau volcanics:
  - tuff.
  - basalt.
- Ulupau tuff.
- Moku Manu volcanics:
  - tuff.
  - basalt.
- Makawao breccia.
- Pali volcanics:
  - basalt.
  - breccia.
- Nuuanu volcanics (3 basalts).
- Kaneohe volcanics.
- Aliamanu tuff.
- Haiku volcanics:
  - basalt.
  - tuff.
- Kalibi volcanics.
- Rocky Hill volcanics.
- Mokulea basalt.
- Mokapu basalt.
- Hawaiiloa volcanics.

Relatively contemporaneous. Occur at and near Honolulu.

Recession of the sea to a level below 55 ft. known as Kahipa stand. Erosion of deposits of previous stand of the sea.

Halt of sea at 55 ft. above present sea level known as Kahuku stand.

Hoodoo quartzite.

Pre-Cambrian (Belt series): Southern central Idaho (Casto region).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Hoodoo qtzite.*—White massive qtzite, 3,650+ft. thick, uncon. underlying schist of unknown thickness, believed to be of Algonkian age, and overlying Yellowjacket fm., both included in Belt series. Type loc., Hoodoo Creek.

C. P. Ross, 1935 (U. S. G. S. Bull. 854). *Hoodoo qtzite.*—White, relatively pure and massive qtzite, 2,000 to 4,000 ft. thick, overlying Yellowjacket fm. Named for exposures along Hoodoo Creek, in NW. part of Casto quad. Upper fm. of Belt series. A. L. Anderson suggests (Idaho Bur. Mines and Geol. Pam. 34, p. 10, June 1930) the rocks here named *Yellowjacket fm.* and *Hoodoo qtzite* may correspond to lower and middle members of Prichard fm. as identified by him in Orofino region.

Hood River conglomerate.

Miocene (upper) or Pliocene (lower): Northwestern Oregon and southwestern Washington.

J. P. Buwalda and B. N. Moore, 1927 (Sci., n. s., vol. 66, p. 236). *Hood River fm.*, proposed for the unique cgl. and ss. strata underlying Dalles fm. in Columbia River gorge. Heretofore called "Satsop fm." but older than typical fossiliferous Quat. marine Satsop fm. of Wash. coast, and is approx. upper Mio. or lower Plio. Type section in cut immediately E. of Columbia River highway bridge across Hood River. In E. part of gorge this cgl. underlies Dalles beds and can be traced into central Wash., where it lies at base of Ellensburg fm.

J. P. Buwalda and B. N. Moore, 1928 (Pan-Am. Geol., vol. 49, p. 313) and 1929 (Geol. Soc. Am. Bull., vol. 39, pp. 116–117). From its relation to Dalles beds the "Satsop" of Columbia River gorge is of equiv. or greater age and not correlative of Quat. Satsop fm. of Oreg. and Wash. coasts.

J. P. Buwalda and B. N. Moore, 1930 (Carnegie Inst. Wash. Pub. 404, pp. 21, 22). *Hood River cgl.*—Gravels in gorge of Columbia River, in places several hundred ft. thick, and heretofore known as "Satsop gravels" but now known to be older than type Satsop of Chehalis Valley, 100 mi. distant. Overlies Columbia River basalt and in places underlies, probably conformably, The Dalles beds. Type section at E. end of Columbia River highway bridge spanning Hood River, just E. of town of Hood River, Oreg. Is probably a phase of The Dalles fm., as suggested by Bretz, but it appears to be rather distinct from the volcanic series.

Hooker slate.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 402). *Hooker sl.*—Notably black sl. with less cleavage than usual in this region. No fossils known, but it appears to be more closely associated with Lower Camb. fm. than with overlying Ord. fms. Underlies Lower Ord. Poultney sl. with a great hiatus btw. and overlies Beebe ls. Named for Hooker Hill, 2 mi. N. of Castleton [Castleton quad.].

Hoopes sand.

A subsurface Ord. sand in Okla. that is known by several other names. See under *Kinter ss.*

Hoosac schist.

Lower Cambrian (?): Western Massachusetts, southwestern and southeastern Vermont, and western Connecticut.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Hoosac schist.*—Feldspathic mica schist or thin-bedded gneiss. Underlies Rowe schist and overlies Dalton phyllite in Green Mtn region, Mass., and Becket gneiss in Hawley quad., Mass.

J. E. Wolff, 1894 (U. S. G. S. Mon. 23, pp. 23–107). *Hoosac schist.*—Albite schist. Conformably overlies the cgl. on top of Hoosac Mtn., Mass., extending northward for miles into Vt. Underlies Rowe schist. Is in contact with Stockbridge ls. and with Vermont fm. [in NW. Mass.].

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 66–76, pl. 34). *Hoosac schist.*—Albitic sericite schist, finer-grained than uncon.

underlying Becket gneiss, and iron and potash absent. Grades into overlying Rowe schist.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 40–41). *Hoosac schist.*—A dark graphitic mica schist, in many places highly garnetiferous, especially at base. In a few places it carries staurolite and kyanite. Is commonly porphyritic. In N. part of area it becomes a gneiss. Equiv. in part at least to Berkshire schist. Thickness 1,500 ft. in Westfield Valley; 4,000 ft. in Hoosac Mtn. Is Ord.

Age changed to Lower Camb. (?) in 1932, because L. M. Prindle and E. B. Knopf, who have studied and mapped the fm., consider it to be Lower Camb. or older. (Am. Jour. Sci., 5th, vol. 24, Oct. 1932.)

Hooser shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., pp. 20, 25). *Hooser sh.*, new name for basal part of Easly Creek sh. of Condra 1927. It consists of (descending): (1) Olive sh., calc., argill., fossiliferous, weathers buff, 2 ft.; (2) sh., weathered buff, with boxwork at places, 1 ft.; (3) sh., grayish, with calc. concretionary sub-zone near base and reddish subzone below middle, 8 ft. Thickness averages about 11 ft. from Nebr. to Okla. Underlies Middleburg ls. and overlies Eiss ls. Type loc. highway cut and ravine just E. of Hooser.

G. E. Condra, 1935. (See under *Bader ls.*)

Hoover division.

Upper Cambrian or Lower Ordovician: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxii, 295–306). *Hoover div.*—Consists of (descending): (1) Fine-grained gritty crystalline lss.; (2) compact, thin, slabby, fossiliferous ls., blue, red, gray, dull brownish, and yellow (called "Burnet marble" by earlier geologists, from great development of series near town of Burnet and neighboring parts of Burnet Co.); (3) dark fucoidal ls. Is upper div. of Leon series. Underlies Hinton div. of San Saba series and overlies, apparently uncon., Wyo div.

Is a part of Ellenburger ls.

Named for Hoover Valley, Burnet Co.

Hoover gas sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Hardinsburg ss. An older Chester sand, called *Hoover oil sand*, has been correlated with Cypress ss.

Hoover sand series.

A series of subsurface Penn. sss. and interbedded strata in central and northern Okla., reported to be 150 to 700± ft. thick and to correspond approx. to Elgin ss.

†Hop Brook limestone.

A name applied by B. K. Emerson (U. S. G. S. Bull. 159, p. 52, 1899) to Coles Brook ls. as exposed in bottom and steep banks of Hop Brook at Sodom, E. part of Berkshire Co., Mass.

Hope limestone.

Silurian (?): Central southern Maine (Hope Township, Knox County).

C. T. Jackson, 1837 (1st Rept. Geol. Maine, pp. 57–58). *Hope ls.* is in the talcose sl. Is indistinctly stratified and is cut through by many small trap dikes, while at points of contact the ls. is frequently converted into dol. Extensively quarried in Hope Twp. Most compact variety is known in commerce as *Lafayette lime.*

Hope gypsum. (In Sumner group.)

Permian: Central Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 10, 11). *Hope gyp.*—A gyp. bed in Geuda salt measures, about 100 ft. lower than Greeley gyp.

G. P. Grimsley, 1899 (Univ. Geol. Surv. Kans, vol. 5, pp. 58–61), gave further description of this gyp. bed, and named a gyp. occurring 10 ft. lower the *Solomon gyp.*

Named for Hope, Dickinson Co.

Hopewell sandstone.

Carboniferous: Canada.

H. M. Ami, 1900 (Canada Rec. Sci., vol. 8, p. 162).

Hopewell formation.

Pleistocene: Jamaica.

C. Schuchert, 1935 (Hist. geol. of Antillean-Caribbean region, p. 417).

Hopkinton dolomite.

Silurian (Niagaran): Eastern Iowa.

S. Calvin, 1906 (Jour. Geol., vol. 14, pp. 572, 574). *Hopkinton ls.*—Dol., very fossiliferous in places, 220 ft. thick, constituting lower phase of western Niagara and heretofore designated as Delaware (preoccupied). Includes zones btw. base of Niagara and top of *Pentamerus*-bearing beds.

T. E. Savage, 1906 (Iowa Geol. Surv. vol. 16), included in Hopkinton "stage" the "*Cerionites* and crinoid beds," overlying the *Pentamerus oblongus* beds.

According to E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22), the Hopkinton dol. is of post-Clinton and pre-Guelph age. According to E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 4, pp. 91–93) it is doubtfully of middle Clinton age. The U. S. Geol. Survey, also E. O. Ulrich, now treat Guelph as upper part of Lockport dol.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 61). Due largely to recent work of E. H. Scobey (unpublished thesis, Univ. Iowa Library) the Alexandrian (Medina, Lower Sil.) Edgewood and Kankakee fms. of Ill. have been recognized in Iowa and separated from the Hopkinton. The upper part of the Hopkinton remaining after removal of the Edgewood and Kankakee is probably= Joliet, Waukesha, and Racine of Ill. [Niagaran]. [In fig. 2 of this rept. the Hopkinton is placed in Niagaran.]

Named for Hopkinton, Delaware Co.

Hoppin slate.

Lower Cambrian: Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 36). *Hoppin sl.*—Chiefly red sh. or sl., with layers and nodules of white ls., overlying greenish sh. or sl., beneath which is a basal white qtzite. Not greatly altered. Lower Camb. fossils. Thickness probably not less than 600 ft.; base not seen. Exposed at 2 places in Narragansett Basin, one at Hoppin Hill, North Attleboro, and the other in Wrentham, ½ mi. S. of West Wrentham village, just N. of Rhode Island bdy. Overlapped by Wamsutta fm. (Carbf.).

Hordes Creek limestone lentil (of Admiral formation).

Permian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 422). *Hordes Creek bed.*—Impure lss., 10 to 30 ft. thick, with some layers of ss. and clay. Memb. of Albany div. Overlies Lost Creek bed and underlies Indian Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192, 193, and charts). *Hordes Creek ls. lentil* is in lower part of Admiral fm. (basal fm. of Wichita group). Overlies Lost Creek sh. memb. and underlies Indian Creek sh. memb.

Named for Hordes Creek, Coleman Co.

Hornerstown marl. (In Rancocas group.)

Eocene (lower): New Jersey Coastal Plain.

W. B. Clark, 1907 (Johns Hopkins Univ. Circ., n. s., 1907, No. 7, Whole No. 199, p. 3). The term *Hornerstown marl* is here proposed to replace *Sewell*, which is found to be preoccupied. Is basal fm. of Rancocas group. Underlies Vincentown sand.

Named for occurrence at Hornerstown, N. J.

Horn River shales.

Devonian: Mackenzie.

E. J. Whittaker, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. B, p. 52).

Hornsboro sandstone.
Hornsboro zone.

Triassic (Upper); Northeastern South Carolina (Chesterfield County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 11, 12). *Hornsboro ss.*, also *Hornsboro zone* (Jurassic and Triassic).—This fm. is bounded on N. by N. C. line, from a point about 3 mi. E. of Hornsboro to a point about 1.2 mi. W. of Hornsboro; the delimiting line then proceeds southeasterly about 1 mi., thence easterly 5 mi., and thence to initial point on N. C. line; from easterly half of this area a narrow strip has been removed through erosion by the Clay Creek waters, which expose the underlying Edgefield-Chesterfield slates. The Hornsboro rocks comprise brown-red and gray sss., varying in places to a purple-brown indurated clay. Numerous intrusive masses of diabase have greatly disturbed, and partly metamorphosed to secondary forms, portions of the red sss. The bodies exhibited in this State are not sufficiently homogeneous to afford valuable quarries. In N. C., where these beds attain much greater thickness, as in Jupiter area, workable beds of coal are included by the Jura-Trias. In many places the coal seams have been disconnected by diabase intrusions, and exhibit so much pyrite that profitable mining is impossible. The close of Jura-Trias in S. C. was characterized by intrusion of a vast series of diabase dikes, prominent in the Jura-Trias and in Edgefield-Chesterfield fms., but progressively less toward the Piedmont.

Named for exposures around Hornsboro, Chesterfield Co.

Horse Bench sandstone lentil (of Green River formation).

Eocene (middle): Northeastern Utah (Uinta Basin).

W. H. Bradley, 1931 (U. S. G. S. P. P. 168, p. 16). *Horse Bench ss. lentil.*—Nearly equal groups of thin-bedded and ripple-marked ss. beds that alternate with a smaller amount of hard greenish gray micaceous and sandy mudstone. Thickness 0 to 55 ft. Is much more resistant than the associated rocks. Lies 475± ft. below top of Green River fm. in area W. of Bitter Creek. Is=part of Evacuation Creek memb. E. of Bitter Creek. Is underlain by grayish-brown sh. and shaly marlstone, much of it sandy and either laminated or flaky. Is overlain by hard, drab, either uniformly colored or faintly banded mudstone, which weathers spheroidal and contains some soft, brown, flaky sh. Named for fact it forms the broad table-land btw. Minnie Maud Creek and Jack Canyon known as Horse Bench, in NE. part of Carbon Co.

Horse Creek limestone member (of Moran formation).

Permian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 419). *Horse Creek bed.*—Mostly hard massive light-gray ls., 5 to 15 ft. thick, with clay parting in places. Memb. of Cisco div. Underlies Santa Anna bed and overlies Watts Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 177–183 and charts). *Horse Creek ls. memb. of Moran fm.* (of Cisco group), 5 to 15 ft. thick; underlies Santa Anna sh. memb. and overlies Watts Creek sh. memb. of Moran fm. in Colorado River Valley.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 170). Horse Creek ls. of Drake is preoccupied (see under Strawn fm.) and discarded. Moran fm. transferred to Wichita group (Perm.).

Named for Horse Creek, Coleman Co.

Horse Creek clay and shale. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 379). *Horse Creek clays and shales.*—Upper 100 ft. usually blue clay, slightly sandy, and containing a few clay ironstone nodules; lower 50 ft. black clay sh. or, in places, shaly black clay of nodular structure. Memb. of Strawn div. Underlies Bull Creek ss. and overlies Fox Ford bed.

Named for valley of Horse Creek, San Saba Co.

Horse Creek coal group. (In Pottsville formation.)

Pennsylvanian: Central Alabama.

Same as Mary Lee coal group.

Horsefly gravels.

Tertiary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 220).

Horseneck sand.

A subsurface sand in Conemaugh (?) fm. (Penn.) of W. Va., that is considered to be younger than Saltsburg ss. memb. Named for Horseneck Creek, Pleasants Co., W. Va. Some geologists correlate it with Clarion ss. memb. of Allegheny fm.

Horsepen. (In Pottsville group.)

Pennsylvanian: West Virginia.

D. White, 1895 (Geol. Soc. Am. Bull., vol. 6, p. 316). "Horsepen" is used for present convenience, without any intention to add to geol. nomenclature, to indicate a group of coals above Pocahontas coal in lower half of Pottsville sections of Tug River and Great Flat Top Mtn. They are more or less exposed near schoolhouse at Horsepen [and at other mentioned localities].

Horse Spring formation.

Tertiary (?): Southeastern Nevada and northwestern Arizona.

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 53) and 1928 (U. S. G. S. Bull. 798). *Horse Spring fm.*—Fine playa and lake deposits of ls., compact clays, sss., gyp., and volcanic tuffs. A variant thickness of light-colored ls. is most persistent and characteristic horizon marker of fm., but it varies considerably in color and other physical properties. Some of the soft white beds are almost pure magnesium carbonate, and the deposits are locally called "the magnesite," being interbedded with thin dol. layers and pink calc. sss., 200 to 300 ft. thick. No fossils. Assigned to Tert. (Mio. ?). Thickness of fm. 1,000 to 2,800 ft. Grades into underlying Overton fangl. (Tert., Mio.?), and is uncon. overlain by Muddy Creek fm. (Plio.?). Well exposed on E. side of Horse Spring Valley, near St. Thomas Gap, Clark Co., Nev.

The finding, later, of a Cret. flora in lower part of Overton fangl., led to reclassification (in March 1936) of the Overton as *Cret. and Tert. (?)*; and, because of physical relationships of the Horse Spring to the Overton, the age designation of the Horse Spring was changed to *Tert. (?)*.

†Horsetail Creek beds.

Tertiary (lower Oligocene): Northeastern Colorado.

W. D. Matthew, 1901 (Am. Mus. Nat. Hist. Mem., vol. 1, pt. 7, pp. 355–374, 444). *Horsetail Creek beds.*—Lower part of White River fm.—the *Titanotherium* beds. Consist of hard white or grayish-white clays with considerable horizontal cleavage and some ss. layers. Older than Cedar Creek and Martin Canyon beds.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 103) and 1918 (Am. Mus. Nat. Hist. Mem., vol. 2, pt. 1, p. 9). *"Horsetail Creek beds"*=Chadron fm. (lower Olig.).

Named for Horsetail Creek, Logan and Weld Counties.

Horsethief sandstone. (Of Montana group.)

Upper Cretaceous: Northwestern Montana and southern British Columbia.

E. Stebinger, 1913 (Am. Inst. Min. Engrs. Bull. 81, p. 2337). *Lennep or Horsethief ss.*—Massive gray ss., 0 to 300 ft. thick, overlying Bearpaw sh. and underlying Lance fm.

E. Stebinger, 1914 (U. S. G. S. P. P. 90, pp. 62–68). *Horsethief ss.*—Gray to buff coarse-grained, much cross-bedded, massive ss. in upper half, and slabby gray ss., becoming shaly toward base, in lower half. In places contains beds of heavy magnetite-bearing ss. Thickness 360 ft. Fossils mainly brackish, but in places it contains a marine littoral fauna. Overlies Bearpaw sh. and underlies continental deposits composing St. Mary River beds of Dawson, which occupy approx. strat. position of Lance fm. of Wyo. Believed to correlate with Lennep ss. of central Mont.

Type loc. is Horsethief Ridge, Blackfoot quad.

Horsethief formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 14).

Horsethief Creek formation.

Pre-Cambrian: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A2, p. 117).

Horsetown formation.

Lower Cretaceous (Shasta series): California and Oregon.

C. A. White, 1885 (U. S. G. S. Bull. 15, pp. 19–32). [See definition under *Knoxville fm.*]

J. S. Diller and T. W. Stanton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 435–464). [See explanation under *Knoxville fm.*]

The Horsetown fm. ranges in thickness up to 6,000 ft. It overlies Knoxville fm. and underlies Chico fm. The upper part may be of early Cenomanian age, and therefore Upper Cret., but U. S. Geol. Survey classifies the whole unit as Lower Cret.

Named for exposures at Horsetown, Shasta Co. Also well exposed on North Fork of Cottonwood Creek.

Horton series.

Mississippian: New Brunswick and Nova Scotia.

J. W. Dawson, 1873 (Rept. on fossil plants of Lower Carbf. and Millstone grit. fms. of Canada, Canada Geol. Surv., 1873).

According to C. Schuchert and C. O. Dunbar, 1933 (Textbook geol., pt. 2, p. 227), corresponds to Pocono group of Appalachian region.

Horton sand.

A subsurface sand in Pottsville fm. (Penn.) of Knox, Knott, and Pike Counties, SE. Ky.

Horton Bluff formation.

Carboniferous: Nova Scotia.

W. A. Bell, 1929 (Canada Geol. Surv. Mem. 155, p. 30).

Hortontown basic eruptives.

Southeastern New York (Poughkeepsie quadrangle).

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148, pp. 11, 37–39). *Hortontown basic eruptive.*—Several outcrops of a massive compact greenish rock in orchard by the house and near the barn on farm of Albert Lawrence at Hortontown. The only occurrence within Poughkeepsie quad. that indicates that an eruptive has penetrated and altered the overlying Paleozoics. [In table on p. 11 *Hortontown hornblende rock* is placed opposite Camb. and Ord.]

Hortonville slate.

Middle Ordovician (early Trenton): Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 369). *Hortonville sl.*—Dark or black sl. with portions sufficiently altered to be called phyllite. Also contains a few small seams of siliceous material giving a local banded appearance. As a rule the bedding is obscured by the cleavage. Is well exposed around Hortonville [Castleton quad.]. Though unfossiliferous is correlated with Snake Hill fm. of N. Y. [which is early Trenton]. Younger than Hyde Manor ls.

Hoskinnini tongue (of Cutler formation). Also **Hoskinnini member.**

Permian: Southeastern Utah (San Juan County) and northeastern Arizona.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1422, 1423, 1441, 1443, 1446). *Hoskinini tongue of Cutler fm.*—Red sss. and sandy sh., 0 to 75 ft. thick, forming top part of Cutler fm. in Monument Valley and other areas in southern San Juan Co., Utah, and NE. Ariz. Uncon. underlies true Moenkopi fm. and overlies De Chelly ss. memb. of Cutler fm. In earlier repts all these beds were included in Moenkopi fm. (Lower Triassic), but they are Perm. Exposed on N. face of Hoskinini [Hoskinnini] Mesa, several mi. W. of Oljeto trading post, in Moonlight Wash, btw. Lees Ferry and Kayenta, NE. Ariz.

Hosmer sand.

Hosmer oil sand.

Hosmer Run oil rock.

Hosmer Run oil sand.

Terms applied by J. F. Carll (2d Pa. Geol. Survey Rept. I, pp. 45-46, 1875) to the First oil sand of Hosmer Run, Warren Co., Pa., which lies 410 to 455 ft. below the Olean cgl. (basal memb. of Pottsville fm.).

Hosmer conglomerate.

Hosmer Run conglomerate.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

J. F. Carll, 1883 (2d Pa. Geol. Surv. Rept. I_4, pp. 250, 254, 259, 268). *Hosmer Run cgl.*—Massive conglomeratic ss. of flat-pebble type, the largest pebbles, white and yellow, being in upper part. Thickness 15 or more ft. on Hosmer Run, near E. line of Spring Creek Twp, Warren Co. Probably same as Wrightsville cgl.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2), shortened this name to *Hosmer cgl.*

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 93). Relation of *Hosmer Run cgl.* of oil-pit region NW. of Garland, Pa., and Woodcock ss. is obscure, but it appears unlikely that they are synonymous. The Hosmer Run is probably referable to Tuna cgl. horizon, which is probably a little lower in section than Woodcock.

Hosselkus limestone.

Upper Triassic: Northern California (Taylorsville and Redding region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Hosselkus ls.*—Fossiliferous ls., 140 ft. thick, considered to be younger than Swearinger sl. and older than Trail beds.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Hosselkus ls.*—Dark-blue to light-gray ls., thin-bedded, in some places decidedly slaty; fossiliferous. Thickness 140 ft. Well developed in Redding region, where upper part is lighter colored and more massive and contains a spiriferlike shell, and lower part is thinner bedded and darker, with small coiled forms. Conformably overlain (not underlain, as originally assumed) by Swearinger sl., and uncon. underlain by Robinson fm. In Redding region it is separated from Robinson horizon by 1,000 ft. of andesitic and rhyolitic lavas, which are overlain by 1,500 ft. of shales, sss., and tuffs of Triassic age.

Named for fact it forms prominent ledges on divide btw. Genesee Valley and Hosselkus Creek, 1 mi. NE. of Hosselkus ranch, Plumas Co.

Hosselkus series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Hosselkus series* as a geographic name for *Upper Triassic series*.

Hosta sandstone member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (Gallup region).

J. D. Sears, 1934 (U. S. G. S. Bull. 860A). *Hosta ss. memb. of Mesaverde fm.*—The ss. that appears in midst of Gibson coal memb. NW. of Walker's store thickens rapidly to N. and E., and within 10 mi. to NE. it is 250± ft. thick. To this unit writer is here applying the name *Hosta ss. memb.*, because it caps the prominent Hosta Butte. It also forms the major cliff or rim and the top of the northward-sloping ridge behind it. To N. the ss. is split into 2 distinct tongues by a wedge of marine sh. that forms Satan tongue of Mancos sh. The upper ss. of Hosta memb. is of earliest Montana age and the underlying rocks are of Colorado age.

Hota formation.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 335, 338).

Hotauta conglomerate. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Hotauta cgl.*—Arkose cgl. characterized by lack of sorting and transportation. Thickness 0 to 6 ft. in Shinumo quad. Rests on Vishnu schist (Archean), the upper surface of which is very uneven, through erosion, representing a great uncon. Is basal fm. of Unkar group (Algonkian). Conformably overlain by Bass ls. Named for Hotauta Canyon, Shinumo quad., in lower part of which the geologic section was measured.

Hotson sand.

A subsurface sand, 8 to 20 ft. thick, in central northern Okla., correlated with part of Eskridge sh. (top of Penn.). In Garber pool it is reported to lie at 1,430 ft. depth, the Hoy sand at 1,100 ft., and the Walker at 1,500 ft.

Hot Springs formation.

Quaternary: Yellowstone National Park.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Nat. Park folio, No. 30), mapped *Hot Spring fms.*, and described them in text under heading *Hot Spring deposits.*

A. Hague et al., 1899 (U. S. G. S. Mon. 32, pt. 2, pl. 10), mapped *Hot Springs fm.*, and this name was adopted in 1904, for the Atlas to accompany Mon. 32; but the Atlas as printed used *Hot Spring fm.*

Named for the Hot Springs, which formed the deposit.

Hot Springs sandstone.

Pennsylvanian: Southwestern Arkansas (Hot Springs quadrangle).

A. H. Purdue, 1910 (Jour. Geol. vol. 18, pp. 282–283). *Hot Springs ss.*—Gray qtzitic ss., in beds 3 to 8 ft. thick, the basal 10 ft. conglomeratic. Thickness 100 ft. Overlies Arkansas novaculite in vicinity of Hot Springs [intervening Fork Mtn sl. apparently absent] and underlies Stanley sh.

Age of Stanley sh. and Hot Springs ss. was changed to Penn. in 1934. (See H. D. Miser, A. A. P. G. Bull., vol. 18, No. 8, 1934.)

Houchen Creek limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 89). *Houchen Creek ls.*—Massive to irregular, or separated by bluish sh. partings; characterized in most exposures by presence of large masses of algal growth. Thickness 4 to 8+ ft. in Nebr., 3+ ft. in NE. Kans. Been traced to Kansas Valley, N. of Belvue [Pottawatomie Co., Kans.]. Underlies Hughes Creek sh. and overlies Stine sh., all included in Elmdale sh. memb. Named for exposures on Houchens Creek, sec. 29, T. 6 N., R. 13 E., Nemaha Co., Nebr.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), transferred Houchen Creek ls. and Stine sh. to Admire sh., and introduced *Oaks sh.* for the bed overlying Houchen Creek ls. Whether Oaks sh. is a part of Hughes Creek sh. as originally defined, or a newly discovered unit, was not stated.

G. E. Condra, 1935. (See under *Hamlin sh.*, where the name was spelled *Houchens Creek ls.*)

Houghton conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 80–81 and chart). *Houghton cgl.* is cgl. No. 14 of Houghton Co.

Belongs to Central Mine group.

Named for occurrence in Houghton mine, Houghton Co.

Houghton moraines.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).

W. A. Ver Wiebe, 1927 (Mich. Acad. Sci., Arts, and Lett. Papers, vol. 7, p. 161). *Houghton moraine* extends across S. side of Houghton Lake from sec. 4, T. 22 N., R. 4 W. to sec. 33, T. 22 N., R. 3 W. *Houghton ground moraine* lies on SW. side of Houghton Lake.

Hounsfield bentonite.

Middle Ordovician (Black River): Central New York (Jefferson County).

G. M. Kay, 1930 (Sci., n. s., vol. 72, p. 365). *Hounsfield bentonite.*—Type section in small quarry just N. of Dexter-Brownville road, 2 mi. E. of town of Dexter, Jefferson Co.; Hounsfield Twp is 1 mi. S. of the locality. In the quarry it occurs as a bed of gray white homogeneous clay, reaching ⅜ in. in thickness, lying [uncon. in 1931 rept.] above Leray ls. and [uncon.] below Watertown ls., in Chaumont fm., of Ord. (upper Black River) age. In Ont. the Hounsfield occurs within the intermediate Glenburnie memb. of Chaumont fm. near Kingston and in Coboconk ls. of Lake Simcoe dist. In upper Miss. Valley it occurs consistently within 2 ft. of base of Spechts Ferry memb. of Decorah fm. The presence of the bed has been reported in Minn. and Tenn. The fact that Hounsfield bentonite has been found to occupy the position that it has in type Black River section establishes new basis for correlating beds in other regions within which the bentonite occurs with those in type section.

G. M. Kay, 1931 (Jour. Geol., vol. 39, No. 4, p. 362), showed uncon. btw. Hounsfield bentonite and overlying Watertown ls. and underlying Leray ls. at its type loc., and on p. 374 he applied *Hounsfield bentonite* in N. Y., Ont., Ky., Tenn., Mo., and Iowa columns of his correlation chart.

House Mountain shales.

Upper Ordovician: Central western Virginia.

J. L. Campbell, 1879 (Am. Jour. Sci., 3d, vol. 18, p. 29), listed, in table of geol. fms. of Virginia Valley, *House Mt. shales* (of Trenton age) as overlying *Lexington lss.* (of Trenton age), and underlying Medina cgl. Not defined. All of definition of both.

J. L. Campbell, 1880 (The Virginias, vol. 1, pp. 41–45). *House Mtn shales*=Hudson River and Utica. Overlie Lexington lss., of Trenton age, and underlie Medina cgl.

Appears to correspond to Martinsburg sh.

Houston marl.

Upper Cretaceous: Northeastern Mississippi (Chickasaw County).

E. W. Hilgard, 1860 (Geol. and Agric. Miss., pp. 96–97). *Houston marl.*—Bluish-gray marl dug from cisterns at Houston, Chickasaw Co. Outcrops of the marl (which extends eastward to Kilgore's Ridge, and probably southward to the Tibby) are scarce, but it is generally not far underground in dist. of its occurrence, as is known in each neighborhood where wells have been dug. Belongs to Rotten ls. group [Selma chalk].

Houston andesite.

Tertiary: Southwestern New Mexico (Mogollon district).

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). *Houston andesite.*—A single flow near base of Cranktown ss. Is porphyritic, but phenocrysts are smaller and less numerous than in the other andesites higher in the series. Thickness about 40 ft.

Named for exposures in valley of Houston Canyon, in SE. part of Mogollon dist.

Houston group.

Pleistocene: Coastal Plain of eastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 780). *Houston group* is proposed to embrace the Pleist. strata of the flat Gulf coastal plain from top of Plio. sands of Citronelle group to base of Recent coastal silts and wind-blown sands overlying the Pleist. deposits in some areas. Outcrop along coastal border of Gulf of Mexico. Are bounded on N. by Hockley escarpment and equiv. rolling ridgeland, and on S. by the beach and wind-blown sands along present shore line. Average thickness 1,500 ft. Named for city of Houston, which is located in middle part of Pleist. section at about contact of the upper clays with the lower sands. Includes Beaumont and Lissie fms.

Houten sandstone.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 257, and Conspectus of geol. fms. of N. Mex., pp. 2, 8). *Houten sss.*—Middle sandy portion of Raton series [Raton *fm.*, of Eocene age] in NE. N. Mex. Thickness 600 ft. Underlies Maxwell sh. and overlies Maya cgl. [See under *Maxwell.* Keyes has also applied this name in Colo. Derivation of name not stated.]

Howard limestone. (In Shawnee group, Kansas.)

Howard limestone member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska and southwestern Iowa.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 67, 105). *Howard ls.* proposed by G. I. Adams in field notes, for ls., 3 to 8 ft. thick, overlying Severy shales and underlying what seems to be equiv. of Osage shales [not true †Osage but the higher Scranton sh.] in Chautauqua, Elk, and Greenwood Counties, Kans.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), defined *Howard ls. memb. of Shawnee fm.* as underlying Scranton sh. memb., and overlying Severy sh. memb., and this has been the generally approved definition for many years. In Kans. the Shawnee is treated as a group and the subdivisions as fms.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 204). Type loc. of Howard ls. is near Howard, Elk Co., Kans. It is typically exposed in NE¼ sec. 7, T. 29 S., R. 11 E., and is here included in Wabaunsee group.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Howard arkose.

Tertiary (Miocene?): Central Washington (Snohomish County).

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 7, pp. 34–50). *Howard arkose fm.*—Coarse, angular, arkosic cgl. with interbedded tuffs, lavas, and andesitic breccias. Thickness 500 to 700 ft. No fossils. Is Tert. and much younger than Eocene arkose of Monte Cristo dist.; may be Mio. Named for Howard Creek, just below Howard Lake. Uncon. overlies West Index andesitic series.

†Howard sandstone member. (In Tuscarora sandstone.)

Silurian: Central Pennsylvania (near Mount Union and Lewistown).

F. M. Swartz, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 101). *Howard ss. memb.* is proposed for red and green beds at top of Tuscarora ss. in sections near Mount Union and Lewistown. This memb. may represent bulk of Albion group of western N. Y.

F. M. Swartz, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 109), replaced this name, which is preoccupied, with *Castanea ss.*, which he excluded from Tuscarora ss.

Howe limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 86, 88). *Howe ls.*—Dark-gray massive dense ls., with considerable free calcite. Weathers buff to yellowish, granular, vesicular or cavernous, and very irregular. At places carries geodes. Thickness 4 to 5 ft. in Nebr. and NE. Kans. Underlies Roca sh. and overlies Bennett sh., all included in Elmdale sh. memb. Named for exposures S. of Howe, Nebr.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 8), introduced into Nebr. section *Red Eagle ls. fm.*, to include (descending) Howe ls., Bennett sh., and Glenrock ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Howell formation.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 11). *Howell fm.*—Dark, more or less massive ls. and pinkish argill. shales, 640 ft. thick. Basal fm. of Middle Camb. in House Range. Underlies Dome fm. and overlies Pioche fm. Type loc., slopes of Howell Peak, on W. side of House Range, about 5 mi. W. of Antelope Springs.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1812), gave a résumé of House Range section in which he recognized btw. Howell fm. and underlying Pioche sh. 205 ft. of bluish gray aren. ls. which he called Langston (?) fm.

†Howenstein limestone. (In Allegheny formation.)

Pennsylvanian: Northeastern Ohio.

G. F. Lamb, 1910 (Ohio Nat., vol. 10, p. 130). *Howenstein ls.* caps Brookville coal in Stark and Mahoning Counties.

Same as Putnam Hill ls. memb.

Named for Howenstine, Stark Co.

Howson andesite.

Pliocene (?): Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Howson andesite.*—Hornblende-andesite lava; porphyritic; mostly light gray, some pink. Thickness 250 ft. Assigned to Plio. (?). Probably not older than Plio. or late Mio. Occurs N. and NE. of head of Howson Creek.

Hoxbar formation.

Pennsylvanian: Central southern Oklahoma (Carter County).

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull., vol. 6, No. 1). *Hoxbar member.*—Top memb. of Glenn fm. Upper part is characterized by white sss. separated by light-blue to yellow and red shales; near top 4 mi. SE. of Ardmore is a coal seam 2 to 4 ft. thick. Basal sediments are characterized by several brown lss., one of which is a prolific *Fusulina cylindrica* horizon. Thickness of memb. 4,000 ft. To SE. it becomes less calc. and lss. grade into shales and shales into sss. and cgls. Fossils listed. Overlies Deese memb. Occurs W. of Hoxbar.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331–347). We are convinced it was not Taff's intention to include in Glenn fm. the beds called *Hoxbar memb.* by Goldston. These beds are younger than Glenn and possibly represent part of Franks cgl.

H. D. Miser, 1925 (Okla. Geol. Surv. Bull. 35, p. 26, footnote). Glenn fm. as mapped on Okla. geol. map. corresponds to Glenn fm. of Goldston, except that his Springer memb. N. of Ardmore is included in Caney sh. His Springer memb. around Criner Hills S. of Ardmore is held by G. H. Girty and P. V. Roundy to be younger than the Springer N. of Ardmore, and is mapped as part of Glenn.

S. Powers, 1927 (A. A. P. G. Bull., vol. 11, No. 10, pp. 1067–1085), mapped *Hoxbar fm.* as overlying Glenn fm.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7–21). *Hoxbar fm.* uncon. underlies Pontotoc series and overlies Deese fm. It is 4,000± ft. thick, and is here divided into several named members. [See Okla. correlation chart.] Basal memb. is here named *Confederate ls. memb.*

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). *Hoxbar fm.*, 4,000± ft. thick, coincides very nearly with Goldston's Hoxbar memb. of Glenn fm.

C. W. Tomlinson, 1934. (See 1934 entry under *Confederate ls. memb.*)

Named for exposures W. of Hoxbar, Carter Co.

Hoy sand.

A subsurface sand, 12 to 20 ft. thick, in central northern Okla., reported to correlate with part of Matfield sh. (Perm.). In Garber pool (Garfield Co.), however, the sand is reported to lie at 1,100 ft. depth, the Kisner at 700, the Whitney at 800, and the Hotson at 1,430 ft.

Hoyt dolomite. (A distinct formation to south.)

Hoyt limestone member (of Theresa dolomite).

Upper Cambrian: Eastern New York (Saratoga and Dutchess Counties).

See explanation under *Little Falls dol.* and *Theresa dol.* Named for exposures at Hoyt's quarry, 3 mi. W. of Saratoga Springs, central eastern N. Y.

Hozomeen series.

Carboniferous: Southern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 14 and 15, 120°30′ to 121°30′). *Hozomeen series.*—Greenstone, cherty qtzite, phyllite, and ls. pods. [Hozomeen Range, B. C., appears to consist largely of these rocks, and Mount Hozomeen, Wash., lies in midst of them.]

C. Camsell, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 118).

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 500, 508).

Huacalote rhyolite.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 322).

Huautla basalt.

Oligocene: Mexico.

R. H. Palmer, 1927 (A. A. P. G. Bull., vol. 11, pp. 1180, 1201).

Hubbardston granite.

Late Carboniferous or post-Carboniferous: Central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 231–236 and map). *Hubbardston granite.*—Chiefly coarse white ragged, highly feldspathic granite of pegmatitic texture, though never distinctly porphyritic or fine grained. Locally the rock becomes a white sugary granulite, full or red garnets, graphite, and great sheets of silky white fibrolite, much of it changed to muscovite. There is also a dark fine-grained biotite granite or gneiss phase resembling Hardwick granite. Named for occurrence at Hubbardston.

Hubbardton slate.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 401). *Hubbardton sl.*—Mainly green sl. with variable amount of purple sl. In some places (notably in W. part of Taconic Range) the purple is more common than the green in upper part of fm. and very similar to that of Bull sl. Thickness estimated at 300 ft. No very sharp div. line btw. this sl. and underlying Stiles phyllite, and bdy is placed where the small qtzite layers end, which is also the horizon where the special colors of the Stiles end. Underlies Barker qtzite. Named for occurrence in village of Hubbardton [Castleton quad.].

Huckleberry clay. (In Pottsville formation.)

A bed of clay, 0 to 6 ft. thick, underlying Huckleberry coal and lying 0 to 12 ft. above Anthony coal and Sciotoville clay in Olive Hill field of Ky. and in Sciotoville field of SE. Ohio. (See Ohio Geol. Surv., 4th ser., Bull. 26, 1923, pp. 150–151, where the names of the clay and coal are quoted.) Derivation of name unknown.

Huckleberry andesites.

Age (?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 21, No. 8, pp. 251, 252, 254). *Huckleberry andesites.*—Markedly different from glassy andesites that form bulk of Brokeoff Cone. Occur near Huckleberry Lake. [Not mapped separately.]

†Hudson system.

Cambrian: Eastern New York.

T. A. Conrad, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 57–63), described the rocks of Hudson River region, N. Y., as "Cambrian or Hudson system."

†Hudson period.

Time term applied by J. D. Dana and other early geologists to epoch covering deposition of rocks underlying Oneida cgl. and overlying Trenton ls.

†Hudson formation.
†Hudson group.
†Hudson shales.
†Hudson terrane.
†Hudson River slate group.
†Hudson River group.
†Hudson River beds.
†Hudson River shales.
†Hudson River formation.
†Hudson River slates.
†Hudson River shales and sandstones.
†Hudson River series.

Terms variously used in early N. Y. repts to include (1) beds of Upper Ord. age only; (2) beds of Upper and Middle Ord. age; and (3) beds ranging in age from Upper Ord. to Upper Camb., both inclusive. The following are the earliest definitions:

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 212, 256–258). ***Hudson River sl. group.***—Slates, shales, and grits with interstratified lss., all of which occur under various modifications, with siliceous and calc. breccias and hypogene and plutonic rocks. In places is uncon. overlain by Shawangunk grit. Occurs in SE. counties of N. Y.

W. W. Mather, 1841 (N. Y. Geol. Surv. 5th Rept., pp. 90–96). ***Hudson sl. series*** (also *Hudson River sl. series*).—Includes all rocks btw. top of Frankfort sl. group and base of Potsdam ss. [As thus defined includes Upper Ord. to Upper Camb., inclusive.]

E. Emmons, 1842 (geol. map of New York). ***Hudson River group or Lorrain[e] shales*** underlies Gray ss. [Oswego ss.] and Shawangunk grit and overlies Utica sl. [As thus defined is all of Upper Ord. age, and later than Utica sl., which is also Upper Ord.]

L. Vanuxem, 1842 (Geol. N. Y., pt. 3). ***Hudson River group.***—Includes shales and sss. of Pulaski and Frankfort sl. and ss. Overlies Utica sl. and underlies Gray ss. of falls of Salmon River and Oswego. Thickness 700 ft. [This definition of "Hudson River group" has been the most widely used.]

In some subsequent repts the Utica sl. also was included, and "Hudson River group" became synonymous with *Upper Ord.* The names "Hudson" and "Hudson River" were also carried into many other States and into Canada for supposedly contemp. deposits. The name in all senses has been discarded by most geologists.

Hudson trilobite beds.

Upper Cambrian: Western Wisconsin.

L. C. Wooster, 1878 (Wis. Geol. Surv. Rept. 1877, pp. 36–41). ***Hudson trilobite beds*** are quite rich in trilobites and brachiopods, including one new sp. of former and several undet. spp. [Seem to be named for Hudson, St. Croix Co. Lie higher than Eau Claire trilobite beds.]

L. C. Wooster, 1882 (Geol. Wis., vol. 4, pp. 101–140). ***Hudson trilobite beds*** lie at best-defined horizon in Potsdam ss., 200 ft. higher than Eau Claire trilobite beds. Overlain by Lower Calcareous Band, 10 ft. thick.

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 160). Franconia section at Hudson is type loc. of Hudson trilobite beds of Wooster.

Probably is part or all of Hudson memb. of Trowbridge et al.

†Hudson schist.

Ordovician, Cambrian, and pre-Cambrian: Eastern New York.

F. J. H. Merrill, 1902 (U. S. G. S. N. Y. City folio, No. 83). ***Hudson schist.***—The schist of N. Y. dist. is given name *Hudson* because it continues northward and connects stratigraphically with the great area of sl. and sh. along Hudson River which has been called respectively *Hudson sl.* and *Hudson sh.* The Hudson schist, Hudson sl., and Hudson sh. represent different phases of alteration of same original rock, and together they form *Hudson fm.* The Hudson fm. continues into New England, and is there a schist, which has been called *Berkshire schist.* [The Hudson schist of N. Y. City quad. is described as mica schist, consisting of biotite and quartz with garnet, staurolite, fibrolite, and cyanite.] Overlies Stockbridge dol. and underlies Newark fm.

According to E. B. Knopf (1927) and other geologists this schist is same as Berkshire schist, which has priority as a name for this schist; and "Hudson" also is objectionable because of its varied applications. Is not considered same as Manhattan schist of New York City region, which is pre-Camb. The Berkshire schist is now classified as of Ord., Camb., and pre-Camb. (?) age. (See under *Berkshire schist.*)

Hudson member (of Franconia sandstone).

Upper Cambrian: Western Wisconsin (St. Croix County).

A. C. Trowbridge, W. H. Twenhofel, G. O. Raasch, F. T. Thwaites, Sept. 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, pp. 81, 92, 134, 140, 159, 160, 431, 446, 449, 454, etc.). *Hudson memb. of Franconia fm.*—At Goodenough Hill, Juneau Co., consists of (descending): (1) Fine-grained white ss., 13 ft.; (2) covered, 19 ft.; (3) fine-grained pink to brown ss., 24.2 ft.; (4) greensand, 5 ft. Underlies Bad Axe memb. of the Franconia and rests on Goodenough memb. of the Franconia. At Hudson it consists of 85 ft. of medium-grained, green to gray glauconitic ss., underlying Bad Axe and overlying Goodenough members. The Franconia section at Hudson, St. Croix Co., is type loc. of Hudson trilobite bed of Wooster and of Hudson memb. of Franconia as defined by Twenhofel, Raasch, and Thwaites. [On p. 309 of this book G. O. Raasch stated that Hudson memb. is *Ptychaspis-Prosaukia* zone.]

Above definition was repeated and somewhat amplified by Twenhofel, Raasch, and Thwaites in Geol. Soc. Am. Bull., vol. 46, No. 11, Nov. 30, 1935, pp. 1701, etc. See under *Mazomanie ss.*

Hudson Bridge limestone. (In Palo Pinto formation.)

Pennsylvanian: North-central Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 21). *Hudson Bridge ls.*—Hard, crystalline ls., dark brown to gray, with local pink splotches and occasionally large masses of chert in top bed. Thickness 7± ft. Outcrops about 3 mi. SE. of Bridgeport, on S. side of West Fork of Trinity River, in E. end of Rebecca Coleman survey, along margin of Trinity River flood plain, and crosses the road 200 yds S. of Hudson Bridge. Is believed to be of lower Palo Pinto age. Probably belongs in Keechi Creek shales. Writers believe it should be included in Palo Pinto fm. Is oldest exposed bed in Wise Co.

†Hudsonian substage (of Wisconsin stage).

Pleistocene (late): Great Lakes region.

M. M. Leighton, 1931 (Jour. Geol., vol. 39, pp. 51-53). *Hudsonian substage (late Wisconsin).*—Includes Port Huron to Des Moines [lobe] and younger moraines. This name was chosen for the last substage because the ice fields about Hudson Bay were approx. equally developed. The early and middle Wisconsin substage is here named *Quebecan.*

M. M. Leighton, 1933 (Sci., vol. 77, p. 168), withdrew *Hudsonian* and replaced it with *Mankato.*

†Hudson River.

See under †*Hudson fm.*

Hueco limestone.

Permian (?): Western Texas and southern New Mexico.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, pp. 32–38). *Hueco fm.*—Mainly massive gray fossiliferous nonmag. ls., locally including beds of sh. and ss. Thickness at least 5,000 ft. Represents the Penn. in Diablo Plateau, Franklin, Cornudas, Diablo, Finlay, and Hueco Mtns. Fossils assigned to Penn. by G. H. Girty. Relations to Delaware Mtn fm. (Perm.) not determined, but supposed to be older.

Later studies by many geologists resulted in differentiating the great mass of lss. called *Hueco ls.* in early repts on Franklin and Hueco Mtns into Helms fm. (Miss.) at base, Magdalena ls. (Penn.), and an uncon. overlying series of beds, of Perm. (?) age, to which some geologists restricted the name *Hueco ls.*, and which included Powwow cgl. at base, and near top the Deer Mtn red sh. memb., 150± ft. thick. This restricted definition is that now employed by U. S. Geol. Survey and geologists generally.

Named for exposures in Hueco Mtns, El Paso Co.

Hueconian.

A name that has been applied, provincially, to the time during which Hueco ls. of western Tex. was deposited.

Huerfano formation.

Eocene (lower and middle): Southeastern Colorado (Huerfano County).

See under *Poison Canyon fm.*

†Huerfano series.

See explanation under *Poison Canyon fm.*

Huerto andesite. (Of Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 36). *Huerto fm.*—Underlies Piedra fm. and overlies Alboroto fm. in Platoro-Summitville dist. Included in Potosi volcanic series.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). *Huerto fm.*—A series of andesitic flows and tuff breccias, 0 to 2,000+ ft. thick, which commonly overlies Alboroto fm. rather regularly. Is absent in Creede dist., where the overlying Piedra deposits rest uncon. on the Alboroto. Named for occurrences on Huerto Peak, in S. part of San Cristobal quad., W. of Huerto Creek.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Huerto andesite.*

Huethawali limestones.

Pennsylvanian (?): Northern Arizona (Grand Canyon).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 336). *Huethawali lss.*—Lower 200 ft. of lss. of Aubreyan series, typically exposed in esplanade at head of Bass Canyon, W. of El Tovar. Older than Havasupai sss.

Derivation of name not stated, but probably Huethawali Peak, which is just W. of head of Bass Canyon.

Hughes Creek shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 85, 89). *Hughes Creek sh.*—Blue argill. sh., dark shales, and thin lss. Thickness 35 to 50 ft. in Nebr. and NE. Kans. Underlies Long Creek ls. and overlies Houchen Creek ls., all included in Elmdale sh. memb. Named for Hughes Creek, Nemaha Co., Nebr.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), transferred Houchen Creek ls. and underlying Stine sh. to Admire sh., and introduced *Oaks sh.* for the bed overlying Houchen Creek ls. This left Hughes Creek sh. the basal memb. of Elmdale sh. Whether the Oaks sh. is a part of Hughes Creek sh. as originally defined, or a newly discovered unit, was not stated, but it appears that it and the true Americus ls. were included in Hughes Creek sh. of previous repts.

G. E. Condra, 1935. (See under *Long Creek ls.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Hughes River flint. (In Conemaugh formation.)

Pennsylvanian: Northwestern West Virginia.

R. V. Hennen, 1911 (W. Va. Geol. Surv. Rept. Wirt, Roane, and Calhoun Counties, p. 258). In Wirt Co. the Brush Creek ls. is replaced by *Hughes River flint*, a reddish-gray and white ledge of chert or flint underlain by dark sh. full of marine shells. Not recognized in Roane Co.

Probably named for occurrence on South Fork of Hughes River.

Huginnin porphyrite.

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).

A. C. Lane, 1898 (Mich. Geol. Surv. vol. 6, pt. 1, pp. 98, 141, 205–206, 207, 208, 209, 212, plates 1, 13). *Huginnin porphyrite* is shown as older than Minong trap.

Belongs in Central Mine group.

Named for exposures in bed of Huginnin Creek, about 50 ft. from shore of Huginnin Cove and about 200 ft. from mouth of the creek, in Isle Royale.

Huishi-Schwatka group.

Triassic to Tertiary: Yukon, Canada.

E. J. Lees, 1934 (Roy. Canadian Inst. Trans., vol. 20, pt. 1, p. 28).

Hulah sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

M. I. Goldman and H. M. Robinson, 1920 (U. S. G. S. Bull. 686Y, pp. 362, 365). *Hulah ss.*—Hard ss., averaging 4± ft. thick; usually weathers yellow or orange. In places rather fossiliferous—nowhere more so than at type loc., where *Productus* is very abundant. Named for good development at top of small ridge at E. edge of town site of Hulah, near center of SE¼ sec. 5, T. 28 N., R. 12 E. The interval separating it from top of Mission ss. ranges from 40 to 55 ft. and averages 50± ft. In that interval lie Possum ss. (above) and Gap ss. (below).

P. V. Roundy, K. C. Heald, and G. B. Richardson, 1922 (U. S. G. S. Bull. 686Z, pp. 398–399, pl. iv). [See under *Revard ss. memb.*]

The U. S. Geol. Survey at present treats *Hulah ss.* as a memb. of Nelagoney fm.

Hull meta-andesite.

Upper Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Hull meta-andesite.*—Greenish to reddish meta-andesite resembling Fant meta-andesite. Prevailing type is greenish and essentially nonporphyritic; occasionally in Little Grizzly Creek region it is decidedly amygdaloidal. Is only partially crystalline. Much of it is in more or less well-defined sheets representing lava flows and tuff. In places is decidedly slaty. It penetrates Mormon ss. and Foreman fm. Most likely erupted near close of Jurassic.

Named for exposures E. of Hull diggings (called Taylor diggings on Taylorsville map).

Hull limestone.

Middle Ordovician (Trenton): Ontario and northern New York.

P. E. Raymond, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 348), named these beds, of Trenton age, *Hull fm.*, and used the name in 1916 and 1921 repts of Canada Geol. Surv.

G. M. Kay, 1929 (A. A. P. G. Bull., vol. 13, No. 9, p. 1214), defined *Hull ls.* as middle fm. of Trenton group, as 35 ft. thick, and as underlain by Rockland ls. and overlain by Sherman Fall ls. In 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 227–229) he defined *Hull fm.* as consisting of ls., 97 ft. thick at Lowville, NW. N. Y., and 100 ft. thick at Deer River, N. Y.

Named for exposures at Hull, Quebec.

Hull porphyry.

Pre-Cambrian: Northwestern Iowa.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 187; Sci., n. s., vol. 40, p. 144). *Hull porphyries*, 475 ft. thick, included in Keweenawan series.

Probably named for Hull, Sioux Co.

Hull agglomerate.

Middle Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81, and No. 5, pp. 895–903). ***Hull aggl.*** (also ***Hull fm.***).—Named by J. S. Diller, 1892 [where?]. Mostly massive, coarse, green aggl., with small amounts of red and purple matter; in places a fine red or green tuff. Thickness 700 ft. No fossils. Of late Middle Jurassic age. Occurs at many places on slopes of Mount Jura, especially on S. end of mtn and on SW. slope from 4,500 to 5,000 ft. elev., in lower end of Hinchman Ravine, SE. and NW. slopes of mtn and north ridge.

Humber limestone.

Age (?): Newfoundland.

J. B. Jukes, 1839 (Rept. on geol. Newfoundland, p. 4).

Humber grit series.

Carboniferous: Newfoundland.

T. Landell-Mills and others, 1922 (Geol. Soc. London, Abstr. Proc. No. 1083, p. 53).

Humber member.

Upper Ordovician: Toronto, Canada.

W. A. Parks, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 103–104).

See quotation under ***Dundas fm.*** Type loc. not stated.

Humber Arm series.

Middle and Upper Ordovician: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, pp. 86, 99).

Humber River.

Ordovician: Ontario.

A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, p. 52).

Humboldt formation.

Pliocene: Northern Nevada.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 434–443). ***Humboldt group*** (*Pliocene*).—Friable gray, white, and drab sss., marly lss., reddish gravels, marly sands, loosely compacted pumiceous tuff, etc., extending, in patches, from W. base of Wasatch Mtns, Utah, to Humboldt River and Mtns, Nev. There is little doubt that all these exposures of Plio. were deposited in one lake. Fossils rare. The beds along Humboldt River are 300 ft. thick. The Humboldt Valley S. of its bend at Lassen's Meadows cuts a canyon through these Plio. strata for 25± mi. exposing cliffs on either bank from 150 to 300 ft. high.

J. C. Merriam, 1914 (Univ. Calif. Pub. Bull. Dept. Geol., vol. 8, No. 12, p. 278). "***Humboldt Pliocene***" of King's Shoshone Lake of Middle Basin area seems to indicate Mio. at what may be considered type loc. Whether other evidence may indicate that a large portion of deposits mapped as Plio. by King really represents that period remains to be demonstrated. It seems probable a considerable part of these deposits may be Mio.; other portions are probably Pleist.

G. D. Louderback, 1924 (Univ. Calif. Pub. Dept. Geol. Sci., Bull. 15, p. 36). There is no question about fact that best exposures of what King called ***Humboldt Pliocene*** and what Russell has called ***Lake Lahontan*** (***Quaternary***) ***lake beds*** are identical.

The U. S. Geol. Survey still tentatively classifies Humboldt fm. as Plio., although recognizing that deposits of Pleist. and Mio. age may have in places been included in the unit designated by that name. Much more work on this problem is needed.

Humboldt limestone.

Pennsylvanian: Southeastern Kansas.

R. Hay, 1887 (Kans. Acad. Sci. Trans., vol. 10, p. 7). The immense bed [in Wilson Co.] we have called ***Dun ls.*** is probably same as the thick ***Humboldt ls.*** of Neosho Valley. It has same irregularity of structure and apparently same fossils.

Probably named for Humboldt, Allen Co.

Humboldt oolite. (In Kinderhook group.)

Mississippian: Central northern Iowa (Humboldt County).

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 109–114). *Humboldt oolite.*—In vicinity of towns of Humboldt and Rutland oolitic lss. of Kinderhook age appear at surface over small areas. The largest of these appears in E. bank of West Fork of Des Moines River in SW. part of town of Humboldt. The rock is gray in color, and texture is typically oolitic. [Fossils listed.] Is believed to represent either a more oolitic and more fossiliferous facies of Alden ls. [top of Kinderhook group] or a younger fm. not preserved in Hardin Co. Is probably younger than Gilmore City ls. of Pocahontas Co. [Van Tuyl does not state that he is naming the beds, but he does use the term *Humboldt oolite* in his description, and the name is in index to the volume.]

Humboldt formation.

Pennsylvanian: Southwestern New Mexico (Central mining district).

H. Schmitt, 1933 (Am. Inst. Min. and Met. Engrs. Contr. 39, pp. 2, 13). Upper Magdalena fm. of A. C. Spencer is here divided into *Humboldt fm.* above, 261 ft. thick, and *Mountain Home sh.* below, 130 ft. thick. These names are introduced for convenience of mapping, and will probably be replaced by Geol. Survey in rept. in preparation by A. C. Spencer. The Upper Magdalena fm. rests on blue ls. (Lower Magdalena ls. of Spencer). [His Mountain Home sh. was named for a mine. Derivation of Humboldt not indicated and not apparent.]

Humbug formation.

Mississippian (upper): Central northern Utah (Tintic district and Oquirrh Mountain region).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 625–626). *Humbug intercalated series.*—Alternating beds of fossiliferous lss., limy sss. and sandy lss. Overlies Godiva ls. in Tintic dist. Total thickness 250 ft.

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107), applied *Pine Canyon ls.* to the 1,000 ft. of Miss. lss. underlying Humbug fm. in Tintic dist., and reported that G. H. Girty states the fossils from Humbug fm. are upper Miss., and those from Pine Canyon ls. are lower Miss. in all but upper 300 ft., which are tentatively regarded as upper Miss.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, pp. 7, 26–29). *Humbug fm.*—In Stockton and Fairfield quads, Utah, consists of interbedded ls. and lenticular ss. and qtzite in beds as much as 100 ft. thick but ordinarily from 2 to 10 ft. thick. Grades into overlying "Great Blue" ls. and into underlying Deseret ls. ("Lower Blue ls." of Spurr, and of upper Miss. (Brazer) age, according to Girty). Total thickness 650 ft. Lower limit of fm. arbitrarily placed at base of lowest considerable qtzite or ss. in Miss. section. Top limit is also an arbitrary line and is probably not drawn at same horizon in all places. Is same as "Lower Intercalated series" of Spurr.

Named for mine formerly called Humbug mine but now known as Uncle Sam mine.

†Humbug limestone.

A name applied by G. W. Crane (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151, 1915) to 378 ft. of nearly pure coarse-grained gray ls., with a few intercalated beds of yellowish-buff aren. ls., said to underlie his Humbug ss., overlie his Tetro ls., and to represent lower part of Humbug fm. of U. S. G. S. of Tintic dist., Utah, but now known to be older than latter fm. and to represent upper part of Pine Canyon ls.

Humbug sandstone.

A name applied by G. W. Crane (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151, 1915) to 224 ft. of calc. ss. with a few intercalated beds of aren. ls., said to overlie Humbug ls. and to be only upper part of Humbug fm. of U. S. G. S., but now known to correspond to all of Humbug fm. of U. S. G. S. in Tintic dist., Utah.

Humphrey shale. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas, southeastern Nebraska, and southwestern Iowa.

A. J. Smith, 1905 (Kans. Acad. Sci. Trans., vol. 19, p. 151). [See 1905 entry under *Olpe sh.*]

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2). [See 1920 entry under *Olpe sh.*]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 63, 77, etc.). *Humphrey sh. memb. of Wabaunsee fm.* underlies Emporia ls., overlies Burlingame ls., and is here divided into (descending) Auburn sh., 20 ft.; Wakarusa ls., 6 ft.; and Soldier Creek sh., 25± ft. The beds form a natural memb. of about same rank as Willard sh., which overlies Emporia ls. [This is definition adopted by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), dropped *Humphrey sh.* and treated Auburn, Wakarusa, and Soldier Creek as fms.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 218, 221). *Humphrey sh.* discarded. Writer concludes type Humphrey does not include Condra's Soldier Creek sh. It included from top of Burlingame ls. up to base of Reading ls.

Named for exposures on Humphrey's ford, 6 mi. SE. of Emporia, Kans.

Humphrey sand.

A subsurface sand, 19 ft. thick, occupying interval btw. 1,567 and 1,586 ft. in L. B. Autman well No. 1, 2 mi. S. of village of Humphrey, Humphrey Twp, Cattaraugus Co., N. Y. (See C. R. Fettke, Geol. Soc. Am. Bull., vol. 44, No. 3, p. 622, 1933.)

Humphrey Creek shale. (In Wabaunsee group.)

A name applied by R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), to the beds designated *Humphrey sh. memb. of Wabaunsee fm.* by G. E. Condra in 1927. Later in 1932 (revised classification chart of Penn. rocks of Kans. and Nebr. dated Oct. 1932) Moore and Condra designated the unit *Humphrey sh.*

Hundred sandstone. (In Washington formation.)

Permian: Northern West Virginia.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel and Tyler Counties, p. 214). *Hundred ss.*—Massive ss. in places, but outside of Church and Clay dists., Wetzel Co., is generally red sh. and sandy beds. Thickness 30 ft. Lies 5 ft. below Upper Washington ls. and 2 to 5 ft. above Hundred coal. Has been called Dunkard ss. by Grimsley. Named for village of Hundred, Wetzel Co.

Hundred-foot sand.

Drillers' term for a sand, probably of late Catskill age, in western Pa. Lies lower than Murrysville sand and higher than Nineveh 30-foot sand.

Hunker series.

Age (?): Canada.

R. G. McConnell, 1900 (Canada Geol. Surv. Rept. on Klondike gold field, pp. 8–9).

Hunker Creek series.

Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 198).

Hunt sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 317). *Hunt ss.*—Green massive or shaly ss., 10 to 20 ft. thick, lying a few ft. below Hunt coal ("the uppermost coal in Bluestone group" and exposed just W. of Hunt School, Mercer Co.), and overlying Hunt sh. All members of Bluestone group [Bluestone fm.], and all exposed in Stony Gap section, Mercer Co., on N. side of Big Ridge, about ¾ mi. S. of Belcher School, where the ss. is 15 ft. thick.

Hunt shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 293, 317). *Hunt sh.*—Red and variegated, 35 ft. thick. Underlies Hunt ss. and overlies Bratton ss. All members of Bluestone group [Bluestone fm.]. [See additional under *Hunt ss.*]

Hunt sand.

A subsurface sand (of Chester Miss. age) in Ind., that has been correlated with Sample ss. memb. of Gasper oolite.

Hunter Canyon formation. (In Mesaverde group.)

Upper Cretaceous: Western Colorado (Book Cliffs coal field).

C. E. Erdmann, 1934 (U. S. G. S. Bull. 851, pp. 22, 33). *Hunter Canyon fm.*—Assemblage of massive brown, buff, and gray cliff-making fluviatile sss. and gray clay sh.; about 60 percent ss. Thin coals near top. Thickness 375 to 1,400 ft. Top fm. of Mesaverde group. Uncon. underlies Eocene (?) deposits and overlies Mount Garfield fm. Named for Hunter Canyon.

Hunters Island iron-bearing series.

Pre-Cambrian: Northeastern Minnesota (Vermilion district).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 118). The rocks of E. extension of N. arm of Vermilion range are known locally as *Hunters Island iron-bearing series.* [The map of Vermilion dist. in Mon. 52 (pl. 6) shows the rocks of the area designated as Hunters Island as consisting of Ely greenstone, Archean granite, Ogishke cgl., Agawa fm., and Knife Lake sl.]

Huntersville chert. (In Oriskany group.)

Lower Devonian: Southeastern West Virginia (Pocahontas and Greenbrier Counties).

P. H. Price, 1929 (W. Va. Geol. Surv. Rept. Pocahontas Co., pp. 106, 108, 233, 236–237, 397, etc.). *Huntersville chert.*—Yellow, gray, to dark, sandy chert, 30 to 65 ft. thick, forming top div. of Oriskany series in Pocahontas and Greenbrier Counties, to which counties it appears to be confined in W. Va. Contains sparse marine fauna of Oriskany age. Directly underlies Marcellus sh. and directly overlies Ridgeley ss. Type loc. in vicinity of Huntersville [SE. part of Pocahontas Co.], where it has been quarried for road material. The Shriver chert, which underlies Ridgeley ss., is not present in county.

Hunter Valley.

Probably lower Mesozoic: Sierra Nevada, California.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Hunter Valley cherts and tuffs,* 1,500 ft. thick, included in Tuolumne group. Underlie Penyon Blanco aggls. and overlie pillow basalts.

Huntingdon stone.

Name listed in U. S. G. S. Bull. 191, and credited to E. T. Cox, 1879 (Ind. Geol. Surv. 8th, 9th, and 10th Ann. Repts, for 1876, 1877, 1878, p. 66). On p. cited Cox simply mentioned "the celebrated Huntington stone," which is quarried for lime at Huntington (the correct spelling), Huntington Co., Ind.

Huntingdon formation.

Eocene: Southern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 17). *Huntingdon fm.*—Ss., cgls., sh., and thin coal beds. [Mapped at and to N. of Huntingdon, B. C., and in Wash.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 519). *Huntingdon fm.*—Heavy masses of medium-grained gray-tinted cgl. alternating with ss. and sh.; cgl. most abundant at base. Thickness 1,000 ft. Occurs on Sumas Mtn, N. of Huntingdon R. R. Station, B. C. Eocene fossils. Is uncon. on Chilliwack series, also on Sumas diorite and Sumas granite.

Huntington series.

Triassic (?): Northeastern Oregon (Blue Mountains).

W. Lindgren, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, p. 579). *Huntington series.*—Lss., calc. shales, and clay slates, with some gyp. and red and green volcanic tuffs. Thickness probably several thousand ft. Rests on old volcanic rocks, largely old rhyolites and tuffs. Overlain by marine Triassic. Occurs in vicinity of Huntington. Indeterminate fossils. Regarded as Triassic.

Huntington dolomite.

Silurian (Niagaran): Northeastern Indiana.

E. M. Kindle, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept., p. 408). *Huntington ls.*—Light-gray or cream-colored granular dolomitic ls. of saccharoidal texture, 150 to 200± ft. thick; about 80 ft. exposed at Huntington. Contains Guelph fauna, a younger fauna than Noblesville dol., which contains Lockport fossils, and also differs decidedly in physical appearance from the Huntington. Both belong to the Niagara. It will be convenient to designate the beds exposed in the Huntington quarries as *Huntington ls.* The same ls. is also exposed in the lime quarries NE. of Delphi. At one place near Delphi it is uncon. overlain by beds of Hamilton age.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Dept. Cons., Div. Geol., Pub. 75, pp. 53, 94–113). *Huntington dol.*—The name *Huntington ls.* was proposed by Kindle for "the beds exposed in the Huntington quarries." Since several distinct fms., complicated by a great coral reef plexus, are now exposed in the quarries at Huntington, the authors have been forced to redefine the type section of Huntington dol. (ls.). As redefined it consists of the exposures of yellowish to grayish saccharoidal dol. along the dredged rock channel of Little River, from NE. cor. of SW. cor. of NE¼ sec. 13, T. 28 N., R. 10 E., eastward nearly to W. line of sec. 8, T. 28 N., R. 10 E., where a cherty fm., here named *New Corydon ls.*, comes in above the Huntington dol. The Huntington is typically a massive to slabby evenly bedded yellowish, gray, or pinkish granular dol. of saccharoidal texture. At 2 localities, however (certain exposures at Huntington and near Georgetown), the fm. is represented by nearly pure pink, crystalline ls. Exact thickness of fm. not known. In quarry at Ridgeville 70 ft. are exposed; 90 ft. in bluff on S. side of Wabash River 3 mi. W. of Logansport; at least 100 ft. exposed in quarries at Delphi; and our meager data at Huntington indicate thickness of 150± ft. We feel certain the fm. thickens from Monon northwestward, but how much we are not prepared to say. Fossils listed. Rests on Liston Creek ls., probably conformably. Grades upward into New Corydon ls. It is practically certain it extends beneath the drift to Chicago dist.

Named for Huntington, Huntington Co.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 159). *Huntington fm.* has not been identified S. of N. half of Randolph Co.

Hunton limestone.

Silurian and Devonian: Southeastern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Hunton ls.*—Nearly pure white ls. and limy marls. At base variable beds of white oolite, in parts of which coarse and fine spherical granules appear as if originally sorted and stratified. Elsewhere spherules ranging in size from that of a small pea to fine grains appear intermingled; in places the oolite is silicified. Succeeding the oolite are bluish and cream-colored granular and fine-textured lss. and marly beds attaining thickness of 100± ft.; many of these beds are crystalline and hard, while others are composed largely of comminuted shell fragments. Near top are marly beds which carry abundance of well-preserved fossils. Uppermost 50 ft. of fm. is for most part hard and thin-bedded. Many nodular cherty concretions and numerous fossils, some of which are beautifully silicified, occur in these beds. Overlies Sylvan sh. and underlies Woodford chert.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Hunton ls.*, 0 to 200 ft. thick, is divisible into 3 members (descending): (1) Crystalline and in part cherty bluish to white ls. with occasional thin marly strata, in places overlain by several ft. of very cherty ls.; (2) 100 ft. of white or cream-colored and occasionally pinkish rather soft ls. interstratified with more friable marly lime and, rarely, calc. clay, with a few ft. of marly white ls. at top; (3) whitish massive crystalline ls., which in places includes a bed of oolite at or near base and thin-bedded compact ls. at top; thickness few ft. to 25± ft. Upper memb. contains Oriskany and perhaps

Onondaga fossils; middle memb. contains Helderberg fossils; and basal memb. contains Niagara fossils in thin-bedded compact ls. at top and Clinton fossils in underlying beds.

C. A. Reeds, 1911 (Am. Jour. Sci., 4th, vol. 32, pp. 256–268). Hunton ls. of Taff is here divided into 4 fms. in Arbuckle Mtns (descending): (1) Bois d'Arc ls., 0 to 90 ft., of Becraft (Oriskany) age, according to C. Schuchert (1922) and E. O. Ulrich (1927); (2) Haragan sh., 0 to 166 ft., of New Scotland age; (3) Henryhouse sh., 0 to 223 ft., of Niagaran age; and (4) Chimneyhill ls., 0 to 53 ft., of Alexandrian age. Overlies Sylvan sh. with uncon. The Bois d'Arc ls. corresponds to upper Hunton of Taff; the Haragan and Henryhouse correspond to middle Hunton of Taff; and the Chimneyhill corresponds to lower Hunton of Taff.

C. N. Gould, 1927 (Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, p. 235). *Hunton* will probably remain as a group name, for purposes of mapping.

Named for exposures near former hamlet of Hunton, SW. part of Coal Co.

†Huntsville.

Mississippian: Northeastern Alabama.

E. A. Smith, 1892 (Sketch of geology of Ala., Birmingham, Ala., Roberts & Son, pam. of 36 pp.). *St. Louis or Huntsville.*—A subdivision of the Sub-Carbf. in Tennessee River Valley. More calc. than beds below. Is=upper Siliceous of Safford and St. Louis group of western geologists. Overlies Lauderdale (Keokuk) and underlies several hundred ft. of Sub-Carbf. lss. [*Huntsville* used in table only.]

The Mississippian rocks in vicinity of Huntsville, Ala., consist of (descending) Bangor ls. restricted, Hartselle ss., Golconda fm., Gasper oolite, Ste. Genevieve ls., and St. Louis ls. (See C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1926, pl. 49, sec. 14.)

Named for exposures at Huntsville, Madison Co.

†Huron group.

Upper Devonian and Mississippian: Michigan (Lower Peninsula).

A. Winchell, 1861 (Mich. Geol. Surv. 1st Bien. Rept. Prog., pp. 71, 139). *Huron group.*—Consists of (descending): (1) Fine bluish gritstones (Pt. aux Barques), 14 ft.; (2) shales, lss., and flagstones, 18 ft. [180 in Am. Jour. Sci., 2d, vol. 33, pp. 353–354]; (3) green sh., 10 ft.; (4) black bituminous sh., 20 ft. Underlies Marshall group and overlies Hamilton group of lss. and shales. Thickness of Huron group 224 ft. Assigned to Portage epoch.

A. Winchell, 1865 (Am. Jour. Sci., 2d, vol. 39, pp. 350–353), gave thickness of *Huron group* as 600 to 700 ft.

A. Winchell, 1871 (Am. Phil. Soc. Proc., vol. 11, pp. 73–82). Huron gritstones, 15 ft. thick, belong to Marshall group.

Includes Coldwater sh., Berea ss., and Antrim sh.

Probably named for outcrops along Lake Huron in Mich.

Huron shale.

Upper Devonian: Northern Ohio.

J. S. Newberry, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 18). *Huron sh.*—Black bituminous sh., 350 ft. thick, designated by former Geological Board as "Black Slate." Overlies Hamilton ls. and underlies Dev. bluish or greenish Erie sh. Extends from lake shore at mouth of Huron River S. to mouth of Scioto.

E. M. Kindle, 1912 (Am. Jour. Sci., 4th, vol. 34, pp. 187–213). Typical *Huron sh.* of Huron River section and to S. consists of black and blue shales characterized by spherical concretions, and is overlain by Cleveland sh. (black and blue shales characterized by cone-in-cone structure) and underlain by Olentangy sh. In Cleveland region the typical Cleveland sh. (black) is underlain by Chagrin sh. (gray, with much ss. in upper part), which in turn rests on Huron sh. (black and gray). The Chagrin sh. of Cleveland section represents lower part of Cleveland sh. and upper part of Huron sh. of Huron River section.

H. P. Cushing, 1931 (U. S. G. S. Bull. 818, on Cleveland, Berea, and Euclid quads), defined Cleveland sh. as resting uncon. on Chagrin sh. (described as containing concretions in lower part and as resting on black shales of Portage age). The relations of Huron sh. to Cleveland and Chagrin shales are still under investigation.

Named for exposures on Huron River, northern Ohio (Huron and Erie Counties).

Huron gritstone.

Mississippian: Michigan (Saginaw Bay region).

A. Winchell, 1871 (Am. Phil. Soc. Proc., vol. 11, pp. 73–82). *Huron gritstones,* 15 ft. thick, belong to Marshall group.

G. P. Grimsley, 1904 (Mich. Geol. Surv. vol. 9, pt. 2, p. 79), included *Huron grindstone* in top of Coldwater sh.

†Huron group.

Mississippian: Indiana.

T. C. Hopkins, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 519–520). *Huron group.*—Alternating beds of ss. and ls., known in some older repts as *Chester,* forming topmost part of Lower Carbf. [Miss.] in southern and west-central Ind. Underlain by Mitchell ls. and overlain by Mansfield ss. [Penn.].

Replaced by Chester group, older name.

Named for Huron, Lawrence Co.

Huron Bay slates.

Age (?): Northeastern Michigan.

T. B. Brooks (Mich. Geol. Surv. vol. 1, pt. 1, 1873, p. 155) stated: The *Huron Bay slates* with associated rocks may be regarded as belonging to L'Anse series, although more than 10 mi. away in NE. direction.

Huronian series (or **epoch**).

As used for many years, this term was defined as the lower provincial series of the system of pre-Camb. rocks in Great Lakes region known as "Algonkian system," and the time covered by their formation. The U. S. Geol. Survey uses the name in the broad sense, i. e., including upper, middle, and lower Huronian. For definition see U. S. G. S. Bull. 769, pp. 105–108. (See also under †*Animikie group.*) The U. S. Geol. Survey, however, no longer uses "Algonkian system," tentatively excludes Knife Lake series from the Huronian (in which it was formerly included), and classifies the Huronian as pre-Camb.

Huronic period.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). Time btw. Algomic period above and Laurencic period below.

Represents earliest part of Huronian epoch of U. S. Geol. Survey.

Hurrah slate.

Post-Ordovician (?): Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 50, 59+, maps). *Hurrah sl.*—Carbonaceous qtzites and black sl., 200 to 800± ft. thick. In places basal few ft. to 50 ft. is black nondolomitic ls. Overlies Sowik ls. and underlies Puckmummie schist. Most continuous exposures are on lower 2 or 3 mi. of Big Hurrah Creek and in shafts and other mine developments of Big Hurrah mine, located at junction of Big and Little Hurrah Creeks. No fossils. Assigned to post-Ord. (?).

Hurry-up sand.

A subsurface sand in Conemaugh fm. (Penn.) of western Pa. that probably corresponds to Mahoning ss. memb. The name has also been applied to sands that probably correspond to Saltsburg and Mahoning ss. members combined. In W. Va. the name has been applied to a much younger sand that is believed to correspond to Waynesburg ss. memb. of Washington fm. (Perm.). In Palo Pinto Co., Tex., the name has been applied to a thick subsurface Penn. sand in base of Millsap Lake fm., lying uncon. on Smithwick sh.

Hushpuckney shale.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 90, 97). [See under *Swope fm.*] Named by Newell.

J. M. Jewett, 1932 (pp. 99, 101, 103 of book cited above). *Hushpuckney sh.* will be proposed by Newell to include sh. underlying Bethany Falls ls. and overlying Middle Creek ls., all members of Swope fm. It is a black sh. a few ft. thick. In Kans. it is coexistent with Middle Creek ls.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 26–27). *Hushpuckney sh.*—Middle memb. of Swope ls. Here named for a creek S. of Fontana, Miami Co., Kans. Typically shown at a R. R. cut, center N. side sec. 13, T. 19 S., R. 23 E. Consists typically of 2 parts, upper half gray argill. sh. and lower half black platy sh. Locally a thin layer of argill. greenish sh. underlies the black sh.; and less commonly the upper part consists of carbonaceous blocky sh. Thickness 4½ to 5½ ft. Overlies Middle Creek ls. memb. and underlies Bethany Falls ls. memb.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Hutchison salt bed. (In Sumner group.)

Permian: Central Kansas.

I. Perrine, 1918 (A. A. P. G. Bull., vol. 2, pp. 73–90). *Hutchison salt beds* belong in upper part of Marion fm.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12). *Hutchison salt bed,* 25± ft. thick, lies in Wellington fm. as here redefined, about 580 ft. below top and 412± ft. above top of Herington ls.

Probably named for Hutchison, Reno Co., central Kans.

Hutchison limestones.

A term applied by C. [R.] Keyes to 25 ft. of Dev. ls. in Iowa that belongs to top of Cedar Valley ls. (See Pan-Am. Geol., vol. 56, pp. 318, 348, 1931. It occupies same interval as that to which name *Lucas ls.* had already been applied, and thickness corresponds to that of latter ls.)

Hutshi group.

Tertiary: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 38).

Hyampom lake beds.

Miocene: Northwestern California (Trinity County).

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 41–43). Near mouth of canyon [where Hay Fork enters] the coal-bearing series, which for convenience we will call *Hyampom beds,* has an exposed thickness of 250 ft., the upper 100 ft. being cgl. and the lower portion sandy, containing here and there concretions. Some of sss. are rather hard, strike N. 85° E., with a dip of 30° SE., and contain coaly beds. Near base of series is 25 ft. of cgl., and bottom part, about 30 ft. thick, is not exposed. Limited to Hyampom Valley, 3 or 4 mi. long and of less breadth. Rests uncon. on underlying beds. Flora identified by F. H. Knowlton as upper Mio.

Hyco quartz porphyry.

Pre-Cambrian: South-central Virginia and central northern North Carolina (Person and Granville Counties).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 15, 19, 20–23, and map). The acid volcanics of Virgilina dist. originally were rhyolite or quartz porphyry and rhyolitic tuffs, but in their present condition are largely sericite schists which may or may not show more than remnants of their original minerals and texture. In this rept these rocks are described under name *Hyco quartz porphyry.* The fm. consists largely of quartz-sericite schist, which represents a mashed and otherwise metamorphosed quartz porphyry or rhyolite, and which was tuffaceous in certain areas. It appears to be oldest of the volcanic rocks, at least its areal distribution indicates that it underlies the other volcanics. Assigned to Ord. (?). Underlies Aaron sl. In SE. part of Virgilina dist. its place is apparently taken by Goshen schist.

A. I. Jonas, 1917 (Va. Geol. Surv. prel. ed. of geol. map of Va.). [Under the block of pre-Camb. extrusive rocks younger than Glenarm series and designated as "aporhyolite" is statement: "In Virgilina area called Hyco quartz porphyry and tuffaceous facies is called Goshen schist."]

Named for Hyco River, Halifax Co., Va., along which occur its largest and most typical exposures.

Hyde granite.

Pre-Cambrian: Northwestern New York (Hammond quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 85, 86–88). ***Hyde granite*** forms area SW. of Hickory Lake in bend btw. Hickory Creek. Is fine-grained pink rock with marked gneissic structure. Intrudes Grenville series. [Appears, from pp. 120–122 and 136, to be named for Hyde School.]

Hyde Manor limestone.

Middle Ordovician (Trenton): Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 368–9). ***Hyde Manor ls.***—Of decided blue color. Consists of massive beds interlayered with thin slabby strata. Considerable schistosity is evident. The fm. is strongly folded. Fossils rather common; good brachiopod fauna of Trenton age. Occurs near N. end of Taconic Range. Underlies Hortonville sl. [Thickness of fm. not given.]

Named for exposures at well-known summer resort, called Hyde Manor, S. of Sudbury, Brandon quad.

Hyder quartz monzonite.

Jurassic or Cretaceous: Southeastern Alaska (Hyder district).

A. F. Buddington, 1929 (U. S. G. S. Bull. 807, pp. 29–39, 58–59, maps, etc.). ***Hyder quartz monzonite.***—The quartz monzonite composing Hyder batholith. Included in Coast Range intrusives. Named for exposures at Hyder.

†Hydraulic limestone.

Descriptive term applied by Swallow to a ls. in middle of Cherokee sh. of Mo. and Kans. that is now known as *Ardmore ls. memb.* The term has also been applied, in a titular sense, to lss. of different ages in other parts of the country, which are used in making cements.

Hygiene sandstone member (of Pierre shale).

Upper Cretaceous: Central northern Colorado (Boulder district and northward).

N. M. Fenneman, 1905 (U. S. G. S. Bull. 265). *Hygiene ss. memb. of Pierre fm.*—Thick-bedded, frequently cross-bedded ss.; much of it dark greenish gray and gritty, remainder light gray; the whole calc. when fresh. Near Boulder it is very thin; to N. it is 250 ft. thick. In places it consists of 2 sss. separated by a sh. parting that thickens to 200 or 300 ft. The upper div. of Hygiene ss. is characterized by large calc. concretions several ft. in diam. The Hygiene lies 1,000 to 3,000 ft. above base of Pierre fm. Typically developed in ridge which passes within 1½ mi. of village of Hygiene [Boulder Co.]. It crosses Little Thompson Creek on Culver ranch, 6 mi. SW. of Berthoud, where a seepage of oil has long been known. At its outcrop W. of Berthoud it is several hundred ft. thick. [As thus defined includes Terry ss. memb.]

M. W. Ball, 1924 (A. A. P. G. Bull., vol. 8, pp. 81–87). The name Hygiene ss. has heretofore been misapplied to a series of sands occurring through strat. interval of 1,700 ft. or more. The assumption seems to have been that only one ss. is present in the Pierre, and every ss. outcrop was called Hygiene and connected up in a single line across the map. A. T. Schwenneson, E. W. Krampert, and C. H. Henley [unpublished repts] restricted the name to basal ss. of the series, since this seems most likely to have been the ss. noted near Hygiene, and the term is so used here. The other sss. have been named and mapped by Schwenneson, Krampert, and Henley [unpublished], in descending order: ***Richard ss.***, Larimer ss., Rocky Ridge ss., and Terry ss. The ***Hygiene ss.*** as restricted is 100 ft. thick, and lies 383 ft. below Terry ss.

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B). ***Hygiene ss. memb. of Pierre sh.***—As now restricted is 0 to 100 ft. thick, lies 200 to 400 ft. below Terry ss. and 2,400 to 3,100 ft. above Niobrara fm. It is not distinguished, either lithologically or faunally, with certainty from the other ss. members of the Pierre.

Hyndman formation.

Pre-Cambrian: Central Idaho (Hailey region).

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10–17). *Hyndman fm.*—Massive qtzite with a green hornfels memb., 600 ft. thick, in upper part, and a schist memb., 1,100 ft. thick, in lower part. Total thickness of fm.

6,600± ft. Is oldest sed. fm. in Wood River region and probably of Algonkian age. Underlies East Fork fm. (also of Algonkian age). Excellently exposed in Hyndman Peak and in cirques at its southern base, in Hailey quad.

Hyneman sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Cypress ss.

†Hypozoic era and †Hypozoic series.

Names that have been applied to all pre-Camb. stratified rocks and the time covered by their formation. For definition see U. S. G. S. Bull. 769, pp. 12, 21, 30. Included in Proterozoic era of U. S. Geol. Survey.

Iaeger sandstones. (In New River formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, pp. 186–191), named, in descending order, the following subdivisions in upper part of "Middle Pottsville series or New River group," beneath Panther cgl.: (1) Iaeger B coal; (2) *Upper Iaeger ss.* (massive to current-bedded, medium-grained, grayish white to brown, cliff-making, 30 to 50 ft. thick); (3) interval 60 to 70 ft.; (4) Iaeger A coal; (5) *Upper Iaeger sh.* (dark gray, argill., laminated, with plant fossils at base, 5 to 85 ft. thick); (6) Iaeger coal; (7) *Middle Iaeger ss.* (massive, medium-grained to coarse, grayish white to light gray, 30 to 40 ft. thick); (8) Lower Iaeger coal; (9) fire clay and sh. 0 to 5 ft.; (10) *Lower Iaeger ss.* (massive to flaggy, medium-grained, micaceous, gray to brown, 20 to 30 ft. thick); (11) *Lower Iaeger sh.* (dark gray, argill., laminated, 20 to 40 ft. thick); (12) Harvey cgl. The Iaeger members are named for their occurrence at Iaeger, McDowell Co.

Iaeger shales.

See under *Iaeger sandstones.*

Iatan limestone. (In Douglas group, Kansas.)

Iatan limestone member (of Douglas formation, Missouri).

Pennsylvanian: Southwestern Iowa, northwestern Missouri, eastern Kansas, and southeastern Nebraska.

C. R. Keyes, 1899 (Am. Geol., vol 23, p. 306). *Iatan ls.*—Middle memb. of Lawrence sh. [broad and abandoned usage of Lawrence] in Mo. and eastern Kans. Underlies Andrew sh. memb. of Lawrence and overlies Weston sh. memb.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), divided Douglas fm. of NW. Mo. and SW. Iowa into (descending) Oread ls. memb., Lawrence sh. memb., Iatan ls. memb., and Weston sh. memb. This classification prevailed for many years. For recent innovations, see under *Weston sh. memb.*, also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for exposures at Iatan, Platte Co., Mo.

Iberville formation.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 5).

Ice River formation.

Age (?): British Columbia.

L. D. Burling, 1912 (Wash. Acad. Sci. Jour., vol. 2, p. 357).

Ice River intrusive complex.

Post-Cretaceous: Alberta.

J. A. Allan, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 185).

Iconium member (of Wellington formation).

Permian: Central northern Oklahoma (Logan and Lincoln Counties).

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 243, 249, etc.). *Iconium memb.*—Upper or shaly part of Wellington fm. in Logan and Lincoln Counties, occurring btw. top of Fallis memb. of Wellington and base of Garber ss. Thickness

470± ft. Lower 270 ft. is 65± percent. sh., with ss. and dolomitic beds well spaced. Lower 200 ft. contains more ss. beds with the sh. beds. Grades into overlying Garber, top of Iconium being placed at base of massive ss. of Garber. The shales of Iconium are red, blocky, nonlaminated, and contain calc. or dolomitic material in form of septarian concretions and veined geodes. The sss. are friable, reddish brown to gray, micaceous, cross bedded, and relatively fine grained. Fossil wood. A few thin calc. or dolomitic beds, usually red, in lower part. Two important ss. beds in upper part are here named *Evansville ss. bed* and *Lowrie ss. bed.* Named for little town of Iconium, near S. quarter cor. of sec. 10, T. 16 N., R. 1 E., Logan Co. The town is 80± ft. above base of Iconium memb.

Idaho formation.

Pliocene and Pleistocene: Southeastern Oregon and western and southern Idaho.

E. D. Cope, 1884 (Phila. Acad. Nat. Sci. Proc. 1883, vol. 35, p. 135; fauna described on pp. 153–166). Still another late Tert. lake existed in eastern Oreg. and western and southern Idaho. No body of water represents it at present time, and the remains of fishes found in its sediments belong to species different from those of the Oregon basin, both recent and extinct. It is to be supposed that this lake was separate from all of the others (Lahontan, Bonneville, and Klamath), and of earlier age, although one of the Plio. series. It may be called *Lake Idaho*, and its sediment the *Idaho fm.*

W. Lindgren, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 632–634). [See under *Payette fm.*]

W. Lindgren, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 93–94, 97–98). [See under *Payette fm.*]

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 198–201, 235–239). Writer presents evidence to support following ideas: (1) A series of terrestrial deposits and lake beds exists in Columbia River basalt, 600 or more ft. below its upper surface, which present a characteristic lithology and a flora of Mio. age. (2) A series of terrestrial deposits and lake beds, in places several thousand ft. thick, overlies Columbia River basalt and Owyhee rhyolite and presents a characteristic lithology and a flora and fauna of Plio. and later age. According to original definitions of *Payette fm.*, none of upper series may be included in it, but the series underlying the basalt and rhyolite can be shown to be true *Payette.* According to original definition of *Idaho fm.*, all of upper series should be included in it. For convenience of discussion, *basin beds* will refer to all lake beds and terrestrial sediments overlying the upper flow of Columbia River basalt or the rhyolite, and *intermontane beds* will refer to all lake beds and terrestrial sediments underlying several hundred ft. of Columbia River basalt or rhyolite. These in no case occur in the plains area. The basin beds (Idaho fm.) overlie Columbia River lava on both N. edge and S. border of the plains without marked angular uncon. but with considerable discon. *Idaho fm.* is here redefined and applied to all *basin beds* in mapped area (Canyon, Gem, Payette, and parts of Ada, Adams, Owyhee, and Washington Counties, Idaho) and in contiguous areas in Idaho and Oreg., and *Payette fm.* is applied to all *intermontane beds* in this area. Idaho fm. consists of lake beds and terrestrial beds which dip toward the downwarp axis and attain a thickness of several thousand ft. in middle of basin. It includes all lake beds overlying Columbia River basalt and Owyhee rhyolite but excludes the Pleist, Upper Mesa and Lower Mesa fms. and alluvium. Interbedded with the upper members is Snake River basalt. The basal beds and upper beds are predominantly sandy, but by far the greater thickness of fm. is light-colored sh. A few beds of volcanic ash and diatomite are conspicuous. The basal sss. are in places well cemented and resistant, but on whole the fm. is poorly consolidated. Most of fm. is well stratified. Plant fossils point to Plio. age. Invertebrate and vertebrate fossils indicate Plio. and Pleist. age. The "Payette fm." mentioned by Washburne is included in Idaho fm. as here defined. Writer does not conceive of a great Lake Payette and a smaller Lake Idaho, as do Lindgren, Russell, Washburne, and others, but visualizes temporary shallow lakes of varying sizes from time to time alternating with intervals of desiccation. Bryan and Buwalda admitted small lakes but also strongly urged flood plains, deltas, and alluvial fans. Idaho fm. includes Poison Creek fm. of Buwalda and *Emmett fm.*, a name proposed by writer in June 1928, for a part of what was originally called *Idaho fm.*

The U. S. Geol. Survey classifies Idaho fm. as Plio. and Pleist., and Payette fm. as Mio.

†Idaho granite.

A term that has been loosely applied to the granitic rocks of Idaho batholith of Idaho.

Idaho Springs formation.

Pre-Cambrian: Central northern Colorado (Georgetown quadrangle).

S. H. Ball, 1906 (Am. Jour. Sci., 4th, vol. 21, p. 374). *Idaho Springs fm.*—Biotite-sillimanite schists, biotite schist, and quartz gneiss, with lenses of silicate rocks. The schists and quartz gneiss are interbedded with and grade into one another, while the lime silicate rocks, although interbedded with the others, appear only to grade into the quartz gneiss. Probably of sed. origin. Oldest memb. of pre-Camb. series in Georgetown quad., and forms the network into which the other fms. were injected. Typically exposed in hills surrounding Idaho Springs.

On 1935 geol. map of Colo. this fm. was assigned to Gunnison River series, which includes all of oldest exposed rocks in Colo.

Idalia clay.

Tertiary: Southeastern Missouri.

C. F. Marbut, 1902 (Mo. Univ. Studies, vol. 1, No. 3, pp. 18, 21, 32). *Idalia clay.*—Black or dark and gray to drab clay sh., 60 to 80 ft. thick, found only in Crowley ridge and usually only in lower part. Overlain uncon. by Benton sands and underlain uncon. by Paleozoic. Assigned to Tert.

Named for exposures at Idalia, Stoddard Co.

Ideal gypsum.

See under *Childress dol. and gyp.*

Idolo beds.

Eocene: Mexico.

E. T. Dumble and E. R. Applin, 1924 (Pan-Am. Geol., vol. 41, p. 341).

Ignacio quartzite.

Upper Cambrian: Southwestern Colorado.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60, p. 8). [See 1st entry under *Hermosa fm.*]

W. Cross, 1901 (U. S. G. S. Bull. 182, p. 35). Earliest Paleozoic fm. of Silverton quad., Colo., is a qtzite with some sandy shales 100 to 200 ft. thick, which is seen on W. side of Animas River from the monzonite contact to Molas Lake, and imperfectly on E. side of the Animas. This qtzite has been traced down the Animas to below Rockwood, and is called *Ignacio qtzite,* from its characteristic development on the bench where lake of that name is situated. A southerly dip carries this qtzite onto S. slope of Needle Mtns, where a few indistinct fossils indicate its Camb. age. The rather shaly beds, often calc. [Elbert fm.], succeeding the qtzite have not yielded fossils. If there are any Sil. strata in this section they are probably represented by these calc. shales and sss. The Ignacio qtzite overlies Algonkian qtzites and slates.

Ignek formation.

Jurassic (?): Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103, 120, map). *Ignek fm.*—Black sh. and subordinate ss., coal, or red beds. Thickness 2,500± ft. Youngest Mesozoic fm. in region. Probably overlies Kingak sh. (Lower? Jurassic). Type loc. is on S. side of Red Hill, in Ignek Valley, at W. end of Sadlerochit Mtns. Occurs at both ends of Sadlerochit Mtns and probably along N. front, but not identified elsewhere. Fauna differs from that of Kingak sh. Is tentatively assigned to Jurassic (?).

Ilchester granite.

Pre-Cambrian (?): Eastern Maryland.

W. H. Hobbs, 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 225–228). *Ilchester granite.*—One of youngest of a series of eruptions in the gneiss and crystalline schist of eastern Md. Medium to coarse grained rock, with a porphyritic aspect caused by the large microcline crystals scattered through the holocrystalline to granophyric groundmass. Occurs at Ilchester, Md.

Iles formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado.

Named by E. T. Hancock, but publication of his rept was delayed, so that name first appeared in U. S. G. S. Press Memo. 16037, Oct. 1, 1923, on map of Hamilton and Seeping Spring Gulch domes and vicinity, Moffat Co.

E. T. Hancock, 1925 (U. S. G. S. Bull. 757). *Iles fm.*—An alternation of thick beds of ss. and sandy sh. with a few thin coal beds near base and near top. Is lower fm. of Mesaverde group in Axial and Monument Butte quads. Thickness 1,350 ft. Trout Creek ss. is top memb., and basal bed consists of 15 to 25 ft. of ss. Rests conformably on Mancos sh. and is conformably overlain by Williams Fork fm., the upper fm. of Mesaverde group of this area. Forms nearly all of Iles Mtn.

Illahe formation.

Oligocene: Northwestern Oregon (Salem Hills, Willamette Valley).

T. P. Thayer, 1933 (Pan-Am. Geol., vol. 59, No. 4, p. 317). *Illahe fm.*—Near-shore marine tuffaceous sediments containing lower-middle Olig. fossils. Occurs in S. part of Salem Hills, SW. of Salem, Oreg. Probably grades eastward into the subaerial Mehama volcanics. The basaltic Stayton lavas, about 400 ft. thick, which are correlated with the Mio. Columbia basalts, lie on the eroded surface of the gently folded Illahe fm. In the Cascades the Stayton lavas rest uncon. on Mehama volcanics. [Derivation of name not stated.]

Illecillewaet quartzite.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 134).

Illinoian stage of glaciation, also **Illinoian drift** (Pleistocene).

Illinoian drift is name applied to third drift of Labrador and Patrician parts of Laurentide ice sheet, the term *Illinoian stage* being applied to time during which this drift was deposited. The name was proposed by F. Leverett, but was first published by T. C. Chamberlin (Jour. Geol., vol. 4, pp. 872–876, 1896), who credited it to Leverett, as *Illinois* till sheet. Leverett defined the term in Chicago Acad. Sci. Geol. and Nat. Hist. Surv. Bull. 2, pp. 11–16, 1897, and in Jour. Geol., vol. 6, p. 173, 1898. The *Illinoian drift* is underlain by Yarmouth soil and interglacial deposits and overlain by Sangamon soil and interglacial deposits. Named for its development in Ill.

†Illinois till sheet.

See under *Illinoian stage.*

†Ilo formation.

Upper Cretaceous: Northwestern Wyoming (Park County).

D. F. Hewett, 1914 (U. S. G. S. Bull. 541, pp. 91, 103, etc.). *Ilo fm.*—Buff and yellow sss. with minor sandy sh. and clay. No coal beds. Saurian bones and fresh-water invertebrates. Thickness 1,790 ft. in Shoshone River section. Underlies (uncon.?) Fort Union fm. and overlies Meeteetse fm. Is Cret. or Tert. Well exposed in open valley NW. of Ilo, a settlement 50 mi. SE. of Cody, hence name.

Same as Lance fm., which is now classified as Upper Cret. in most areas.

Image member. (In Queen Charlotte group.)

Jurassic: British Columbia.

C. H. Clapp, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 21).

Imlay moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Imlay, Lapeer Co.

Imperial formation.

Miocene (late lower): Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, pp. 434–435). There appears to be good reason to suspect that more than one Plio. fm. is represented on flanks of Coyote Mtn (which is also called *Carrizo Mtn*). Very little reason exists for placing the coral reef, the lowermost exposed fossiliferous stratum, with the great oyster reefs of upper part. For a long time the deposits about Coyote Mtn have been called "Carrizo Creek beds," or "Carrizo fm.," the latter proposed definitely in 1914 by Kew; but F. E. Vaughan has shown that these names are inapplicable because of prior use elsewhere. This is to be regretted, but it seems that current usage demands a different name. Since we are unable as yet to correlate definitely any of the fossil-bearing strata with any named fm. elsewhere, I would propose that it be known as *Imperial fm.* The type loc. should be taken as the coral reef exposed in Alverson Canyon on S. side of the mtn. This coral reef has a distinctive fauna. It is succeeded by about 200 ft. of very fossiliferous calc. sss. for which I propose the name *Latrania sands.* Above the Latrania sands are enormous deposits of clay, here named *Coyote Mountain clays.* Above the clays, and interbedded with them near the top to some extent, are extensive deposits of oyster shells for which the name *Yuha Reefs* has been selected. According to above nomenclature, Conrad's fossil mollusks came from the Yuha Reefs; Kew's echinoderms are from the Latrania sands; and Vaughan's corals from Imperial fm. It is believed that further work will necessitate further subdivision rather than a consolidation of above fms. [According to foregoing the name *Imperial fm.* was proposed as a substitute for *"Carrizo Creek beds,"* but as defined it was also restricted to the coral reef forming basal part of *"Carrizo Creek beds."*]

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1–25), redefined *Imperial fm.*, restricting it to marine deposits, and dividing it into an upper or siltstone memb. (1,400± ft. thick) and a basal cgl. memb. (a few inches to 700 ft. thick). He correlated the basal cgl. memb. with Imperial fm. of Hanna in narrow sense, and the siltstone memb. with Latrania sands, Coyote Mountain clays, and interbedded Yuha Reefs of Hanna. He assigned his Imperial fm. to late lower Mio., and his overlying Palm Spring fm. (nonmarine) to middle or upper Mio.

Incarnacion fire clay.

Pennsylvanian: Central northern New Mexico.

C. L. Herrick, 1904 (Jour. Geol., vol. 12, p. 242). *Incarnacion fire clay*, basal bed of Sandia fm. near Socorro, N. Mex. Uncon. overlies Incarnacion granite. Named for mining dist. in which it occurs.

Incarnacion granite.

Age (?): Central New Mexico.

C. L. Herrick, 1904 (Jour. Geol., vol. 12, pp. 237–251). Near Socorro the *Incarnacion granite* uncon. underlies Sandia fm. Named for mining dist. in which it occurs.

Inch Arran latites.

Devonian: New Brunswick.

W. V. Howard, 1926 (Geol. Soc. Am. Bull. vol. 37, p. 487).

Independence shale member (of Wapsipinicon limestone).

Middle Devonian: Central eastern Iowa.

S. Calvin, 1878 (Am. Jour. Sci., 3d, vol. 15, pp. 460–462). *Independence shales.*—Fossiliferous, argill., fine-grained shales charged with bituminous matter. Thickness 20 to 25+ ft. Basal div. of Dev. at Independence. Underlies Dev. lss.

In subsequent repts (up to 1928) W. H. Norton placed Independence sh. below his Davenport beds and above his Otis beds, and this assignment was followed by G. F. Kay and E. T. Apfel, 1929 (Iowa Geol. Surv. vol. 34, pp. 17–18).

T. E. Savage, 1925 (Jour. Geol.), classified Wapsipinicon ls. (of which this sh. was considered a memb.) as Upper Dev.; E. O. Ulrich (1911) as Middle Dev.

The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, assigned this sh. to Upper Dev., excluded it from Wapsipinicon ls., and treated it as a distinct fm. overlying Davenport memb. of Wapsipinicon, which was excluded from Upper Dev. On p. 24 A. C. Trowbridge stated they are undecided whether it is Upper or Middle Dev.

M. A. Stainbrook, 1935 (pp. 249–254 of 1935 rept cited above). *Independence sh.* lies conformably below Cedar Valley ls. and uncon. on Davenport ls. Carries large Upper Dev. fauna.

†Independence limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth and W. H. H. Piatt, 1894 (Kans. Univ. Quart., vol. 2, pp. 115–117). *Independence ls.*—Heavy ls., 40 ft. thick at Independence. Overlain by 80 to 150 ft. of shales with interbedded sss. May be same as Oswego ls., but differs in character.

Preoccupied. Replaced by Drum ls. according to G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 37); but R. C. Moore states (Kans. Geol. Surv. Bull. 22, 1936, p. 109) †Independence ls. of Adams is Dennis ls.

Named for Independence, Montgomery Co.

Independence gas sand.

A subsurface sand, of early Penn. (Cherokee) age, 0 to 100± ft. thick, in Independence field, central northern Okla., reported to occur at horizon of Bartlesville sand, but to be a distinct body.

Index granodiorite.

Jurassic (?): Central Washington (Snohomish County).

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 7, pp. 34–50). Very closely resembles Mount Stuart granodiorite, but in this rept will be designated *Index granodiorite*. Constitutes by far the larger part of areal geology of Index mining dist. Assigned to Jurassic (?).

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). *Index granodiorite*, Jurassic or Cret., intrudes Gunn Peak fm. Outcrops typically near town of Index, Snohomish Co. To SW. of Index is uncon. overlain by Tert. lavas.

Indian conglomerate.

Eocene (?): Southern California (southern part of Santa Ynez quadrangle, Santa Barbara County).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 10, pp. 344, 350–352, pl. 46, and map). *Indian cgl.*—Rudely sorted pebbles and boulders, up to 1 foot diam., in coarse-grained ss. matrix, firmly cemented. In Indian Canyon, where the fm. is over 500 ft. thick, the cgl. is in beds 8 ft. thick, or less, separated by massive, thick-bedded sss. which sometimes attain aggregate thickness of 25 ft. Near its base, in places, are lenses of ss. A characteristic feature is large percentage of acid porphyry pebbles. Varies in thickness from 25 ft. in Mono Creek to 500 ft. in Indian Canyon. Rests, with probable uncon. in places at least, on Cret. rocks, and is conformably overlain by Mono sh. Best developed in Indian Canyon, whence its name. Assigned to Eo.

M. F. Keenan, 1932 (San Diego Soc. Nat. Hist. Trans., vol. 7, No. 8, pp. 53–84). Paleontologic evidence points to Cret. (Chico) age of Indian cgl. and Mono sh., instead of Eo.

Indian sand.

A subsurface sand in western Pa. that is correlated with Morgantown ss. memb. of Conemaugh fm.

Indiana oolitic limestone.

Mississippian: Indiana.

C. E. Siebenthal, 1901 (Ind. Dept. Geol. and Nat. Res. 25th Ann. Rept., pp. 390–393), and C. E. Siebenthal and W. S. Blatchley, 1908 (Ind. Dept. Geol. and Nat. Res. 32nd Ann. Rept., pp. 305, 307). *Indiana oolitic ls.*—Oolitic ls. overlying

Harrodsburg ls. and underlying Mitchell ls. Formerly called Bedford oolitic stone, Spergen Hill ls., White River stone, etc.

Trade name for Spergen ls. Named for its commercial importance in Ind.

Indiana travertine.

A trade term applied to a very coarse-grained stone containing many large cavities, occurring at intervals in upper part of Spergen ls. of Ind., which is known to the trade as "Indiana oolitic ls."

Indiana till.

A term applied by C. [R.] Keyes to an early till sheet (of pre-Nebraskan age, he stated) in Ind. and Ill. (See Pan-Am. Geol., vol. 58, pp. 203, 217, 1932.)

Indianan till.

C. [R.] Keyes, 1926 (Pan-Am. Geol., vol. 45, p. 151). East of Mississippi River probably most of so-called Kansan till comes from Labradoran center, and it should therefore be distinguished from Kansan till by some such title as *Indianan till*.

Indian Cave sandstone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 50, 201). *Indian Cave ss.* = lower and major part of Towle sh. (basal subdivision of Admire group of Moore) and in places cuts out upper beds of underlying Wabaunsee group [restricted]. [This is all of definition.]

Indian Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 386). *Indian Creek bed.*—Shaly sandy clay, thickness not stated. Memb. of Strawn div. Overlies Antelope Creek bed or, where that is absent, Comanche Creek bed. Underlies Ricker bed. [Named for Indian Creek, Brown Co.]

Drake applied *Indian Creek* to 2 units, one in Admiral fm. (Perm.), and the other in Strawn fm. (Penn.). E. H. Sellards (Univ. Tex. Bull. 3232, pp. 105, 170, 173, 1933) retained the name for the Penn. unit and discarded it for the Perm. unit, altho the Perm. name has had greater usage.

Indian Creek shale member (of Admiral formation).

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 423). *Indian Creek bed.*—Clay, more or less sandy throughout, at many places slightly shaly, and at some places carbonaceous; of bluish, purplish, and yellowish colors. Thickness 75 to 100 or more ft. Memb. of Albany div. Overlies Hordes Creek bed and underlies bed No. 5 (25 to 60 ft. of ls. with some marly clay).

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192, 193, and charts). *Indian Creek sh. memb.* is included in Admiral fm. (basal fm. of Wichita group). Overlies Hordes Creek ls. lentil and underlies "bed No. 5" of Drake.

Named for Indian Creek, Coleman Co.

See also under *Indian Creek bed* (Penn.).

Indian Fields formation.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 60). *Indian Fields fm.* introduced, for convenience, to include Oldham ls. at top, Plum Creek clay in middle, and "those layers of ls., usually 1 to 2 ft. thick, beneath Plum Creek clay which are regarded as belonging above the line of uncon. marked, in east-central Ky., by *Whitfieldella subquadrata* and oolitic iron ore bed." Included in Crab Orchard div., of Niagaran age. Overlain by Alger fm. and underlain by Brassfield ls.

Named for Indian Fields, Clark Co.

Indian Gap limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western parts of Mercer and Summers Counties, pp. 52, 108, 326, 340). *Indian Gap* (*Winifrede?*) *ls.*—Dark-gray hard ls. 1 to 2 ft. thick, with marine fossils. Directly overlain by 1 to 5 ft. of fossiliferous limy sh. Lies 5 to 10 ft. below Chilton rider coal, 65 to 149 ft. below Winifrede coal, and 28½ ft. above Chilton coal. Occurs at Indian Gap, Raleigh Co.

Indian Gulch.

Mesozoic: Sierra Nevada, California.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Indian Gulch aggls., tuffs, sss., and cgls.*, 3,500 ft. thick. Basal fm. of Mariposa group on Merced River and southward into Indian Gulch quad. Underlies Mariposa slates.

Indian Hill series.

Upper Cretaceous: Southeastern Massachusetts (Marthas Vineyard).

N. S. Shaler, 1888 (U. S. G. S. 7th Ann. Rept., map, pl. 20, p. 340). *Indian Hill series* [on map].—There are two sets of deposits on Marthas Vineyard the relations of which are not as yet determined. One of these is the hidden series, which is certainly known from the drift in dist. about Indian Hill and on shores of Cotamy Bay. It is shown only by abundant fragments of its beds contained in glacial drift in region about Indian Hill and the rarer fragments which are found on Chappaquiddick Island and neighboring shores of Cotamy Bay. These fragments, which on certain fields about Indian Hill constitute a large part of the glacial detritus, are the wastes from deposits of highly ferruginous ss., often taking on the form of an impure siliceous hematite. The fragments can not have been transported more than a few hundred ft. from their original position. The obscure fossils lead to belief the beds are Lower Cret. or older.

According to L. W. Stephenson (personal communication) the fossil invertebrates collected at Indian Hill are of Upper Cret. age.

Indian Hollow sands.

Pleistocene: Northwestern Pennsylvania (Warren County).

See under *Clarendon gravel*.

Named for Indian Hollow, Warren Co.

Indian Ladder beds.

Upper Ordovician: Eastern New York (lower Mohawk Valley).

J. M. Clarke, April 15, 1911 (N. Y. State Mus. Bull. 149, pp. 10–12). *Indian Ladder beds* (upper part of Frankfort sh. as previously identified in eastern N. Y.). Several hundred ft. of strata characterized by rapid alternation of shales and thin sss. with argill. ls. beds. Carry different fauna from lower beds of Frankfort sh., which contain a eurypterid fauna throughout. Named for exposures at Indian Ladder [near Meadowdale, Albany Co.]. Field work in charge of H. P. Cushing, W. J. Miller, and R. Ruedemann.

R. Ruedemann, December 15, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 720, abstract of paper read by title at Dec. 1910 meeting). *Indian Ladder beds*, upper part of Frankfort sh., carry different fauna from underlying beds and are present only in the east [Mohawk Valley].

R. Ruedemann, 1912 (N. Y. State Mus. Bull. 162), restricted Frankfort sh. to the fm. as exposed in Utica region, which is absent in Mohawk Valley, the sh. in lower Mohawk Valley formerly called *Frankfort* being much older, and named by him *Schenectady fm.* He recognized *Indian Ladder beds* as distinct fm. in Mohawk Valley, equiv. in age to part of Frankfort sh. but faunally entirely different. Thickness 0 to 300± ft. Rest on Schenectady fm., of Trenton age.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 43). *Indian Ladder beds* consist of thin sss. and shales with massive ss. at top. Formerly included in "Hudson River group," of which they form uppermost div. in lower Mohawk Valley. Are characterized by distinct fauna and differ lithologically from underlying Schenectady beds. Distinct fm. from Frankfort sh. but equiv. to it in time.

H. P. Cushing and R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169). *Indian Ladder beds* of western trough at Saratoga Springs and vicinity are 300+ ft. thick, and contain a faunule hitherto known only from Eden beds about Cincinnati, but of age roughly corresponding to Frankfort beds of central N. Y. Are of basal Lorraine age. Rest uncon. on Schenectady fm., of middle and upper Trenton age.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258), restricted Frankfort sh. to Utica Basin and to rocks older than *Indian Ladder beds* of lower Mohawk Valley, which rest uncon. on Schenectady beds. In 1929 (Geol. Soc. Am. Bull., vol. 40, p. 414) he repeated assignment of *Indian Ladder beds* to basal Lorraine.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 292). *Indian Ladder beds.*—Fauna not represented anywhere else in east N. Y. It is of Cincinnatian (Frankfort) age. The beds are 400+ ft. thick.

Indian Mills sandstone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell and Giles Counties).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 400). *Indian Mills ss.*—Usually greenish gray, fine-grained, partly massive, partly shaly; 30 to 100 ft. thick. Underlies Bradshaw sh. and overlies Indian Mills sh.; all members of Bluefield group [fm.]. Type loc. on N. side of Indian Creek just W. of Indian Mills, Summers Co. Also observed in Mercer and Monroe Counties, and in Tazewell and Giles Counties, Va.

Indian Mills shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 401). *Indian Mills sh.*—Green or red and variegated; 20 to 70 ft. thick; marine fossils. Underlies Indian Mills ss. and overlies Raines Corner ls.; all members of Bluefield group [fm.]. Type loc. same as Indian Mills ss. Also observed in Monroe Co.

Indian Point formation.

Silurian (Niagaran): Quebec (Gaspé Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 52).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). Faunas of Bouleaux, West Point, and Indian Point fms. of the middle Sil. Chaleur series are of Lockport and Guelph age.

Indian River group.

Age (?): Canada.

R. G. McConnell, 1900 (Canada Geol. Surv., Rept. on Klondike gold fields, p. 8).

Indian River series.

Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 198). [See also A. H. Brooks, 1906 (U. S. G. S. P. P. 45, p. 213), for Indian River series, Yukon Terr.]

Indian River slate.

Lower Ordovician (Chazy): Southwestern Vermont (Rutland County) and eastern New York (Washington County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 403). *Indian River sl.*—The fm. that furnishes the well-known red sl. of N. Y. sl. industry. Is mainly bright red sl. with, locally, a few thin seams or layers of fine green qtzite. Red color is due to iron oxide. Conformably overlies Poultney sl. and conformably underlies an unnamed black sl. Named for Indian River, a few mi. S. of Granville [Washington Co.], N. Y., where several red sl. quarries are located on banks of the stream.

Indian Spring red beds. } (In Tonoloway limestone.)
Indian Spring sandstone. }

Silurian: Northern Maryland.

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol., pp. 46–49). *Indian Spring ss.*—Lies about 120 ft. above base of Tonoloway fm. Is thin and inconspicuous at Pinto, but increases in thickness eastward. In vicinity of Hancock it is argill. and about 5 ft. thick. East of Hancock it becomes very hard and dense and breaks into irregular fragments. Seems to occupy strat. position of Bloomfield ss. of Claypole. The red beds here called *Indian Spring red beds* are associated with it in North Mtn, becoming conspicuous in easternmost exposures. Named for occurrence at Indian Spring, Washington Co. [In tables in book cited the Indian Spring red beds are placed beneath Indian Spring ss.]

Indian Springs shale. (In Chester group.)

Mississippian: Southwestern Indiana.

C. A. Malott and J. D. Thompson, Jr., 1920 (Sci., n. s., vol. 51, pp. 521–522). *Indian Springs sh.*—Olive sh., 20 ft. thick, which characteristically underlies Golconda ls. Overlies Cypress ss. [Later repts give thicknesses from 5 to 58 ft.]

Probably named for Indian Springs, Martin Co.

Indian Springs member (of Bird Spring formation).

Mississippian (upper): Southeastern Nevada (Las Vegas quadrangle).

C. R. Longwell and C. O. Dunbar, 1936 (A. A. P. G. Bull., vol. 20, No. 9, pp. 1200–1207). In Good Springs dist., Nev., the basal memb. of Bird Spring fm. consists of thin-bedded ss., sh., and ls. with local cgl. This basal memb. changes considerably in character. Near Indian Springs, 50 mi. NW. of Las Vegas, yellow, orange, and reddish shales are interbedded with lss. and subordinate sss. in a section 700 ft. thick. Because of its peculiar lithologic character and fauna, this zone appears to have formation value, but writers refer to it in this paper as *Indian Springs memb. of Bird Spring fm.* Overlies Monte Cristo ls. and underlies lower Penn. zone of *Fusulinella.* Fossils assigned to upper Miss. (Chester) by Girty.

†Indian Territory division.

Name applied by R. T. Hill (Geol. Soc. Am. Bull., vol. 2, 1891, p. 504) to *Washita group* of Okla.

Indidura formation.

Cretaceous: Mexico (Coahuila Peninsula).

W. A. Kelly, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 7, p. 1028).

Indio formation. (Of Wilcox group.)

Eocene (lower): Southern Texas.

A. C. Trowbridge, 1923 (U. S. G. S. P. P. 131D). *Indio fm.*—The strata overlying the marine Midway fm. and underlying Carrizo ss. in Gulf Coastal Plain of Tex. adjacent to Rio Grande. Consists chiefly of thin-bedded and laminated argill. sand and aren. sh., but includes some layers of massive clay and lenses and layers of ss. The clay and sh. are greenish or bluish gray and light chocolate brown, and most of them are gypsiferous. The ss. is gray, yellow, green, and brown, is not notably cross bedded, and is of various textures. Includes some beds of lignite and many calc. and aren. concretions. Thickness 648 to 700± ft. Is basal fm. of Wilcox group.

The overlying Carrizo sand and Bigford fm. were formerly considered to be of Wilcox age, but are now assigned to Claiborne group by most geologists. This leaves the Indio the only representative of Wilcox group in Tex.

†Indio formation.

Miocene (middle or upper): Southern California (Riverside County).

J. P. Buwalda and W. L. Stanton, 1930 (Sci., n. s., vol. 71, pp. 101–106). *Indio fm.*—Several thousand ft. of strongly folded and erosionally bevelled terrestrial deposits, consisting of clays, probably playa deposits, arkosic sss. and fangls. with considerably worn fragments in subequal thicknesses. Form entire exposed section in Indio Hills. Type section along a NE.-SW. line through Indio Hills about 2 mi. NW. of Thousand Palm Canyon. At all localities overlies the marine Carrizo fm., probably uncon. No fossils, but strat. relations to Carrizo fm. and well-indurated character of Indio fm. indicate probable age not greater than middle Mio. and not less than lower Plio.; in short, approx. middle Neocene.

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1–25), replaced this preoccupied name with *Palm Spring fm.*

Industry sandstone.

See under *Kittanning ss. memb.*

Inglefield sandstone.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84). *Inglefield ss.*—Massive ss. with thin sh. partings; 20 or more ft. thick. Underlain by Ditney fm. and overlain by Pleist. glacial deposits. [Later repts give thicknesses up to 150 ft.]

Supposed equiv. of Merom ss., and name was dropped by E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4, Sep. Pub. 21, p. 525).

Named for Inglefield, Vanderburg Co.

†Ingles conglomerate member.

Silurian: Southwestern Virginia.

M. R. Campbell, 1925 (Va. Geol. Surv. Bull. 25). *Ingles cgl. memb.*—Basal 40 ft. of Price fm. (Miss.). Consists of white quartz cgl.; in places entirely white or gray ss., but white quartz pebbles generally occur in the ss., either scattered through it in thin and irregular layers or in a thick bed of well-rounded quartz pebbles cemented by gray or white quartzose sand. Exposed on Ingles Mtn, back of Radford.

Later work developed fact that the ss. on Ingles Mtn is Clinch ss. (Sil.). See C. Butts, 1933 (Va. Geol. Surv. Bull. 42, p. 36).

Ingleside formation.

Pennsylvanian: Central northern Colorado (Larimer County region).

R. M. Butters, 1913 (Colo. Geol. Surv. Bull. 5, pp. 68, 75, etc). *Ingleside fm.*—Alternating lss. and hard fine-grained sss., gray to almost white, through pink to almost red; basal Ingleside is a light-colored ss. somewhat harder than the rest. Name is considered necessary to avoid confusion by use of *Lyons* in too broad a sense. Is quite different from the Lyons as described by Fenneman, especially in fact it contains the ls. bands, some of them very pure. Is also in a different and lower horizon than the Lyons. It lies conformably on Fountain fm. Possibly it should be regarded as merely a lithological unit in the Fountain, showing a change in conditions of sedimentation transitional to Lykins conditions. Contact with Fountain is hard to place, but appears to be at top of last prominent band of arkose cgl., though there are bands of ss. in the Fountain similar to those in the Ingleside. It extends geographically from beyond State line to the N. to a point a little N. of Lyons. Typically developed at Ingleside quarries and at Owl Canyon [3 mi. N. of Ingleside]. Thickness 100 to 125 ft. Underlies Lyons ss.

W. T. Lee, 1927 (U. S. G. S. P. P. 149) published the following as his interpretation of the section at Ingleside, Colo.:

Lykins fm. (basal part):
1. "Crinkled ss.," brecciated ls., gyp., and red sh., 75± ft.
2. sh., red, soft, 175 ft.

Lyons ss., 25 ft. (ss., yellowish pink, cross-bedded, ridge making).

Satanka (?) sh., 375 ft. (red sh., poorly exposed, with thin layers of ridge-making ss.). "Possibly belongs with underlying fm."

Ingleside fm.:
1. ss., ledge making, red to yellowish pink (Tensleep ss. of Darton), 65 ft.
2. ls., pink to gray, with many solution cavities and masses of calcite, 25 ft.
3. ss., red, intensely cross bedded, 25 ft.
4. ls., gray, brittle, impure, in places variable, 22 ft.
5. ss., red, massive, cross bedded, 40 ft.
6. ss., limy, gray, quartzose, 6 ft.
7. sh., soft, red.
8. ss., red, ledge making, 100± ft.

Fountain fm.

Pl. 1 of above rept showed Satanka (?) sh. as thinning out before reaching Spring Canyon, Larimer Co., where the Ingleside was shown as overlain uncon. by Lyons ss. as restricted by Lee.

Ingleside chert. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Ingleside chert.*—Radiolarian chert, prevailingly dull brownish red, especially in its thicker and more evenly bedded portions, but also includes some yellow and green rock, and locally rock of other colors. Contains thousands of thin beds of earthy sh. In many places the rock is true jasper. Max. thickness about 530 ft. Is overlain by Bonita ss. and underlain by Marin ss. Next to top fm. of Franciscan group.

Named for exposures in San Miguel Hills, E. of town of Ingleside, San Francisco Co.

Ingonish gneiss.

Pre-Cambrian (?): Cape Breton Island.

W. J. Wright, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 274).

Ingraham gas sand.

A subsurface sand, 25± ft. thick, of Miss. age, in central Okla., which lies lower than Jefferson gas sand and higher than Chattanooga sh.

Ingram sand.

See under *Quinn sand.* This sand has also been spelled *Ingraham sand.*

†Inoceramus beds.

Paleontologic name applied by C. A. White (Geol. Iowa, vol. 1, 1870, p. 289) to Niobrara ls., because of presence of many species of *Inoceramus.*

Inola limestone member (of Boggy shale).

Pennsylvanian: Northeastern Oklahoma (Rogers County).

S. W. Lowman, 1932 (Summaries and abstracts of technical papers presented before Tulsa Geological Society 1932, unpaged; paper dated Dec. 19, 1932). *Inola ls.*—A ls. in lower part of Boggy sh., occurring in black sh. interval btw. salt sand or Enterprise [Bluejacket] ss. of Okmulgee underground and upper Earlsboro or Red Fork sand of Seminole underground. Named for an outlier on a hill E. of town of Inola [Rogers Co.].

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520), treated this ls. as a memb. of Boggy sh.; gave its thickness as 0 to 10 inches; and showed that it lies 80 to 150 ft. below Taft ss. memb., 40± ft. above Bluejacket ss. memb., and 10 ft. above Crekola ss. memb.

Institute limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth, 1894 (Kans. Univ. Quart., vol. 2, pp. 122, 124). *Institute ls.*—Thin ls. system exposed at Haskell Institute, Lawrence. Included in Lawrence shales.

This ls. was renamed *Haskell ls.* by R. C. Moore (1931), who now includes it in his Stranger fm.

Interior formation.

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

F. Ward, 1922 (S. Dak. Geol. Nat. Hist. Surv. Bull. 11, pp. 18–20 and map). *Interior phase of the Pierre.*—Thin-bedded sandy sh., predominantly yellow brown, but variegated with browner and purpler colors in upper portions, forming top 35 ft. of the Pierre in SE. part of Pennington Co. and SW. part of Jackson Co., S. Dak. Fossils warrant placing the beds in the Pierre, although in field they were called Fox Hills. If accepted as Pierre the strong color contrast and sandier texture require explanation. They grade into underlying typical Pierre, which consists of dark gray-blue sh. containing occasional thin calc. concretionary lenses. They uncon. underlie Chadron fm. (Olig.). The Nebr. Geol. Surv. has called these beds *"Rusty memb." of the Pierre* (E. F. Schram, personal communication).

H. R. Wanless, 1923 (Am. Phil. Soc. Proc., vol. 62, p. 194). *Interior fm. of Ward* consists of 0 to 45 ft. of lavender and blue clays weathering to rusty-brown color, diversified by calc. nodules with cone-in-cone structure and concentrically banded nodules of pink or red color strongly impregnated with oxides of iron. Ward believes these clays represent Fox Hills. Prof. Toepelman suggests they may be a slightly sandy phase of Pierre. Writer is inclined to agree with Toepelman that they were formed by weathering and leaching, rather than that their characters are primary, as Ward suggests. Rest on Pierre with very irregular surface. Named by Ward because of development in vicinity of town of Interior, S. Dak.

F. Ward, 1926 (Am. Jour. Sci., 5th, vol. 11, pp. 350–352). Type loc. of *Interior fm.* is a few mi. W. of Interior, Jackson Co., S. Dak., where thickness is almost 30 ft. Is 45 ft. thick 21 mi. N. of type loc. In my 1922 rept there was some disagreement as to whether the beds were basal Fox Hills or upper Pierre, the latter position finally being agreed upon. [Discusses pros and cons.] Since then author has seen additional exposures, and conclusion reached is that Interior fm. is really Fox Hills. [Gives reasons for this opinion.]

†Intermediate series.

A descriptive term applied in some early repts on SW. Colo. to the series of Mio. volcanic rocks underlying Potosi volcanic series and overlying San Juan tuff, and now known as *Silverton volcanic series.*

Intermediate limestone.

Devonian: Canada.

R. G. McConnell, 1887 (Canada Geol. Surv. Ann. Rept., vol. 2, pp. 15D, 19D–21D).

Intervale clay slate.

Silurian (?): East-central New Hampshire (North Conway quadrangle).

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, map, p. 80). One small area of clay sl. has been found in North Conway quad. It may be either the less intensely metamorphosed equiv. of Montalban schists or it may be a fragment of a westward extension of the great Sil. sl. belt of central Maine. Writer favors latter interpretation; but more field work in adjacent areas is needed to settle the question. It is proposed to call this group *Intervale clay slates,* because the known occurrence in North Conway quad. is on S. slope of Mount Pequawket, just E. of Kearsarge Village trail at elev. of 1,500 ft. Two mi. NE. of Intervale [village], in vicinity of the trail, the sl. strikes N. 75° E. and dips vertically. Uncon. underlies Moat volcanics (Dev.?). Tentatively assigned to Sil. (?). Was called *Kearsarge andalusite group* by Hitchcock, but writer believes it does not belong to Hitchcock's "Kearsarge andalusite group."

Inwood limestone.

Pre-Cambrian: Southeastern New York.

F. J. H. Merrill, 1890 (Am. Jour. Sci., 3d, vol. 39, pp. 389–390). The position and strat. of the ls. areas of Westchester Co. have been carefully studied by Professor Dana, who has estimated thickness of the bed in Tremont and Harlem River valley at 600 to 750 ft. Writer's measurements indicate thickness varies from 600 to 800 ft., it being apparently greater on New York [Manhattan] Island than in Morrisania. The eastern bed at Tuckahoe is but 150 ft. thick. For this rock I propose the name *Inwood ls.,* from the locality on N. Y. [Manhattan] Island in vicinity of which it is well exposed. [This village of Inwood is W. of Fordham and in Harlem quad.] Underlies Manhattan schists and overlies Fordham gneiss, from which it is in a few places separated by 5 to 10 ft. of thinly bedded qtzite [later named *Lowerre qtzite*]. Included in Manhattan group.

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). Max. thickness of *Inwood ls.* unknown, but is about 700 ft. thick in Harlem River. No fossils. Exact age indeterminate, but is probably Calciferous-Trenton [Beekmantown to Trenton]. Underlies Manhattan schist and overlies Lowerre qtzite (0 to 16 ft. thick).

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83). [Stockbridge ls. (of Camb. and Ord. age) was extended into this area and used to replace *Inwood ls.,* now considered to be pre-Camb.]

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378), assigned Manhattan schist and *Inwood ls.* to pre-Camb., and named the underlying qtzite *Lowerre qtzite.* Under description of Sprout Brook Valley he in several places called the Inwood ls. the *Sprout Brook ls.*

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 47–57). *Inwood ls. (or dol.)* assigned to *Cambro-Ordovicic (?).* Generally supposed to be = Wappinger ls.

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). *Inwood ls.* conformably underlies Manhattan (Hudson) schist and uncon. overlies Fordham gneiss. Thickness 750 ft. Is essentially a coarse marble, more strongly mag. than usual. Has no fossils and is of undet. age. Other names for it are Tuckahoe marble, Sing Sing marble, and Stockbridge dol. Whether or not it is = Stockbridge dol. of Mass. no one is in position to say.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 21). Berkey holds that in all probability these fms. [Lowerre, Inwood, and Manhattan] are pre-Cambric and offers good evidence that they are not metamorphosed Paleozoic sediments.

J. F. Kemp, 1912 (Int. Geol. Cong., 11th sess., Stockholm, Compt. rend., vol. 1, pp. 702–711). Manhattan mica schist and *Inwood ls.* assigned to pre-Camb. and equivalence with Huronian of Lake Superior suggested.

C. R. Fettke, 1914 (N. Y. Acad. Sci., vol. 23, pp. 194–248). Berkey and writer think *Inwood ls.* is pre-Camb., but Merrill, Dana, Mather, and others believe it is Cambro-Ord. Berkey thinks Sprout Brook ls. is=Inwood ls.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226). *Inwood ls.* tentatively assigned to pre-Camb., but its age is uncertain. We are inclined to consider it a part of Grenville. [Correlated with later Grenville (pre-Camb.) on their correlation chart, p. 140.]

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799). *Inwood ls.* correlates with Cockeysville marble of Md. and SE. Pa., which U. S. Geol. Survey classifies as Algonkian.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 210), assigned this ls. to pre-Camb.

The terms "Algonkian system" and "Archean system" have been discarded, and Inwood ls. is now classified simply as *pre-Camb.*

Inwood sandstone.

Silurian (?): Southeastern Pennsylvania (Lebanon County).

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 635). Swatara Gap is 11 mi. NW. of Lebanon, Pa. At S. end of the gap is Inwood Station, on Phila. & Reading Ry. The section E. of Swatara Creek shows Marcellus fm., Onondaga ls. (20 ft.), Inwood ss. (49 ft.), Bloomsburg red beds, [and other fms. down to Tuscarora ss.]. The *Inwood ss.* is greenish-gray argill., somewhat arkosic ss. Concealed above. Age unknown, probably Cayugan.

Inyan Kara group.

Lower Cretaceous: Western South Dakota, northeastern Wyoming, and (in wells) southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Inyan Kara group.*—An extremely variable group, consisting of discontinuous beds of ss., sandy sh., cgl., lignite, and variegated siltstone. In general, though not in detail, the higher sss. are more heavily iron stained and slabby and the lower ones lighter gray and massive. Continental fossils throughout greater part but marine fossils in upper 20 ft. Thickness 150 to 350 ft. Includes (descending) Fall River ss. (the so-called Dakota ss. of previous repts on NE. Wyo. and SE. Mont.), Fuson fm., and Lakota ss. Named for exposures along Inyan Kara Creek, NE. part of Moorcroft quad., Wyo.

Inyo marble.

Lower Cambrian: Eastern California (Inyo Range).

H. G. Hanks, 1886 (Calif. State Min. Bur. 6th Ann. Rept. State Min., pt. 1, p. 25). The *Inyo marble* caps White Mtn. Is a dol. of finest quality, as pure and white as finest Carrara marble. Is found at numerous localities in Inyo Range from White Mtn southward 100 mi. or more.

The rocks that cap White Mtn were mapped by E. Kirk (U. S. G. S. P. P 110, pl. 1, 1918) as Lower Camb.

Inyo series.

Middle and Lower Triassic: Southern California (Inyo Range).

J. P. Smith, 1910 (Jour. Geol., vol. 18, table opp. p. 217). *Inyo series* includes black ls. of Inyo Mtns (*Parapopanoceras* beds), of Middle Triassic age, and gray lss. of Inyo Mtns (*Meekoceras* beds), of Lower Triassic age.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Inyo series* as geographic name for *Lower Triassic series.*

Inyo granite.

J. H. Maxson, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 311), in a brief note entitled "Strat. of Inyo Range," stated that the rocks were invaded on E. side of the range by *Inyo granite* (*late Jurassic*). Not defined, and apparently not intended as a geol. name.

Inyoan series.

Lower Triassic: Southeastern California and Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 59, 79). In SW. Nev. and adjoining parts of Calif. early Triassic sedimentation is important. The *Inyoan series*, as it may be called, of Death Valley region, attains thickness of 1,200 to 1,500 ft. and is characterized by well-defined fauna. The section consists mainly of early Triassic shales, of which five subdivisions are easily differentiated. Composes all early Triassic of Nev., and is divided into five unnamed fms. (descending): 10 ft. of lss., 800 ft. of shales, 15 ft. of lss., 400 ft. of shales, and 100 ft. of cgl. The name *Koipatoan series* is given to Middle Triassic and *Staran series* to late Triassic.

Named for Inyo Co., Calif.

Iola limestone. (In Kansas City group, Kansas.)

Iola limestone member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 109). *Iola ls.*—Thick-bedded ls., 30 to 40 ft. thick, underlain by Chanute shales and separated from overlying Carlyle ls. by 75 ft. of sh.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). The ls. exposed at Carlyle is Plattsburg ls., but the ls. that has been called *Carlyle* is an older bed—the Farley ls. bed in Lane sh. memb., which overlies Iola ls. ("Crusher ledge").

R. C. Moore, 1932 (Nebr. Geol. Surv. Bull. 5, 2d ser., issued before Mar. 1932, p. 17), showed Iola ls. of "current nomenclature" as younger than true Iola ls., and called it *Argentine ls.*, which he showed as lying on Lane sh. "(=upper part of so-called Chanute sh. of current nomenclature)." He divided Iola ls. into (descending) Raytown ls., Muncie Creek sh., and Paola ls. The rest of so-called Chanute sh. of "current nomenclature" he divided into (descending) Chanute sh., Drum ls., Dewey ls., and Quivira sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 92, 97). *Iola ls.* is typically developed at Iola, [Allen Co.], Kans., and is not changed in this revised classification of the rocks of Kans. The upper or main body of ls. is termed *Raytown ls.* An underlying black fissile sh. is termed *Muncie Creek sh.*, and a blue dense bed with "middle" characteristic is designated *Paola ls.* All of these units are recognized in Kansas City section. [Derivation of new names not stated.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 51). So-called Iola ls. of Kansas City area is Frisbie-Argentine ls. members of Wyandotte ls., and pinches out before Iola is reached. On tracing type Iola ls. N. from Iola I found main upper part of it is continuous with Raytown ls. of Hinds and Greene, and this was confirmed in field by R. C. Moore and J. L. Rich. The Iola overlies Chanute sh., underlies Lane sh., and is divided into following 3 members: Raytown ls., Muncie Creek sh., and Paola ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 112–113). *Iola ls.* at Iola (where it is 30 ft. thick and extensively quarried) is chiefly light bluish-gray, irregularly thin-bedded fine-grained ls. containing many thin veinlets of calcite. It rests on Chanute sh. and is overlain by Lane-Bonner Springs sh. At Kansas City and vicinity the ls. ("Crusher ledge") that has long been called Iola is now known to be an entirely different fm. that belongs above Lane sh. and is now known as *Argentine ls.* The main part of true Iola is represented in NE. Kans. and NW. Mo. by Raytown ls., formerly included in Chanute sh. The Iola is now divided into 3 (descending) members—Raytown ls., Muncie Creek sh., and Paola ls. It extends into south-central Iowa and into Platte Valley, Nebr. In southern Kans. it becomes very thin and is locally absent. It is not found along State line either in Kans. or Okla., but is thought to be = Dewey ls. of Okla.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Iola shale.

Pennsylvanian: Eastern Kansas.

E. Haworth, 1894 (Kans. Univ. Quart., vol. 2, p. 124). *Iola sh.*—Sh., 75 ft. thick, underlying Carlyle ls. and overlying Iola ls. in Cherryvale-Lawrence section.

Conflicts with Iola ls. For present interpretation of relations see 1936 entry under †*Carlyle ls.*, and also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Probably named for Iola, Allen Co.

†Iola beds.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Iola beds.*—Include Vilas sh., Allen [Plattsburg] ls., Concreto or Lane sh., Iola ls., and Chanute sh.

Preoccupied and conflicts with adopted classification. Includes upper part of Kansas City group and lower part of Lansing group.

Ion member.

Middle Ordovician (Trenton): Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

G. M. Kay, 1928 (Sci., n. s., vol. 67, p. 16). *Ion memb. of Decorah fm.*—Calc. sh. and argill. lss., the lss. irregularly dolomitized in SE. part of their outcrop in Iowa. The beds become more argill. to N. and more calc. to SE. Thickness 16 ft. Top memb. of Decorah fm. Rests on Guttenberg ls. memb. Type loc. about 1 mi. SW. of hamlet of Ion, Allamakee Co., Iowa. Fossils are of basal Trenton (Rockland) age. [See also Kay, 1929 (Jour. Geol., vol. 37, No. 7, Oct.-Nov., pp. 639–671), who stated this memb. corresponds to Fucoid bed and *Chasmatopora* bed of Minn.]

G. M. Kay, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 295), showed his Ion, Guttenberg, and Spechts Ferry members as present in Minn. and NW. Ill.

Ione formation.

Eocene: Northern California (Gold Belt region).

W. Lindgren, 1894 (U. S. G. S. Sacramento folio, No. 5). During Neocene period the auriferous gravels accumulated on slope of Sierra Nevada, and at same time there was deposited in the gulf then occupying the Great Valley a sed. series consisting of clays and sands to which name *Ione fm.* has been given. The largest development occurs S. of American River. The strata form characteristic flat-topped hills, and consist of a succession of light-colored clays and white or yellowish-white sss. Is usually overlain by a few ft. of reddish Pleist. gravel and rests on Chico fm.

H. W. Turner, 1894 (Am. Geol., vol. 13, pp. 229–249). *Ione fm.* consists of white shales, clay, and sand of Mio. age. Is best developed in Amador and Calaveras Counties, where it is separable into:

1. Ione clay rock or tuff, 100+ ft.
2. Ione ss., 100+ ft.
3. White clay and sand beds containing coal seams, 860+ ft.

Howel Williams, 1929 (Calif. Univ. Pub. Dept. Geol. Sci. Bull., vol. 18, No. 5, pp. 112, 124+). *Ione sands.*—Very siliceous sands with anauxite; usually pure white, but often stained brown, pink, or purple. Thickness 100 to 150 ft. Underlie Butte gravels, with minor discon., occasionally with erosion uncon. Overlie Marysville fm. with minor discon. The term *Ione* is applied to these sands in sense adopted by Dr. V. T. Allen, who has permitted this brief advance statement of his work. Previous to Allen's work the term had been used so widely to include deposits of very different lithology and often of different ages, that it had long since lost all accurate connotation. Allen has redefined the term, restricting it to the quartz-anauxite sands of the Meganos. His work indicates clearly that this peculiar lithological unit is of surprising uniformity throughout wide belt along foothills of Sierra Nevada, and that it probably represents a single persistent horizon. He has shown that Ione sands are probably the age equivalents of the "Bench gravels" of the Sierra, and that they were chiefly derived by the erosion of an intensely weathered granitic series. The fm. is often characterized by strong current bedding.

V. T. Allen, 1929 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 14, pp. 347–419). *Ione fm. restricted* to lower two members of type section, i. e., to the white clay and sand beds containing coal seams and the overlying white or red ss. The upper clay rock or rhyolite tuff formerly included is now considered to probably be Mio., and is here excluded. It is separated from underlying Ione fm. restricted by an extensive erosion period. The lower clays of the Ione were not formed from rhyolitic tuffs, as heretofore supposed. As here restricted the fm. is a lithologic unit serviceable in mapping and valuable in correlation, and it can be traced for more than 200 mi. The work of writer lends support to belief the Ione is contemp. with the white quartz gravels of Sierra Nevada. The Ione is composed of delta deposits formed at mouths of many westward-flowing streams. The presence of marine fossils in upper part shows that it accumulated on shores of an Eocene sea. From 1913 to 1916 R. E. Dickerson made valuable contributions to our knowledge of the Ione by finding Eocene marine fossils in it. He designated the Ione as the *Siphonalia sutterensis* zone, which he considered the uppermost part of Tejon Eocene. He concluded the Ione is the marine or estuarine equiv. of the auriferous gravels of Sierra Nevada. In 1921 B. L. Clark referred Dickerson's uppermost Eocene *Siphonalia sutterensis* zone to the Meganos Middle Eocene. This reference applied especially to the marine Ione, such as Dickerson described from Oroville Table Mtn and Marysville Buttes, but not to type section. Perhaps latter was excluded because of its limited fauna and poor preservation of the forms obtained.

Allen's 1929 restricted definition of Ione fm. is present adopted usage. The "Ione clay rock or tuff" at top of Turner's Ione fm. has been named *Valley Springs fm.* and assigned to Mio.

Named for exposures at Ione, Amador Co., where it overlies Mariposa sl. It has been described as younger than Tejon, as=upper part of Tejon, and as older than Tejon and=Meganos fm.

†Ione clay rock or tuff.

See under *Ione fm.*, H. W. Turner, 1894.

†Ione sandstone.

See under *Ione fm.*, H. W. Turner, 1894.

†Ionia sandstone.

Pennsylvanian: Southern Michigan (Ionia County).

A. Winchell, 1871 (Mich. Geol. Surv. Rept. Prog., btw. pp. 26 and 33). *Ionia ss.* is=Woodville ss. Borings have demonstrated correctness of this opinion of mine published 10 years ago.

For further information see *Woodville ss.*

Ionia moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Ionia, Ionia Co.

†Iota subdivision.

A Greek name applied by F. W. Cragin (U. S. G. S. Bull. 266, 1905) to middle 50 ft. of Malone fm. of Malone Mtn, El Paso Co., Tex.

Iowa marble.

Mississippian: Central northern Iowa.

C. A. White, 1870 (Iowa Geol. Surv. vol. 2, pp. 312–313). Some of upper layers of Kinderbook div. in Le Grand quarries, Marshall Co., furnish a beautifully banded stone which has become known as *"Iowa marble."*

Iowa terrane.

A term applied by C. [R.] Keyes to Iowan drift (Pleist.). He also uses *Iowa stage* (instead of *Iowan stage*).

Iowa series.

Mississippian: Mississippi Valley region.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 282+, and No. 5, pp. 408–416). *Lower Mississippian or Iowa series*, as it may be called for want of any comprehensive name already in use. Extends from top of Ste. Genevieve ls. (exclusive of Shetlerville fm., which belongs in Chester series) to base of Kinderhook group.

Probably named for Iowa.

Iowa City marble.

Trade name. Same as Iowa marble of the trade.

Iowa Falls dolomite.

Mississippian: Central northern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 52, 92, 97). *Iowa Falls dol.*—Heavily bedded (except at very top, where layers are comparatively thin), yellowish to brownish, slightly vesicular beds of dol. Thickness 20 to 50 ft. Few fossils. Overlies Eagle City beds and underlies, with evidence of discon., Alden ls. Included in Kinderhook group. Named for exposures in gorge of Iowa River at Iowa Falls, Hardin Co.

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 388, 406, 412–419). *Iowa Falls memb. of Hampton fm.* is here used exactly as defined by Van Tuyl. Thickness 77 ft. Very local, exposures being practically confined to a few mi. of Iowa River Valley in Hardin Co.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 243, 245). Eagle City ls. and Iowa Falls dol. are with little question Burlington. They contain Burlington fossils, as identified by both Van Tuyl and Laudon, mingled, it is true, with forms of Kinderhook aspect.

Iowan stage of glaciation, also **Iowan drift** (Pleistocene).

Iowan drift is name applied to third drift of Keewatin part of Laurentide ice sheet; *Iowan stage* being the name applied to time during which this drift was deposited. This drift was named for its exposures in eastern Iowa. The name "*East Iowan*" was originally applied by **T. C.** Chamberlin (Geikie's Great ice age, 3d ed., 1894, pp. 724–775) to the *second* drift sheet, the name *Kansan* being then applied to the *oldest* drift. In 1895 (Jour. Geol., vol. 3, pp. 270-277) Chamberlin, at suggestion of Upham, shortened the name of *second* drift sheet to *Iowan*. In 1896 (Jour. Geol., vol. 4, pp. 872–876), as result of further studies, he shifted the name *Kansan* to the *second* drift (which is the drift that covers NE. Kansas), and shifted the name *Iowan* to a younger drift (supposed to be the *fourth* drift), the name *Illinois* (from unpublished rept of F. Leverett) being applied to the *third* drift. The *Iowan* drift has generally been regarded as later than Illinoian drift (the name applied to third drift of Labrador part of Laurentide ice sheet), but Leverett later expressed opinion that the Iowan drift, also the loess to which the names *Iowan* and *Peorian* have been applied, may be of same age as Illinoian drift.

G. F. Kay and M. M. Leighton now include Peorian loess and Iowan glacial stage in the Wisconsin stage. (See under *Wisconsin stage.*)

†Iowan loess (Pleistocene).

Name formerly applied to the loess deposit in Iowa and Ill., "mainly interglacial, succeeding the development of the Sangamon soil and weathered zone on the Illinoian till, and also succeeding the development of the pebbly concentrate on the Iowan drift." (See under *Peorian loess.*)

G. F. Kay and M. M. Leighton, 1933 (Geol. Soc. Am. Bull., vol. 44, pp. 669–673, August 31), include in Wisconsin stage the Iowan drift and Peorian loess, and recognize *Iowan loess* as a part of Peorian loess. (See under *Wisconsin stage.*)

Iowa Point shale. (In Calhoun shale.)

Pennsylvanian: Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 51, 102). *Iowa Point sh.*, top bed of Calhoun sh., consists of (at type section in Missouri River bluff just E. of Iowa Point, Kans.), (descending): (1) Bluish argill. bedded to massive sh., with carbonaceous flakes and plant leaves; (2) blue to brownish sh. with some sand, becoming a loose ss. at places; (3) bluish to brownish bedded argill. sh. Thickness 10± ft. at Iowa Point, Kans., Forest City, Mo., and SE. Nebr. Underlies Curzen ls. (basal bed of Topeka ls.) and overlies Meadow ls.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 47), stated that true Meadow ls. belongs down in Stanton ls., and he applied *Sheldon ls.* to the ls. underlying Iowa Point sh. and overlying Jones Point sh.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), restricted *Calhoun sh.* to beds above Sheldon ls., below Topeka ls., and included Jones Point sh. and Sheldon ls. in Deer Creek ls. (redefined). Calhoun sh. restricted thus occupies interval of beds previously named *Iowa Point sh.* In 1933 (Nebr. Geol. Surv. Paper No. 2, p. 5) Condra stated Iowa Point sh. was discarded for Calhoun restricted.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11). *Calhoun sh. fm.* divided into (descending) Iowa Point sh., Sheldon ls., and Jones Point sh.; and R. C. Moore followed this classification in his 1936 rept. (Kans. Geol. Surv. Bull. 22).

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. For Condra's latest interpretation of strat. position of this sh. see 1937 entry under *Topeka ls.*

Ipava shale and sandstone. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Ipava sh. and ss.* to the clay, sh., and sss. composing that part of Carbondale fm. beneath Springfield (No. 5) coal and above Vergennes ss. in Fulton Co. Derivation of name not stated, but probably is the town in Fulton Co.

Ipperwash limestone.

Devonian: Ontario.

C. R. Stauffer, 1915 (Canada Geol. Surv. Mem. 34, p. 11).

Ipperwash limestone member.

Devonian: Ontario.

W. Malcolm, 1915 (Canada Geol. Surv. Mem. 81, p. 42). Ipperwash ls. memb. of Hamilton fm.

Ira slate.

Lower Ordovician (Beekmantown): Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 398). *Ira sl.*—Dark-gray or black sl. with very little banding or means of determining bedding, but a few ft. of sl. in lower part contains gray siliceous seams. Secondary quartz is developed in these beds and they are tightly squeezed and dissected by folding so that locally the fm. resembles finely banded gneiss. Sedimentary contact btw. the sl. and underlying Williston ls. is sharp. Upper contact with West Rutland marble is equally sharp, with complete change from muddy sediments to pure ls., and it appears to be uncon. with the West Rutland. The sl. disappears at N. end of Taconic Range, but to S. it expands into a belt 1 or 2 mi. wide. Thickness probably 700 or 800 ft. Is well developed in town of Ira, which adjoins West Rutland on S., Castleton quad.

Irasburg conglomerate.

Lower Ordovician: Northeastern Vermont (Orleans and Washington Counties) and Quebec.

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 82). *Irasburg cgl.*—As it contains beds of siliceous ls. lithologically identical with Waits River ls. it should both mark the basal memb. of Lower Trenton series and the great erosional uncon. on W. Its strat. position is capable of 2 interpretations: (1) That it is basal memb. of Waits River ls. formed upon the rapidly subsiding sea floor when the sea transgressed upon pre-Camb. schists; (2) that it is basal memb. of a younger series of rocks lying in narrow belt btw. Montpelier sl. on E. and pre-Camb. schists on W. Named for Irasburg, Orleans Co., where it is best represented.

C. H. Richardson, 1912 (8th Rept. Vt. State Geol., p. 171). *Irasburg cgl.* assigned to Ord. All its boulders are pre-Ord. Underlies Waits River ls.

C. H. Richardson and E. F. Conway, 1912 (8th Rept. Vt. State Geol., p. 151). *Irasburg cgl.*—Lowest memb. of Ord. in east Vt. Is a ls. cgl. discovered and named in 1904. Pebbles are all pre-Ord. in a ls. matrix. Rests uncon. on pre-Ord (Camb. ?) schists.

C. H. Richardson et al., 1914 (9th Rept. Vt. State Geol., p. 309). In *Irasburg cgl.* at type loc. are boulders 1 to 3 ft. diam.

C. H. Richardson, 1916 (10th Rept. Vt. State Geol., p. 125). *Irasburg cgl.* is true basal cgl. Is uncon. on Camb. schists. Has been traversed approx. 100 mi., northward into Canada and southward through Irasburg and into Northfield. In entire distance the pebbles are of Camb. materials and the matrix Ord.

C. H. Richardson, 1919 (11th Rept. Vt. State Geol., pp. 46, 106, 128). *Irasburg cgl.* as it exists in Irasburg is wanting in Roxbury, Vt., but its geological equiv. as discovered in Northfield last summer extends into Roxbury. If Northfield were not preoccupied I would call this basal cgl. in Northfield the *Northfield cgl.*

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 107–110). When discovered the *Irasburg cgl.* was supposed to be a more or less local phase of Waits River ls., but it is not. It carries a few plates of muscovite and biotite which are characteristic of Waits River ls. series. It has been followed into Canada for 200 mi. and S. through Vt. for 100+ mi. Discovery site is in bed of Lords Creek just outside S. limit of village of Irasburg. The area exposed in Irasburg Twp is 4 mi. long and ½ mi. wide. This cgl. or its time equiv. can be divided into 5 more or less distinct phases: *Irasburg phase, Albany phase, Northfield phase, Coventry phase, Magog, Quebec, phase.* The *Irasburg phase* is characterized by boulders more than 2 ft. diam., by porphyritic andesites, and by granite boulders. Fossils prove the cgl. began as early as Beekmantown. [For descriptions of the other "phases" see under each name.]

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., p. 346). The *Irasburg, Albany,* and *Northfield cgls.* form base of Ord. in eastern Vt.

Irasburg granite.

Devonian: Northeastern Vermont (Orleans County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Probably named for Irasburg Twp or Irasburg village, in Orleans Co.

Ireland sandstone.

Pennsylvanian: Central Kansas (Woodson County).

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 96, 113). [See under *Douglas fm.,* Moore, 1932.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 157, etc.). *Ireland ss. memb. of Lawrence sh.*—Massive or irregularly cross-bedded buff or brownish ss., some tens of ft. thick, prominent in Lawrence sh. at some places. Occurs partly in form of large sheets of varying horizontal extent and thickness, and partly as channel fillings associated locally with deposits of ls. cgl. up to 8 or 9 ft. thick in bottom of channel depressions. In Douglas and Leavenworth Counties the channel ss. is in contact with lower part of Lawrence sh., Haskell ls., Stranger fm., and probably in places with Iatan ls. and Weston sh. In type region top of Ireland ss. is only few ft. below top of Lawrence sh. Type loc., on Ireland Creek and farm of W. E. Ireland, 5 mi. SW. of Yates Center, Woodson Co.

Irene conglomerate.

Pre-Cambrian(?): Southeastern British Columbia and northwestern Idaho.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 6 and 7, 116°30′ to 117°30′). *Irene cgl.*—Massive, greatly sheared; thin ls. lenses.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 141, 178, 194). *Irene cgl. fm.*—Coarse cgl. with some lenses of metamorphosed sss. and pelites a few inches to several ft. thick, metamorphosed to phyllitic schists. Thickness 5,000+ ft. Grades into overlying Irene volcanics. Basal fm. of Summit series. Assigned to Belt series. Rests uncon. on pre-Camb. Priest River terrane. Outcrops on summit and slopes of Irene Mtn, B. C.

C. W. Drysdale, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 61). assigned this fm. to Camb.

Irene volcanic formation.

Pre-Cambrian(?): Southeastern British Columbia and northwestern Idaho.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 6 and 7, 116°30′ to 117°30′). *Irene volcanic fm.*—Thick flows of pyroxene andesites, with some pyroclastics and a massive interbed of mag. ls.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 144, 178, 194). *Irene volcanic fm.*—Effusive greenstone, with few subordinate layers of basic tuff, a thick band of cgl. breccia, and a strong bed of dol. intercalated. Thickness 6,000 ft. Outcrops along W. slope of Irene Mtn, B. C. [just E. of 117th mer. and just N. of 49th par.]. Conformably underlies Monk fm. and grades into underlying Irene cgl. All included in Summit series, Beltian.

Irish sand.

A subsurface sand in eastern Okla., which is said to correlate with Tyner fm. (Ord.), also with the subsurface Wilcox sand. Named for the green shales with which it is associated. Also called "Green series."

Irondale limestone. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia, western Maryland, and southern Pennsylvania.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 95). *Irondale ls. and ore.*—Buffish-gray ls. with iron immediately beneath. Thickness 0 to 2 ft. Lies 155 ft. above Upper Freeport coal and directly beneath Masontown [?] coal. Occurs at Irondale, Preston Co., W. Va., and adjoining regions. [See also I. C. White, 1903 (W. Va. Geol. Surv. vol. 2).]

According to C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 58, pl. 6), the *Irondale ls.* at Wheeling, W. Va., underlies fire clay beneath Brush Creek coal and overlies Mahoning red bed. In places rests on Corinth ss.

Irondequoit limestone member (of Clinton formation).

Silurian: Central and western New York and Ontario.

J. M. Clarke, 1906 (N. Y. State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12). The Clinton group of deposits in Rochester and Ontario Beach quads (field work by C. A. Hartnagel), is now divided, in accordance with Mr. Hartnagel's determinations, into following units (descending): *Irondequoit ls.*, Williamson sh., Wolcott ls., Furnaceville iron ore, and Sodus sh. Will be described by Hartnagel in forthcoming rept.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114, pp. 5–35). *Irondequoit ls.*—Layers of ls. separated by bands of sh., the sh. bands in lower part green and in upper part gray. Top memb. of Clinton fm. in Rochester and Ontario Beach quads. [Rochester sh. is now considered top memb. of Clinton fm.] Rests on Williamson sh. and underlies Rochester sh. Named for town just N. of Rochester. [A. W. Grabau (Jour. Geol., vol. 17, 1909) gave 17 ft. as thickness of Irondequoit ls. In Niagara quad. it is 10 to 15 ft. thick.]

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). Fauna of *Irondequoit ls.* is very nearly that of Rochester sh., to which it should, therefore, be transferred. [Chadwick classified it as basal memb. of Rochester sh., which he treated as a distinct fm. overlying the Clinton. All other writers, however, continue to treat it as distinct from Rochester sh.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 49). East from Wayne Co. the *Irondequoit ls.*, while still recognizable, has increased so much in shaly content as to be no longer recognized as a ls. It has been traced to Niagara River, where it directly overlies Wolcott ls. Excluded from Rochester sh.

C. Schuchert, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 314), identified 4 ft. 5 in. of *Irondequoit ls.* at Hamilton, also at other places in Ont., resting on 8 ft. 8 in. of Wolcott ls.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347, etc.), placed *Irondequoit ls.* below Rochester sh. and above Williamson sh., which is position assigned to it by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10).

†Iron Mountain series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvii, 274). *Iron Mtn series.*—Metamorphosed rocks; in descending order, chloritic slates and shales, carbonaceous schists, ferruginous rocks, and qtzites. Middle div. of Fernandan system. Underlies Click series and overlies Valley Spring series.

Same as Valley Spring gneiss.

Named for Iron Mtn, NW. of Valley Spring, Llano Co.

Iron Mountain conglomerate.

Upper Cambrian: Southeastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 354). *Iron Mtn cgl.*—Cgl. underlying La Motte ss. and forming basal part of Ozark series in SE. Mo. Possibly of Camb. age.

A. Winslow, 1896 (U. S. G. S. Bull. 132). *Iron Mtn cgl.*, 0 to 100 ft. thick, underlies La Motte ss. and overlies Archean granites and porphyries.

C. R. Keyes, 1901 (Am. Geol., vol. 28, pp. 51–53). [See 1901 entry under *Lamotte ss.*]

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 267). [See 1905 entry under *Lamotte ss.*]

Subsequent Mo. repts treat Lamotte ss. as basal Camb. fm. in Mo., and mention a cgl. at base, but apparently some authors still consider Pilot Knob cgl. to be older than Lamotte and of pre-Camb. age.

Named for Iron Mtn, St. Francois Co.

Iron Mountain porphyry.

Pre-Cambrian: Southeastern Missouri.

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4, p. 30), and 1895 (Mo. Geol. Surv. Sheet Rept. No. 4, vol. 9). *Iron Mountain porphyry.*—Quartz porphyry, 300 ft. thick, in bold rugged hills near E. limit of Ozark region, the best known of which are Pilot Knob and Iron Mtn. Assigned to Archean. Older than Pilot Knob cgl. and younger than Knob Lick granite.

On 1922 geol. map of Mo. this porphyry is assigned to Laurentian (?).

J. Bridge (personal communication) states this fm. is now considered to be pre-Camb., and it is so classified by U. S. Geol. Survey.

Named for Iron Mtn, St. Francois Co.

Iron Mountain intrusive.

Cretaceous (?): Western Texas.

C. Schuchert, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 400), under heading "Iron Mtn intrusive," stated that the rocks (syenite porphyry) form a conspicuous intrusive stock N. of Marathon known as Iron Mtn.

Iron Ridge ore bed.

Silurian: Southeastern Wisconsin.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 561). With possible exception of the Mayville, which may be late Clinton, and the *Iron Ridge ore bed*, which is probably of Brassfield age, the Clinton group is not represented in Wis. [The Brassfield is now regarded as pre-Clinton.]

Iron River iron-formation member (of Michigamme slate).

Pre-Cambrian (upper Huronian): Northeastern Wisconsin and northern peninsula of Michigan.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Iron River iron-fm. memb.*—The iron-fm. separating upper slates of Michigamme sl. from the lower slates of that fm. in Iron River (Mich.), Crystal Falls (Mich.), and Florence (Wis.) districts.

Ironshore limestone.

Recent or Pleistocene: Cayman Islands, British West Indies.

C. A. Matley, 1924 (Pan-Am. Geol., vol. 42, pp. 313–315). *Ironshore ls.*—Consolidated coral sand, marl, and ls., representing latest accretion to the area of Cayman Islands, and forming a low rocky shore, known locally as "ironshore." Rises inland to a height of 12 to 15 ft. above the sea, where it is generally backed by raised marine cliffs of the older Bluff ls. Is of Recent, or possibly of Pleist., age.

Ironside beds.

Pliocene: Northeastern Oregon (north part of Malheur County).

J. C. Merriam, 1916 (Univ. Calif. Pub. Dept. Geol. Bull., vol. 10, No. 9, pp. 129, etc.), described a *late Tert. fm.* that contained fossil mammals near Ironside, and consisted of buff sandy shales and shales with but little sand, standing at varying angles up to 20° at least. "Good reason for believing that the sediments at Ironside are not younger than middle Plio. and not older than late Mio." Merriam seems to have studiously avoided naming the beds or using the term *Ironside beds.*

J. C. Merriam, 1919 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 11, No. 5, p. 437e), mapped *Ironside Pliocene.*

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, p. 99). Sed. beds at Ironside (J. C. Merriam, Calif. Univ. Dept. Geol., Bull. 10, p. 129) have recently been designated *Ironside fm.* They consist of buff-colored sandy shales and shales, possibly 200 ft. thick, now deformed, which yielded a small vertebrate fauna that Merriam considers to be younger than Rattlesnake Plio. [Called *Ironside beds* in table in this Bull.]

Ironside dolomite member (of Sultan limestone).

Devonian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 14, etc.). *Ironside dol. memb.*—Dark gray to black dol., in beds 2 to 5 ft. thick. Basal memb. of Sultan ls. Thickness 5 to 125 ft. Underlies Valentine ls. memb. of Sultan ls. and overlies Goodsprings dol. Exposed near Ironside mine, 1 mi. N. of Boss mine, on W. side of Spring Mtns Range. E. Kirk says fossils are late Middle Dev. or early Upper Dev.

Ironstone quartz diorite.

Devonian (?): Central and southern Massachusetts and northeastern Connecticut.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 168–170 and map). *Ironstone quartz diorite* is the rock that forms the dark hornblendic border zone of the Milford granite. Is a dull-black, massive rock, of fine to medium grain. Named for exposures in long railroad cut at Ironstone, in town of Blackstone, Mass.

Ironton slate.

Pre-Cambrian: Southeastern Missouri (Iron County).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 252). *Ironton terrane.*—Slates, 200 ft. thick, overlying Pilot Knob cgl. and uncon. underlying La Motte ss. Assigned to Animikian.

Probably named for Ironton, Iron Co.

Ironton sandstone member (of Franconia sandstone).

Upper Cambrian: Southwestern Wisconsin.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 550). *Ironton memb.*—A few ft. of hard calc. coarse-grained ss. forming basal memb. of Franconia fm. in SW. Wis.

E. O. Ulrich, 1924 (Trans. Wis. Acad. Sci., Arts, and Lett., vol. 21, pp. 83, 93–94). *Ironton ss. memb.*—Basal ss. of Franconia fm. in SW. Wis. Has been recognized and studied at many places in Sauk, Richland, Vernon, La Crosse, Monroe, Jackson, Adams, and Juneau Counties, where it varies in thickness from about 2 ft. to 12 or possibly 15 ft. At Ironton [Sauk Co.], the type loc., it varies from 5 to 10 ft. Top is even. The memb. is composed mainly of reworked washed and relatively coarse residual grains of Dresbach ss., the surface of which had previously been subjected to subaerial leaching and wear. It extends downward to lowest plane indicating reworking and redeposition of the weather-loosened top sands of underlying Dresbach fm. It commonly includes a few grains of glauconite and other material that is not present in undisturbed underlying beds of Dresbach ss. But to make sure of identification of Ironton memb. it is advisable to search for its characteristic fossils. In Dresbach proper no organic remains—except perhaps worm burrows—have so far been observed.

Additional details are given by W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites in Geol. Soc. Am. Bull., vol. 46, No. 11, 1935, pp. 1698–1699, etc.

Ironwood iron-formation.

Pre-Cambrian (middle Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic).

C. R. Van Hise, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, p. 338). *Ironwood fm.*—Cherty iron-bearing carbonates, ferruginous slates and cherts, jaspilites, ore bodies, and actinolite-magnetite schists. Thickness 850 ft. Underlies Tyler sl. and overlies Palms fm. City of Ironwood, Mich., is partly located on the fm.

Later repts give thickness 850 to 1,500 ft.

C. R. Van Hise and C. K. Leith in 1909 (U. S. G. S. Bull. 360) and 1911 (U. S. G. S. Mon. 52) assigned this fm. to upper Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184) changed name to *Ironwood iron-fm.*, and assigned the fm. to middle Huronian.

†Iroquois moraine.

Pleistocene (Wisconsin stage): Northwestern Indiana (Newton and Jasper Counties).

F. Leverett, 1899 (U. S. G. S. Mon. 38). A ridged belt and bowldery strip N. of Iroquois River, in Newton and Jasper Counties, Ind.

F. Leverett, 1915 (U. S. G. S. Mon. 53, p. 126). Further work has shown that Iroquois moraine is simply a continuation of Marseilles morainic system, produced entirely by Illinois lobe, and "Iroquois moraine" has been discarded.

Iroquois.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region.

Iroquois stage.

Pleistocene.

W. Upham, 1895 (Am. Geol., vol. 16, p. 106). Included in Champlain epoch.

Iroquois clay.

Pleistocene: Ontario.

A. P. Coleman, 1909 (Ontario Bur. Mines Ann. Rept., vol. 18, pt. 1, p. 297).

Irvine formation.

Pliocene (?): Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 3). *Irvine fm.*—Unconsolidated sand, gravel, and clay capping the river hills in Richmond quad. Rests uncon. on Carbf. Assigned to Neocene.

A. M. Miller, 1925 (Ky. Geol. Surv., 6th ser., vol. 21, p. 141). Fossils of *Irvine fm.* seem to indicate late Pliocene or early Pleist. age.

Named for Irvine, Estill Co.

Irvine sand.

A subsurface sand, of Dev. age, in eastern Ky.

Irvineton parvafacies.

Upper Devonian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 28). The parvafacies of the Chagrin magnafacies within the Venango stage is termed *Irvineton parvafacies*, from village of that name on Allegheny River 4 mi. W. of Warren, Pa. [On p. 35 he speaks of the *Conewango parvafacies* of the *Irvineton magnafacies*.]

Irving greenstone.

Pre-Cambrian: Southwestern Colorado.

E. Howe, 1904 (Jour. Geol., vol. 12, pp. 501–509). *Irving fm.*—Greenstone complex, including schists and massive basic rocks sometimes possessing a porphyritic structure, others partly mashed or brecciated, and a few distinctly granular, while no well-defined system of bedding or stratification could be made out. All rocks are of dull-greenish color and appear to have undergone extensive alteration. At two places massive qtzite was found, and at a number of localities extremely siliceous schists. Rarely light-gray gneiss and mashed qtzite occur. Overlain by

Algonkian cgls. and qtzites, from which they are separated by an erosion interval of unknown extent, the overlying Algonkian cgl. containing quantities of pebbles of Irving greenstone. At first the Irving was assumed to be a part of the great Archean complex of schists and gneisses known to occur near by in Animas Canyon, but it is now regarded as early Algonkian.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Irving greenstone.*—A complicated series of greenstone, greenstone porphyry, and greenstone schist, with subordinate quartz-mica schist and granite gneiss, and a few bands of qtzite, often mashed and schistose. Prominently exposed in SE. part of quad. and composes Irving Peak. Distinguished from underlying Archean schists by distinctive character of certain of its more massive members and by presence of sed. rocks. Actual base nowhere seen. Thickness exposed appears to be at least 10,000 ft. Overlain uncon. by Vallecito cgl. Considered to be most probably of Algonkian age.

On 1935 geol. map of Colo. this fm. was assigned to Gunnison River series, which comprises the oldest exposed pre-Camb. rocks in Colo. The terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey, the Irving greenstone is now classified as pre-Camb.

Isabel sandstone.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to an undescribed ss., 7 to 50 ft. thick, near top of Pottsville fm. (Penn.) of central western Ill. Shown on p. 192 as uncon. overlain by a thin bed of sh. underlying coal No. 2, and as in places cutting out all beds down to near top of his Bernadotte ss. Derivation of name not stated.

Isabella stage.

Quaternary: Puerto Rico.

B. Hubbard, 1923 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 95).

Isabella granodiorite.

Late Jurassic (?): Southern California (Kernville quadrangle).

W. J. Miller, 1931 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 20, No. 9, pp. 343–352). *Isabella granodiorite.*—A large, generally massive, rather variable intrusive body consisting mainly of granodiorite. Typical occurrence in vicinity of Isabella. Grades into granite, also through quartz diorite into diorite. Is distinctly younger than the gabbro diorite that cuts Kernville series. May be late Jurassic. It more or less intricately cuts Kernville series and the intrusive gabbro diorite.

Isanti moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Isanti County).

F. Leverett, 1932 (U. S. G. S. P. P. 161, p. 80). Third moraine of Rush Lake morainic system. Named for occurrence at old Isanti village, 1½ mi. N. of present town of Isanti, Isanti Co.

†Ischua sandstone.

Upper Devonian: Western New York.

E. N. Horsford, 1840 (N. Y. Geol. Surv. 4th Ann. Rept., pp. 466, 469–470). The *Ischua sss.* are developed in Allegany Co. at a few localities. The Ischua stone quarries, lying almost wholly in town of Machias, contain stone with which there are none other in the country to be compared.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 152–153). Horsford early appropriated the name *Ischua ss.* to Cuba ss. lentil of Chemung fm.

Ishawooa intrusives.

Miocene: Yellowstone National Park, Wyoming.

A. Hague et al., 1904 (U. S. G. S. Mon. 32, Atlas; Canyon, Lake Crandall, and Ishawooa sheets). *Ishawooa intrusives.*—Massive andesite, diorite, and granite porphyry bodies penetrating the late basic breccia in Ishawooa quad. Also occurs as dike rocks, varying from diorite to granite porphyry, breaking through the late basic breccia in Canyon, Lake, and Crandall quads., Yellowstone Park.

Named for development on W. side of Ishawooa Mesa, Yellowstone National Park, Wyo.

†Ishpeming formation.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Upper Peninsula).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 590). *Ishpeming fm.*—Cgl., qtzite, grünerite-magnetite schist, and associated rocks. Underlies Michigamme fm. and uncon. overlies Negaunee fm. Includes Bijiki schist and Goodrich qtzite. Surrounds and underlies Ishpeming.

Unnecessary name, the Bijiki and Goodrich both being recognized in the dist.

Isidro formation.

Tertiary: Mexico (Lower California).

A. Heim, 1922 (Geol. Mag., vol. 59, p. 539).

†Island series.

Upper Cretaceous: Southeastern New York (Staten Island) and southeastern Massachusetts (Marthas Vineyard).

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., pp. 335–336). *Island series.*—Ferruginous concretionary beds extending from Staten Island to Marthas Vineyard, and considered to be very latest phase of Potomac fm.

A. Hollick, 1906 (U. S. G. S. Mon. 50). The Raritan and Cliffwood [Magothy] fms. are="Island series" of Ward.

Island Creek shale.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Island Creek sh.*, new name; underlies Farley ls. and overlies Argentine ls.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Wyandotte ls.* Derivation of name not stated. On p. 46 *Island Creek sh.* is described as consisting of 1 to 14 ft. of gray argill. sh.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 60). *Island Creek sh. memb. of Wyandotte ls.*—Gray argill. or limy sh., 0 to 15 ft. thick. Overlies Argentine ls. memb. and underlies Farley ls. memb. Named for Island Creek, in N. part of Wyandotte Co., Kans. Type exposures W. and S. of Wolcott.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Island Hill formation.

Lower Devonian: Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Island Hill fm.* consists of a few layers of more or less cherty and siliceous fossiliferous ls. with a thin basal ls. cgl. Thickness 3 ft. Assigned to Oriskanian series. Uncon. underlies Whetstone Branch sh. and overlies New Scotland ls. Named for isolated hill on Yellow Creek about 3 mi. above its mouth. The fm. is largely confined to its type loc.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details of this fm. Thickness 3 ft.

Island Lake series.

Pre-Cambrian: Manitoba.

J. F. Wright, 1928 (Canada Geol. Surv. Summ. Rept. 1927, pt. B, pp. 63, 71).

Island Mesa beds.

Upper Devonian: Northern central Arizona.

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 500). Twelve mi. NE. of Jerome, on Verde River, and SW. of Island Mesa, the increase of aren. matter in upper part of Dev. is appreciable. The little shells of *Camarotoechia eximia* and

O. saxatilis found in ls. at Jerome invariably occur in ss., here. Even more striking is faunal aspect of uppermost layers. The usual complex of Upper Dev. fauna of Jerome fm. is at hand, but within 125 ft. from base of overlying Redwall ls. (Miss.) there are 40 ft. of grayish-lavender thin-bedded shaly ls. and sh. overlain by 8 ft. of massive aren. purplish-gray ls. containing rich Dev. fauna. Above these beds are purplish aren. sh. (11 ft. thick) and ledge-forming aren. ls. and ss. of same color (64 ft. thick). This terminal part of Dev. of north-central Ariz., underlying the Redwall in the abrupt cliff of the plateau and attaining thickness of 122 ft., is not represented at Jerome. It is characterized by peculiar assemblage of Mollusca and is here designated *Island Mesa beds*.

Island Mine conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).

A. C. Lane, 1898 (Mich. Geol. Surv. vol. 6, pt. 1, pp. 99, 204, 206, 217, and pl. I). Belongs to Marvine's group C [=Eagle River group].

Named for occurrence in Island mine, Isle Royale.

Island Run sand.

A subsurface sand in Conemaugh fm. (Penn.) of W. Va., that lies at or near horizon of Morgantown ss. memb.

Isle La Motte marble.

Ordovician (Lower and Middle): Northeastern New York and northwestern Vermont (northern part of Lake Champlain).

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. of 2d dist., p. 386). *Isle La Motte marble.*—Black ls. remarkably thick-bedded. Character connects it rather with Birdseye than with Trenton ls. Is 8 ft. thick at Watertown and 12 ft. thick at Isle La Motte. Is called *Seven-foot tier*. Underlies Trenton ls. and overlies Birdseye [Lowville] ls. [As thus defined applies to post-Lowville part of Black River group. Isle Lamotte is an island of 4,670 acres in Lake Champlain about opposite village of Chazy, N. Y., in Rouses Point quad., Grand Isle Co., Vt.]

W. W. Mather, 1843 (Geol. N. Y., div. 4, geol., pt. 1, p. 367). Black marble of Isle la Motte belongs to Black River ls.

E. Emmons, 1846 (N. Y. Nat. Hist. Agric., vol. 1, btw. pp. 113 and 206). *Isle Lamotte marble* consists of 7 to 30 ft. of black finely granular marble, underlying Trenton ls. and overlying Birdseye ls.

C. B. Adams, 1846 (2d Rept. Geol. Vt., p. 164). *Isle la Motte ls.* includes the several members known as Chazy and Birdseye ls., etc., since they are most fully exhibited on Isle La Motte.

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1). Black River ls. or *Isle La Motte marble* consists of 20 ft. of black marble, underlying Trenton ls. and overlying Birdseye ls. The Isle La Motte ls. of 2d Ann. Rept. Vt. Geol., p. 164, included Black River, Birdseye, and Chazy lss.

H. Ries, 1899 (N. Y. State Geol. 17th Ann. Rept., pp. 357–370). In Champlain Valley the Black River ls. is locally known as *Isle Lamotte marble*. Overlies Birdseye ls.

G. H. Perkins, 1904 (4th Rept. Vt. State Geol., map opp. p. 113, pp. 121–143). Isle La Motte shows following exposed fms.: Glacial clay; Utica sh.; Trenton ls.; Black River ls.; Chazy (643 ft. thick and=major part of "Isle La Motte ls." of early Vt. geologists); and Beekmantown ls. The early Vt. geologists were so impressed by the mass of Chazy on the island that they called it "Isle La Motte ls." The name *Chazy ls.* was given to major part of Adams' Isle La Motte ls. by Hall and Emmons after the fine exposure of this rock at Chazy Village, N. Y. The only area of Black River ls. on the island was included by Adams in his Isle La Motte ls.

G. H. Perkins, 1916 (10th Rept. Vt. State Geol., pp. 200–212). Probably best exposure of Chazy in all its divisions is on Isle La Motte, for nowhere else in Champlain Valley are these so well displayed. [Map shows that Isle La Motte comprises glacial clay, Utica, Trenton, Black River, Chazy, and Beekmantown.]

Isle La Motte sandstone.

Lower Ordovician: Northwestern Vermont (northern part of Lake Champlain).

H. M. Seely, 1906 (5th Rept. Vt. State Geol., pp. 174–187). *Isle La Motte ss.* is usually the base of Chazy fm. in Champlain Valley, Vt. Named for Isle La Motte. Is 25 ft. thick at the Head, on Isle La Motte.

H. M. Seely, 1910 (7th Rept. Vt. State Geol., pp. 257–313), stated his *Isle La Motte ss.* is ferruginous ss., so named for large development on island.

Isle Royale amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, p. 195). *Isle Royale cupriferous amygdaloid* occurs 510 ft. above cgl. No. 8 in Portage Lake section.

Belongs to Central Mine group. The mineralized part is Isle Royale lode. Named for occurrence in Isle Royale mine, Houghton Co.

Isle Royale flow.

Includes Isle Royale amygdaloid and underlying trap.

Isle Royale trap.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is the trap bed underlying the Isle Royale amygdaloid, and forms basal part of Isle Royale flow.

Islesboro formation.

Cambrian (?): Central southern Maine.

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, pp. 2–3). *Islesboro fm.*—A series of somewhat metamorphosed rocks, mainly of sed. origin, which occupy larger part of Islesboro and neighboring smaller islands. Lower memb. consists of slates, schists, calc. shales, impure qtzites, and small amounts of pyroclastics, but sl. is by far most abundant rock. Lower memb. is at least 300 to 400 ft. thick and probably considerably more. Upper memb. is Coombs ls., 7 to 100 ft. thick. The fm. underlies Battie qtzite. Assigned to Camb. (?). Named for development on Islesboro, Waldo Co.

On 1933 geol. map of Maine, by A. Keith, these rocks are included in Ord. and Camb. block.

†Itasca moraine.

Pleistocene (Wisconsin stage): Northern Minnesota.

Mapped by W. Upham, 1894 (Minn. Geol. and Nat. Hist. Surv. 22d Ann. Rept., pl. 1, p. 49). Extends eastward from Lake Itasca.

This name is no longer used, because detailed mapping by F. Leverett has shown that the morainal belt in region described follows a different course from that indicated by Upham.

Itascan till.

A term introduced by C. [R.] Keyes for a till sheet (of Keewatin lobe) that he considers to be pre-Kansan and younger than his Moingonan till sheet. (See Pan-Am. Geol., vol. 47, No. 5, 1927, p. 352.)

Ithaca shale member (of Portage formation).

Upper Devonian: New York.

James Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 318–325). *Ithaca group.*—Alternating slaty and compact sh. and argill. ss., but differs from underlying strata by fossils and in some particulars in lithologic character. Sometimes contains thin layers of impure ls. Underlies Chemung group and overlies more than 200 ft. of [unnamed] argill. sss. and shales which rest on Upper Black sh. [Genesee sh.] overlying the Tully ls. Named for occurrence at Ithaca.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 381). A series of thin ss. flags with fucoides resembling those below the Ithaca separates Chemung group from Ithaca group.

According to Vanuxem's 1942 rept the Chemung "group" overlies Ithaca "group" and the Ithaca overlies Portage or Nunda group.

E. Emmons, 1846 (Agric. N. Y., vol. 1, pp. 190–193). Ithaca group is included in Chemung group, because there is no necessity of separating the Ithaca from the Chemung group.

H. S. Williams, 1882 (Am. Ass. Adv. Sci. Proc., vol. 30, pp. 186–191). *Ithaca sh.* is proposed for a soft, fragile argill. sh., very similar to the lighter-colored masses of Marcellus sh., and found well represented at Ithaca, forming transition beds btw. Portage and Chemung rocks. Total thickness about 25 ft. Contains plant beds and a recurrent Hamilton fauna. Lower bdy not clearly defined, but where *Spirifer laevis* has been found in the Portage below, the top of this sh. is observed to lie 50 to 60 ft. above highest strata containing that fossil.

C. S. Prosser and H. S. Williams, 1888 (Am. Inst. Min. Engrs. Trans., vol. 16, pp. 945–946), gave following downward succession of strata: Chemung; Upper Portage sss. and shales of H. S. Williams, 600 ft.; Middle Portage (consisting of Upper Ithaca, 200 ft.; Typical Ithaca, 100 ft.; and Lower Ithaca, 150 ft.); Lower Portage sss. and shales, 250 ft.; Genesee shales.

C. S. Prosser, 1893 (Am. Jour. Sci., 3d, vol. 46, pp. 217–218). Ithaca group of Vanuxem or middle Portage of Prof. Williams is 450 ft. thick.

J. M. Clarke, 1894 (N. Y. State Mus. 47th Ann. Rept., p. 750). Downward succession: Chemung; Portage sss. of Naples section [typical Portage] = Upper Portage of Ithaca section; Ithaca or Middle Portage; Lower Portage; Genesee.

J. M. Clarke, 1897 (N. Y. State Geol. 15th Ann. Rept., pp. 33–62). Portage group is a series of aren. deposits representing the time which elapsed from close of Hamilton period (including Tully ls. and a portion of Genesee sl. where present [more inclusive than the Hamilton of modern nomenclature]) to opening of Chemung period. The historical Ithaca group is the sedimental equal of major part of entire Portage fm., and is younger than Sherburne sss. or lower Portage beds.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, with map). The Ithaca beds of Canandaigua and Naples quads are divided into ***West Hill flags and sh.*** above and *Grimes ss.* below. They overlie Hatch sh. and flags of Portage beds [restricted] and underlie High Point ss. of Chemung beds.

H. S. Williams, 1906 and 1907 (Jour. Geol., vol. 14, pp. 579–598, and vol. 15, pp. 93–112; Am. Ass. Adv. Sci. Proc., vol. 56, pp. 265–267). *Ithaca sh. memb.* of Nunda fm., which is strat. equiv. of Portage or Nunda group of Hall, is divided at Ithaca into Enfield sh. memb., 550 to 800 ft.; Ithaca sh. memb., 80 to 460 ft.; and Sherburne flagstone memb., 188 to 260 ft. The Ithaca contains a *Reticularia laevis* zone at top and Ithaca *Lingula* shales (black sh.) at base, and is the typical Ithaca group of Hall and later writers.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 74). In western N. Y. the Portage fm. consists of the beds carrying the Naples fauna; in central N. Y. of the Sherburne and Ithaca beds partially intercalated with the Naples fauna; in eastern N. Y. of the Sherburne and Ithaca beds (marine) overlain by Oneonta beds (brackish). The Enfield sh. memb. composes greater part of original "Ithaca group" of Hall, the restricted Ithaca being the lower part of Hall's "Ithaca group."

H. S. Williams, 1913 (U. S. G. S. P. P. 79). Portage fm. of western N. Y. is divided into Enfield sh. memb. (top), *Ithaca sh. memb.*, and Sherburne memb. (base). It underlies Cayuta memb. of Chemung fm. and overlies Genesee sh. The Oneonta ss. of Chenango Valley is time equiv. of upper part of Ithaca memb. and in part younger than the Ithaca.

G. H. Chadwick, 1922 (Geol. Soc. Am. Bull., vol. 34, pp. 68–69). The Ithaca beds of Chemung Co. underlie Enfield sh., uncon. overlie Sherburne ss., and are = Grimes ss. and Hatch sh. of Steuben and Allegany Counties.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), defined *Ithaca sh.* as underlying *Enfield sh.* and overlying *Cashaqua sh.* (*Sherburne ss.*), and included them all in Portage group.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 314–352). *Naples group* divided into Enfield or Attica memb. above (which includes Hatch and Rhinestreet) and *Ithaca or Sonyea memb.* below (which includes Cashaqua and Middlesex). Underlies Cayuta memb. of Chemung group and overlies Sherburne memb. of Genesee group.

The U. S. Geol. Survey at present treats Ithaca sh. as a memb. of Portage fm.

Ithaca facies sub-group.

Upper Devonian: Central southern New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 202). *Ithaca facies sub-group* of Ithaca region divided into (descending) Triphammer sh. memb., Marathon ss. memb., Williams Brook coquinite memb., and Cascadilla sh. memb. Underlies Enfield facies sub-group and overlies Middlesex sh. of Genesee group.

Iuka formation.

Mississippian (early): Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Iuka fm.*—In Miss. is almost wholly chert and pulverulent silica. At one or two places in Miss. and at several places in Ala. it contains ls. as well as chert. Overlies Carmack ls., with great uncon., and is separated from overlying Alsobrook fm. by a large uncon.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23, passim), gave many details of *Iuka fm.* "Includes all beds from definite uncon. at top of Carmack ls. to base of Chester series." "Named for county seat of Tishomingo Co., Miss., around which it is more or less exposed."

Ivan limestone member (of Thrifty formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31). *Ivan ls.* lies 50 to 80 ft. below top of Thrifty fm., of Cisco group. Is separated from underlying Avis ss. and from overlying Blach Ranch ls. by shales with some ls. and ss.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 24; Univ. Tex. Bull. 2132, pp. 154–158). *Ivan ls. memb. of Thrifty fm.*—Light-yellowish to brownish-gray massive, locally nodular unfossiliferous ls., 2 to 8 ft. thick. Lies 35 to 80 ft. above Avis ss. memb. of Thrifty and 30+ ft. below Blach Ranch ls. memb. Not traceable very far to NE. but has been mapped into Eastland Co., to S. In places SE. of Breckenridge a ls. occurs in the ss. and sh. interval btw. Avis ss. and Ivan ls., but it is distinguished from the Ivan by numerous fossil corals. The Ivan ls. is same as "Speck Mtn" ls. of Drake [1893] of Colorado River Valley.

Named for exposures in vicinity of Ivan, Stephens Co.

Ivan Creek limestone.

Same as Ivan ls., the original name.

Ivanhoe limestone member (of Shady dolomite).

Lower Cambrian: Southwestern Virginia (Wythe County region).

C. Butts, 1933 (Va. Geol. Surv. Bull. 42, p. 3 and columnar section on geol. map of Appalachian Valley of Va.). *Ivanhoe ls. memb. of Shady dol.* [See explanation under *Patterson ls. memb.* This name was adopted from an unpublished ms. by L. W. Currier.]

L. W. Currier, 1935 (Va. Geol. Surv. Bull. 43). *Ivanhoe ls. memb.*—Dense massive ls. with subordinate dol. beds and a few thin red shaly or sandy partings. Thickness 0 to 600± ft. Top memb. of Shady dol. in lead and zinc region of SW. Va., from Huddle to Bertha. In Austinville basin probably represented in part by series of fossiliferous ls. beds alternating with crystalline dolomites. Grades into underlying saccharoidal dol. memb. of Shady and underlies Rome fm. Named for exposures at and around Ivanhoe, Wythe Co.

Ivy Point member.

Middle Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 11, 47). *Ivy Point memb. of Ludlowville sh.*—Coarsely bedded and hard sh. in upper and lower parts, with softer sh. in middle. Coarse layers may be cross-bedded. Land plants associated with marine invertebrates. Thickness 50 ft., although some exposures show thicknesses in excess of this, and type section seems to be slightly less. Type section is in first ravine N. of Ivy (or Willow) Point on E. side of Skaneateles Lake, about ¾ mi N. and slightly W. of Spafford Landing. Base of the Ivy Point is here about 107 ft. above Staghorn Point submember of Otisco memb. of the Ludlowville. Lower 15 or 20 ft. show some cross-bedding.

Iwana green schist.

Post-Carboniferous (?): Eastern Alabama.

See description under *Hillabee green schist.* Is intrusive. Named for exposures about Iwana, Coosa Co.

†Izard limestone.

Middle and Lower Ordovician: Northern Arkansas.

R. A. F. Penrose, Jr., 1891 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 1, pp. 102, 112–113, 121–124, 587–593). *Izard ls.* suggested by J. C. Branner for massive blue or grayish blue ls., 280 ft. thick, overlying saccharoidal ss. and underlying St. Clair ls. [broad and abandoned use of St. Clair]. Sometimes assumes finely granular semi-crystalline structure. Weathered surface frequently shows very irregular spots and lenticular seams of buff-colored earthy appearance, varying in thickness from 1/8 to 1/2 inch. Near top are frequently strata of cream-colored or dark watery blue ls. with smooth, even, compact structure and conchoidal fracture.

Is now differentiated into Plattin and Joachim lss. at its type loc.—Penters Bluff, SE. Izard Co. (See H. D. Miser, U. S. G. S. Bull. 715G, 1920.)

Jacalitos formation.

Pliocene (lower): Southern California (Coalinga region).

R. Arnold and R. Anderson, 1908 (U. S. G. S. Bull. 357). *Jacalitos fm.*—Sand, gravel, clay, and ss., 1,600 to 3,600 ft. thick, with characteristic fauna. Underlies, in places probably uncon., the major beds of blue sand that are characteristic of lower part of Etchegoin fm., but the Jacalitos also includes a great thickness of blue-sand beds at its summit in SE. part of Kreyenhagen Hills. Uncon. overlies Santa Margarita fm. Named for exposures both N. and S. of Jacalitos Creek, and in Jacalitos Hills, Fresno Co.

Some California geologists are applying this name in San Joaquin Valley to cover "Arnold's original type Jacalitos and about 1,000 ft. of strat. higher beds." (See H. W. Hoots and S. C. Herold, Geol. of nat. gas, A. A. P. G., 1935, pp. 127, 130.)

Jackass Mountain conglomerate group.

Lower Cretaceous: British Columbia.

A. R. C. Selwyn, 1872 (Canada Geol. Surv. Rept. 1871–72, p. 60).

Now referred to Kootenai fm.

Jackass Mountain group.

Lower Cretaceous: British Columbia.

G. M. Dawson, 1877 (Canada Geol. Surv. Rept. 1875–76, pp. 253–255). Exact syn. of Shasta group of Calif.

Jackfish Lake conglomerate.

Pre-Cambrian: Ontario.

J. E. Gill and J. E. Hawley, 1931 (Jour. Geol., vol. 39, p. 656).

Jackfork sandstone.

Pennsylvanian (early Pottsville): Southeastern and central southern Oklahoma and southwestern Arkansas.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Jackfork ss.*—Brown and drab ss., shaly ss., and thin ss., 3,800 ft. thick. Overlies Standley sh.

J. A. Taff, 1909 (U. S. G. S. Bull. 380, p. 289). *Jackfork ss.* of Ouachita Mtns is 5,000 ft. thick, overlies Standley sh., and underlies Caney sh. [not true Caney and now known as *Johns Valley sh.*].

C. W. Honess, 1924 (Okla. Bur. Geol. Circ. No. 3). My own observations show that *Jackfork ss.* of McCurtain Co., Okla., is 10,000 to 13,618 ft. thick, provided whole section of sss. above Stanley sh. be included in one fm., and indeed there is no means of dividing it on lithological grounds, for upper part is in no wise different from lower part, and there is no large body of sh. which might be taken for Caney or any fm. resembling Atoka. The Jackfork grades into underlying Stanley sh. The Upper Jackfork, 7,000 ft. thick, is apparently a sandy shoreward phase of Atoka fm., of Penn. age, and is separated from Lower Jackfork by Morrow beds equiv. to Wapanucka ls. of Arbuckle Mtns. The Lower Jackfork is 6,000 ft. thick and overlies Stanley sh.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, pp. 36–37). There has been much controversy on age of *Jackfork fm.* A Morrow (lower Penn.) fauna has been found by Honess at base of his "Upper Jackfork" ss., which he correlates with Atoka fm. Miser therefore excludes "Upper Jackfork" of Honess from Jackfork fm. and maps it as Atoka on State map. The true Jackfork ss. is classified as of Miss. age by U. S. Geol. Survey.

H. D. Miser, 1925 (Okla. Geol. Surv. Bull. 35, p. 37, footnote). Honess and I went together in 1923 to his main fossil locality in his Jackfork ss. In his rept he correlates the fossil-bearing beds with Wapanucka and Morrow fms. The ss. that overlies the fossil-bearing horizon is called by him *Upper Jackfork* and the ss. below is called by him *Lower Jackfork*, because it looks like real Jackfork and not like Atoka. If we, in applying fm. names, are to follow time equivalency instead of lithologic character, the Upper Jackfork of Honess should, in my opinion, be called *Atoka*. I have so called it and shown it on State map. Taff says he believes Honess' Jackfork fauna is not from real Jackfork but from Atoka.

H. D. Miser and C. W. Honess, 1927 (Okla. Geol. Surv. Bull. 44, pp. 11–12). Caney sh. in its type loc. (Johns Valley, formerly called Caney Basin or Cove, in upper Cane Creek Valley, 6 mi. N. of Eubanks, Pushmataha Co., Okla.) rests on Jackfork ss. This relation holds in a fairly large part of Ouachita Mtns of Okla., but Caney seems to overlap progressively both Jackfork and Stanley toward NW., in northern Atoka and southern Pittsburg Counties. If Caney does not overlap Stanley and Jackfork, it is possible, as suggested by Honess, that Stanley and Jackfork are=parts of Caney sh. In this latter case the Stanley and Jackfork wedge into the Caney laterally, and typical Caney sh. that rests upon Jackfork ss. may be one of southward-thinning beds of sh. The true relations of Caney, Jackfork, and Stanley will probably be discovered in time.

The Penn. rocks of the area S. and E. of Ti Valley-Choctaw belt of Ouachita Mtns of SE. Okla. and western Ark. are now divided by U. S. Geol. Survey into (descending): Atoka fm., 6,000 ft.; Johns Valley sh., 0 to 1,000 ft. (formerly included in Caney sh.); Jackfork ss., 5,000 to 6,600 ft.; Stanley sh., 6,000 to 10,000 ft.; and (in Hot Springs quad., Ark.) Hot Springs ss., 0 to 200 ft. In the Ti Valley-Choctaw belt of Ouachita Mtns, Okla., the downward succession is Atoka fm., Wapanucka ls., Springer fm., and *Caney sh.* (now restricted to Miss. part of rocks formerly called *Caney sh.*). In Arkansas Valley of Ark. the Atoka overlies Jackfork ss. (See H. D. Miser, 1934, A. A. P. G. Bull., vol. 18, No. 8.)

Named for Jackfork Mtn, Pittsburg and Pushmataha Counties, Okla.

†Jacksboro formation. (In Cisco group.)

Pennsylvanian: Central northern Texas (Jack and Young Counties).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Jacksboro fm.*—Approx. 60 ft. of lss. and ss. with a little sh. Contains the fossiliferous *Campophyllum* bed that is everywhere recognized. Top memb. is *Jacksboro ls.*, which plays out in the ss. hills SW. of Jacksboro [Jack Co.] and appears again in section N. of Finis, on Mineral Wells-Graham road. Is present only in Jack Co. and E. part of Young Co. Basal fm. of Cisco div. Underlies Bunger fm. and overlies Eastland fm., of Canyon div.

According to F. B. Plummer and R. C. Moore, 1922 (Tex. Univ. Bull. 2132, p. 138 and table 2), Jacksboro ls. memb. of Graham fm. is characterized by *Campophyllum torquium*, but Campophyllum bed of Drake is the much younger Gunsight ls. memb. of Graham fm.

Jacksboro limestone member (of Graham formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Jacksboro ls.*, top memb. of Jacksboro fm. [See 1919 entry under †*Jacksboro fm.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 127–143). *Jacksboro ls. lentil.*—A ls. near base of Graham fm. (of Cisco group) in Brazos River Valley. In vicinity of Jacksboro it consists of 2 ls. beds separated by 12 ft. of sandy sh. and ss. Total thickness of memb. 25± ft. Overlies Finis sh. and underlies Gonzales Creek sh. and ss., all members of Graham fm. The lower ls. bed is dark gray (weathering rusty yellow), hard, crystalline, 1 to 4 ft. thick, and filled with *Campophyllum torquium*. The upper ls. is poorly bedded, massive, shaly, 6 to 18 ft. thick, in places very fossiliferous, and 5 or 6 mi. to SW. changes to calc. ss., and to NE, of Jacksboro grades into shales.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), transferred Jacksboro ls. and Finis sh. to Caddo Creek fm., and stated (p. 112) that Home Creek ls. memb. includes Jacksboro ls.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 62+), included Finis sh. and Gonzales Creek sh. in Graham fm. The U. S. Geol. Survey draws base of Graham fm. at top of Home Creek ls. This is where base was put by F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501).

Named for exposures in vicinity of Jacksboro, Jack Co.

Jacksina formation.

Pre-Permian: Southeastern Alaska (headwater region of Copper and Tanana Rivers).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 26, in column of table credited to "Schrader, geologic reconn. of headwater region of Copper and Tanana Rivers, Alaska: Prof. Paper, in preparation"), showed *Jacksina fm.* opp. Sil. This rept. by Schrader appears never to have been published, as his subsequent duties called him to the States. Above is only known use of *Jacksina fm.*

Jackson formation.

Eocene (upper): Gulf Coastal Plain (southwestern Alabama to southern Texas).

T. A. Conrad, 1856 (Phila. Acad. Nat. Sci. Proc., vol. 7, pp. 257–258). [See 1856 entry under *Vicksburg group.*]

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 128–135). *Jackson group.*—Marls and soft lss., the marls white and blue, often indurate. [Fossils listed.] *Zeuglodon* common. Thickness 80 ft. Underlies Red Bluff group, which seems to be intermediate, in position and fossils, btw. Vicksburg group above and Jackson group below.

E. W. Hilgard, 1867 (Am. Jour. Sci., 2d, vol. 43, pp. 29–41). *Jackson group* is present at Red Bluff, where it underlies Red Bluff group.

Most early repts excluded the Red Bluff clay ("group") from the Jackson, and either treated it as distinct from the Vicksburg or included it in the Vicksburg. The Forest Hill (†Madison) sand has also been both included in and excluded from the Jackson, but it is now generally agreed that it is probably approx. contemp. with Red Bluff clay and more properly belongs in Vicksburg group. (See under *Red Bluff clay.*)

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, No. 7, pp. 187–190). Typical *Jackson fm.* of Miss. is composed chiefly of more or less calc. clay and less prominent sand and marl beds, divided into Yazoo clay memb. above [70 to 600 ft. thick] and Moodys calc. marl memb. below [35 to 90 ft. thick]. It underlies Vicksburg group (Olig.), the basal fm. of which is Red Bluff clay (marine) and the contemp. Forest Hill sand (shallow water), and it overlies Claiborne group (middle Eocene). Contains a large marine fauna. [Cooke also stated (Ala. Geol. Surv. Spec. Rept. No. 14, p. 274, 1926) that at its type loc. (Jackson, Miss.) the fm. consists chiefly of massive, plastic, gray clay with a sandy shell bed at base.]

The Jackson fm. is now recognized by U. S. Geol. Survey from southern Tex. to Tombigbee River in SW. Ala. East of Tombigbee River in Ala. and in western Ga. the deposits of Jackson age are represented by Ocala ls.; farther E. in Ga. and in western S. C. they are represented by Barnwell fm.; in eastern S. C. they are represented by Cooper marl (above) and Santee ls. (below). The Fayette ss. of eastern Tex. is also of Jackson age.

Named for exposures at Jackson, Miss., along Pearl River and Moodys Branch.

See also *Fayette ss.*

†Jackson formation.

Pennsylvanian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *Jackson coal group.*—Underlies Woodville ss. and overlies Parma ss. Thickness 47+ ft.

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30). *Jackson Coal Measures.*—Black shales, fire clays, black band iron ore, coals, and sss., the sss. generally white. Thickness 400 to 600 ft. Uncon. underlies Woodville ss. and overlies Parma ss.

A. C. Lane, 1901 (Mich. Miner, vol. 3, No. 1, p. 9). We are considering replacing *Jackson* (preoccupied) by Saginaw.

A. C. Lane, 1902 (Mich. Geol. Surv. vol. 8, pt. 2, map at end), used *Saginaw fm.* for the beds overlying Grand Rapids group, thus abandoning "Jackson."

Named for exposures at Jackson.

Jackson limestone. (In Greene formation.)

Permian: Southwestern Pennsylvania (Greene County).

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 97, 110, 112). *Jackson ls.*—Tough, impure, rock, containing some crystalline sphalerite, and associated with plant-bearing shales in Jackson Twp. near White Cottage, Greene Co. Exposed in Center and Jackson Twps. Seems to be persistent for at least 30 mi. Lies about 275 ft. above Nineveh coal and about 30 ft. below Gilmore ss.

†Jackson rocks.

A name locally applied to Marietta ss. in Roane Co., W. Va., because it weathers into fantastic shapes on land of Mr. Munson Jackson.

Jackson sand.

A subsurface sand, of Miss. age, in western Ky. and Hart Co., Ill., that has been identified as Cypress ss., of Chester group. (See A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932.)

Jackson sand.

A subsurface sand, of Paleozoic age, in Healdton field, Carter Co., southern Okla., lying lower than Healdton sand and higher than Simpson sand.

Jacksonboro limestone.

Miocene (lower): Eastern Georgia (Screven County).

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 83–84). *Jacksonboro ls.*—A stratum of ls. containing very numerous casts of shells and occasionally a silicified specimen, on the whole not unlike Tampa ls. This stone was formerly burned for lime. [Lists fossils.] The section here [near confluence of Brier Creek and Beaver Dam Creek, which together form a tributary of the Savannah River, 3 mi. below Jacksonboro, Screven Co., Ga.] showed 5 ft. of ferruginous sand and over 12 ft. of compact marly rock with fossils. At present the presumption is obviously in favor of early Mio. age of this deposit.

W. H. Dall, 1903 (Trans. Wagner Free Inst. Sci. Phila., vol. 3, pt. 6, p. 1573). No reasonable doubt the horizon of Jacksonboro white ls. is practically that of Tampa ls.

Later studies of T. W. Vaughan and C. W. Cooke showed this ls. to be a bed in Tampa ls.

Jacksonburg limestone.

Middle Ordovician: Northern New Jersey.

H. B. Kümmel, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). *Jacksonburg ls.*—The lss. hitherto called Trenton ls. in N. J. repts, but which contain fossils of Lowville [now included in Black River], Black River, and lower Trenton age. Thickness 135 to 150 ft. Includes (descending): (1) Calc. shales; (2) dark blue or black fossiliferous lss., 30 to 40 ft.; (3) shaly beds, 30± ft.; (4) dark blue or black fossiliferous lss., 30 to 40 ft.; (5) basal cgl., few inches to 50 ft. At Jacksonburg, Warren Co., shales and thin-bedded shaly lss. 19 or 20 ft. thick occur at base of section, overlain by 102 ft. of ls., and top of section is not seen. Underlies Martinsburg sh. and uncon. overlies Kittatinny ls.

Jacksonian.

Time term used by some geologists to cover the epoch during which the Eocene Jackson fm. and contemp. beds were deposited in the Coastal Plain.

Jackson Park shale. (In Kanwaka shale.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). *Jackson Park sh.* is applied to basal memb. of Kanwaka sh. in eastern Kans. Underlies Clay Creek ls. [Derivation of name not stated. On p. 52 Jackson Park sh. is stated to be 52 ft. thick.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 170). *Jackson Park sh. memb.*—Basal memb. of Kanwaka sh. Chiefly bluish-gray and yellowish-brown sandy sh., 50+ ft. thick along Kansas River; thins to less than 1 ft. in Nebr. Underlies Clay Creek ls. memb. Type loc. Jackson Park, SE. part of Atchison, Kans.

†Jacksonville formation.

Miocene (upper): Northeastern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 124–125, 157, 158, 327). *Jacksonville ls.*—A porous, slightly phosphatic yellowish rock, derived from calc. sand, and containing numerous molds of fossil shells belonging to newer Mio. fauna. The borings at Jacksonville passed through what appears to have been this rock for nearly 300 ft. Considered to be younger than Alum Bluff fm. and older than Grand Gulf group.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept.). *Jacksonville fm.* consists of light-gray to white ls. weathering yellow, and light-gray to yellow clay and gray sand, with some chert beds. Is contemp. with Choctawhatchee marl and younger than Alum Bluff fm. [group].

G. C. Matson, 1913 (Carnegie Inst., vol. 4, pp. 126–131). [Same definition as above. Thickness given as 400 to 500 ft.]

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Dall's "Jacksonville ls." and "Manatee River marl," which it has been found impracticable to map separately, are here included in Hawthorn fm. (of Alum Bluff group), although their faunas seem to be younger than typical Hawthorn. [The fauna of †Jacksonville fm. was reported by T. W. Vaughan in 1921 and Julia Gardner in 1924 to be *upper* Mio. and younger than Alum Bluff group, which is lower and middle Mio. The Hawthorn fm. is lower Mio.]

Named for exposures in excavation made for city waterworks at Jacksonville.

Jacob sand.

Pleistocene: Southeastern New York (Long and Fishers Islands) and islands of southern New England (Block, Nantucket, Marthas Vineyard, No Mans Land, and probably Cape Cod).

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367–390). *Jacob sand* (interglacial), fine gray sands or the equivalents, 40+ ft. thick, conformably overlying Gardiner[s] clay on Long Island and eastward to New England islands and Cape Cod. Conformably underlies Herod gravel. Correlated with Yarmouth stage of Mississippi Valley.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Jacob sand* of Long Island and islands to E. is transitional from Gardiners interglacial stage to Herod glacial substage, and seems to mark the first influx of new material on the advance of the ice sheet, bringing to a close the interglacial stage characterized by Gardiners clay. Time of deposition called *Jacob stage*. Thickness on Long Island 0 to 50 ft. Named for exposures near Jacob Hill, 8 mi. NE. of Riverhead, L. I.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Jacob sand* (transitional btw. Gardiners clay and Herod gravel memb. of Manhasset fm.) occurs on Block, Nantucket, Marthas Vineyard, No Mans Land, and probably Cape Cod. Correlated with upper part of Yarmouth stage of Mississippi Valley. Time of deposition called *Jacob stage.*

Jacob stage.

The time covered by deposition of *Jacob sand* (Pleistocene).

Jacob sand.

A subsurface sand in lower part of Jackson fm. (upper Eocene), in Driscoll pool, Duval Co., SE. Tex. See I. R. Sheldon, 1933 (A. A. P. G. Bull., vol. 17, No. 7, p. 819).

Jacobsville sandstone.

Upper Cambrian: Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 692). Red and brown ss. striped with streaks of red clay sh., conglomeratic where it laps upon older fms. Thickness 0 to 1,500+ (4,000?) ft. In view of uncertainty of relation of the three parts of the Lake Superior sss. as used by Houghton, separate names seem to us likely to be useful, and we propose not only the term *Freda ss.* for that W. of the Copper Range, but the term *Jacobsville* (from Jacobsville, where the famous quarries of Portage redstone occur) *ss.* for that E. of the Copper Range, and we suppose this term may apply to all the Lake Superior ss. skirting the coast at intervals to Grand Island, while the term *Munising ss.* is to apply to upper 250 ft. of Lake Superior ss. which crosses the bluffs back of Munising, dips southerly, and is white or light colored. Relations to Freda ss. undet., and may be same fm

Named for exposures at Jacobsville, Houghton Co.

Jacque Mountain limestone member (of Maroon formation).

Permian: Western central Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48). *Jacque Mtn ls.*—Light bluish gray ls., characterized by an oolitic structure in certain layers. Top memb. of Maroon fm. Conformably overlain by Wyoming fm. [Map shows upper part of Maroon fm. exposed on lower slopes of Jacque Mtn and Jacque Ridge, and that upper part of Jacque Gulch is cut in upper part of the Maroon.]

The present approved definition of Maroon fm. is for the beds above the †Weber grits and below Morrison fm., including the beds called "Wyoming fm." by Emmons at the time he defined Jacque Mtn ls. The Jacque Mtn ls. is not, therefore, the top memb. of Maroon fm., but occurs near the middle of the Maroon as now recognized.

Jacumba volcanics.

Early Quaternary or late Tertiary: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 138–140, map). *Jacumba volcanics.*—Extrusive rocks well exposed in several areas N. to E. of Jacumba, in southern Peninsular Range. Under microscope are olivine basalts. Extensively eroded. Thickness several hundred ft. Rest on Table Mtn fm. Are late Tert. or early Quat.

Jagger Bend limestone. (In Belle Plains formation.)

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 426). *Jagger Bend bed.*—To S. mostly alternating flaggy, smooth ls., carbonaceous shaly ls., and carbonaceous clay, 25 to 75 ft. thick. Fossiliferous. To N. carbonaceous nature not so apparent. Memb. of Albany div. Underlies Valera bed and overlies bed No. 8 (50 to 75 ft. of clay).

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, p. 195). *Jagger Bend ls.* is a memb. of Belle Plains fm. (middle fm. of Wichita group). Underlies Valera sh. memb. and overlies "bed No. 8" sh. of Drake.

Named for Jagger Bend of Colorado River, central Texas.

Jameco gravel (also **formation**).

Pleistocene: Southeastern New York (Long and Fishers Islands) and islands of southern New England (Block Island, Marthas Vineyard, and probably Cape Cod and Nantucket Island).

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). *Jameco gravels* (glacial), 100 ft. thick. Underlie Sankaty beds and uncon. overlie glacial gravels 35 to

325 ft. thick, which are believed to represent Pensauken of N. J. Named for Jameco pumping station of Brooklyn water works, a few mi. S. of Jamaica, N. Y., where borings first revealed the beds. Correlated with Kansan glacial stage of Mississippi Valley.

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367-390). *Jameco gravel.*—Stratified glacial gravels, 40 to 100 ft. thick. Conformably underlie Gardiner clay and uncon. overlie Mannetto gravel. Correlated with Kansan.

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). *Jameco gravel* of Long Island consists of dark-colored sands and gravels that vary considerably in coarseness and are distinguished by small percentage of contained quartz. Underlies Sankaty fm. and overlies Mannetto gravel.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467-469). *Jameco gravels,* 100 ft. thick, granitic, often sandy. Regarded as outwash from second, probably Kansan, glacier. Writer in 1904 recognized this fm. in cliffs of Block Island, Marthas Vineyard, and Cape Cod. Underlies Gardiner clay and uncon. overlies Mannetto of Veatch.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Jameco gravel,* glacial gravel, 50 to 100 ft. thick on Long Island. *Jameco stage* applied to time during which the deposit was laid down, which is tentatively correlated with Kansan stage of Mississippi Valley. Underlies Gardiners clay and uncon. overlies Mannetto gravel.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Jameco gravel* on Block Island and probably on Nantucket Island and Cape Cod. *Jameco fm.* on Marthas Vineyard, where it is divided into (descending): Moshup till member, 0 to 10 ft.; coarse gravel; ferruginous boulder bed. Underlies Gardiners clay and overlies Mannetto fm. Time covered by its deposition is called *Jameco stage* and correlated with Kansan stage of Mississippi Valley.

Jameco stage.

The time covered by deposition of *Jameco gravel.*

†Jamesburg formation.

Pleistocene: New Jersey.

R. D. Salisbury, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 60-72). *Jamesburg fm.*—The third yellow gravel fm. Consists of gravel, sand, and loam, loam perhaps most abundant. Includes pebbles from Beacon Hill gravel and from Pensauken. Not distinctly stratified. Thickness 8 to 12 ft. Uncon. overlain by fourth yellow gravel fm., and uncon. underlain by Pensauken fm., the second yellow gravel fm. Well exposed in upper part of railway excavation near Jamesburg.

Practically a synonym of Cape May fm., and its use has been discontinued.

†James River series.

Lower Cretaceous: Eastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 318). *James River series or Basal Clays of Potomac fm.*—As seen on James River it consists of very coarse gray sand, not distinguishable from and perhaps same as that of Rappahannock series. Contains great number of clay lenses and clay balls. I am, however, disposed to refer the coarse sands of James and Appomattox Rivers to Rappahannock series and to confine James River series to the underlying clay deposits; but as these clays are often actually embedded in the sands, this would require assumption they have all been transported and redeposited. For the smaller clay pellets, clay balls, and clay lenses this assumption is abundantly sustained, but some of the clay lenses form strata sometimes 100 ft. in length and a few ft. thick. The series is well developed on James River from Richmond to Dutch Gap Canal, on Appomattox from below Petersburg to near its mouth, and and on W. bank of Potomac btw. Mount Vernon and Aquia Creek.

W. B. Clark and B. L. Miller, 1912 (Va. Geol. Surv. Bull. 4). James River series and part of Rappahannock and Aquia series of Ward are included in Patuxent fm.

James River shale.

Devonian (?): Southwestern Missouri.

E. M. Shepard, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, pp. 56, 67). *James River shales.*—Bluish-black, slightly carbonaceous soft and frequently fossiliferous shales, thin-bedded and often accompanied by pyrites. Underlie Kings [King] ls. and overlie Maquoketa shales. Same as Eureka sh.

The 1922 geol. map of Mo. shows that the fms. along and near James River consist of Jefferson City dol. overlain by undiff. Mississippian fms., in which are included all beds above Craghead Creek sh.

James River formation.

Ordovician: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 241).

Jamestown conglomerate.

Upper Devonian: Western New York.

G. D. Harris, 1891 (Am. Geol., vol. 7, pp. 164–174). [In text he refers to the cgl. forming top memb. of Chemung group at Jamestown, N. Y., as *Jamestown cgl.* and *Jamestown well cgl.*, and says it lies 662 ft. lower than horizon of Panama cgl.]

Only record of name. See also †*Chemung cgl.*

Jamestown limestone member (of McLeansboro formation).

Pennsylvanian: Southwestern Illinois (Perry County).

A. H. Bell, C. Ball, and L. McCabe, 1931 (Ill. Geol. Surv. Press Bull. No. 19). *Jamestown ls. memb.*—Dark-blue ls., 2½ ft. thick, containing *Productus* sp. Top lies 4½ to 7 ft. below Bankston Fork ls. memb. and base lies 18± ft. above Herrin (No. 6) coal in vicinity of Pinckneyville and Jamestown, Perry Co. Typically exposed in vicinity of Jamestown.

Jamesville limestone.

Silurian: Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 26, 27, 30–31). *Jamesville ls.*—Rather dark-blue ls. replete with stromatoporoids and corals. Thickness 0 to 20 ft. Best seen in E. part of Onondaga Co. In W. part of county thickness is reduced by erosion. Included in Manlius group. Conformably underlies Pools Brook ls. and overlies, with sharp contact, Clark Reservation ls. Included in Manlius in Vanuxem's 1842 rept. p. 115. Has been classed as Helderbergian, or probably Helderbergian, by some authors. Named for Jamesville, town of De Witt, Onondaga Co. Type section is at "Green Lake" State Park (Clark Reservation), W. of Jamesville.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 18). [See 1935 entry under *Manlius ls.*]

Jane Lew sandstone. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, p. 153). Jane Lew ss.—Massive, greenish gray, weathering to dark brown, fine grained, micaceous, and somewhat shaly ss., 10 to 15 ft. thick. Overlain by 30 to 60 ft. of Pittsburgh red sh. and underlain by 42 ft. of Pittsburgh red sh. Exposed on Hackers Creek, just E. of Jane Lew, Lewis Co.

Jasper conglomerate.

Pre-Cambrian: Northwestern Iowa and southwestern Minnesota.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 187; Sci., n. s., vol. 40, p. 144). *Jasper cgl.*—Cgls., 30 ft. thick, comprising basal fm. of Animikean series. Older than Sioux qtzite.

Probably named for Jasper, Pipestone Co., Minn.

Jasper limestone.

Lower Ordovician (Chazy or older): Northern Arkansas (Eureka Springs, Harrison, and Yellville quadrangles).

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Jasper ls.*—Consists of ls. interbedded with considerable ss. The ls. is even-bedded, grayish blue, noncrystalline, in layers few inches to 4 ft.; conchoidal fracture; numerous minute cavities filled with colorless calcite crystals. Some of sss. are 5 ft. thick; are most abundant and thickest near base. Basal bed of fm. is white, friable ss. 8 to 20 ft. thick. Total thickness of fm. 0 to 50 ft. Uncon. underlies Fernvale ls. and uncon. overlies [so-called] Joachim ls. Named for Jasper, Newton Co.

E. T. McKnight, 1935 (U. S. G. S. Bull. 853). The so-called Joachim ls. of Eureka Springs-Harrison folio is a part of Everton ls. The *Jasper ls.* uncon. underlies true St. Peter ss. and overlies Everton fm. Writer believes more work may prove that it properly belongs to Everton fm., with which it is closely associated.

Jasper series.

Pre-Cambrian: Alberta.

J. A. Allan, P. S. Warren, and R. L. Rutherford, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 231).

Jasper Creek shale. (In Graford formation.)

Pennsylvanian: Central northern Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 33). *Jasper Creek shales.*—Shales with 4 sss., each 10 to 15 ft. thick. The shales are light-colored, with yellow and brown beds; are often sandy or carry thin beds of ripple-marked ss. flags. The sss. pinch out to NE. and the shales change to ls. on N. side of Trinity River. Thickness 300+ ft. Lie in valley of Jasper Creek and on the slopes of escarpment to W. Are exact strat. equiv. of Chico Ridge ls. to N. of Trinity River. Contain characteristic Graford fossils and belong in that fm.

Jasper Knob zone. (In Negaunee formation.)

Pre-Cambrian (middle Huronian): Northern Michigan (Marquette County).

J. L. Adler, 1935 (Jour. Geol., vol. 43, No. 2, pp. 113–132). *Jasper Knob zone of Negaunee fm.*—Typically thin *straight-bedded* (characteristic feature) layers of jasper btw. which are intercalated usually thinner layers of specularite; the non-specular iron oxide is chiefly martite and magnetite. Outcrops examined show that a few lenses of very subordinate extent contain white or gray chert and blue hematite, more of which may exist in lower part of this zone around Negaunee. At base a few soft ore bodies rest on the dolerite sill. Not unlikely that in places Jasper Knob zone rests on Corning Creek zone of the Negaunee. Type loc., SE. part of Ishpeming, N. slope of Jasper Knob.

Jay granite.

A name casually applied by F. W. Topham (Geol. of Maine, Dept. of Geol. Union Coll. Schenectady, p. 66, 1932—a mimeographed thesis) to middle Sil. granite quarried at North Jay quarries.

Jefferson limestone. (Also **Jefferson dolomite.**)

Middle Devonian: Montana (widespread), western Wyoming, southeastern and south-central Idaho, northern Idaho, northern Utah.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Jefferson lss.*—Brown and black crystalline lss., 640 ft. thick. Underlie Three Forks shales and conformably overlie Gallatin fm. Well exposed in hills on both sides of Missouri River just below junction of the Three Forks of the Missouri, and on both sides of the Jefferson a few mi. above its mouth, in Three Forks quad., SW. Mont.

Jefferson gas sand.

A subsurface sand, of Miss. age, in central Okla., which lies 15 ft. below Lyons-Quinn sand and above Ingraham sand.

†Jefferson dolomite.

An abbreviated form of Jefferson City dol., employed by C. [R.] Keyes.

Jefferson City dolomite.

Lower Ordovician (Beekmantown): Missouri and northern Arkansas.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 373, 375). *Jefferson City ls.*—Mag. lss., 175 ft. thick, underlying Roubidoux or Saccharoidal ss. [not Roubidoux, but St. Peter ss.] and overlying Moreau ss. [Roubidoux fm.] in central Mo. Forms top part of Gasconade ls. [an early broad usage of Gasconade].

Until 1911 the name *Jefferson City ls.* was applied to all rocks in Mo. underlying "Saccharoidal ss." and overlying Roubidoux fm., and it has been thus applied in some later repts. In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27) E. O. Ulrich defined Jefferson City ls. as indicated by following succession (downward): St. Peter ss.; Everton; uncon.; Yellville ls.; uncon.; Jefferson City; Roubidoux. According to A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202, p. 5), the Jefferson City ls. of Ulrich's 1911 rept cited above included Cotter dol. and Jefferson City dol. of present nomenclature; and in 1912 Ulrich determined that his Cotter dol. is younger than Jefferson City dol. at its type loc., and restricted Jefferson City to the beds beneath the Cotter. This is present commonly accepted definition. (See also under †*Jefferson City group.*)

Named for exposures at Jefferson City, Cole Co., Mo.

†Jefferson City group.

Lower Ordovician (Beekmantown): Missouri.

C. L. Dake, 1921 (Univ. Mo. School Mines and Met. vol. 6, No. 1). In published Mo. repts Jefferson City is made to include everything from Roubidoux below to Everton ls. above. As a result of recent work this fm. is now split up into Jefferson City restricted at base, followed by Cotter and Powell. While it is still impossible over most of Ozark region to draw boundaries btw. these units, it is thought best to call attention to known presence of each, since it allows a more thorough comparison with adjacent regions. The term *Jefferson City group* will be used to indicate all three.

Jeffersonian stage.

Pleistocene: Central northern Oregon.

E. T. Hodge, 1930 (Monthly Weather Rev., vol. 58, pp. 405–411). *Jeffersonian stage (Pleistocene).*—The younger epoch of glaciation and great precipitation in Oreg. Possibly correlates with Vashon, the youngest glacial epoch of Wash., and with Wisconsin stage of No. Am. Not as extensive as Cascadian stage. Nearly one-third of Mount Jefferson was cut away from its E. side by great Pleist. glaciers.

Jeffersonville limestone.

Middle Devonian: Indiana and north-central Kentucky.

E. M. Kindle, 1899 (Bulls. Am. Pal., vol. 3, No. 12, pp. 8, 23, 110). *Jeffersonville ls.*—Ls., about 20 ft. thick, underlying Sellersburg ls. and overlying Niagara ls.

Contains Onondaga fossils. Regarded as probably=Columbus ls. of Ohio.

Named for Jeffersonville, Clark Co., Ind.

Jellico formation.

Pennsylvanian: Northern Tennessee coal field.

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 14, 18–21). *Jellico fm.*—Applied to 500 or 600 ft. of rocks overlying Briceville sh. and underlying Scott sh. in northern Tenn. coal field. The rocks occupying this position have previously been called *Wartburg ss.*, but that name is a misnomer and has been so misapplied that it is discarded. The ss. at Wartburg occupies strat. position in lower part of Briceville sh., 30 or 40 ft. beneath Poplar Creek or Oliver Springs coal. More than three fourths of the Jellico is sh., but sss. are more prominent in it than in either underlying Briceville or overlying Scott fm. The Pioneer ss. is top memb. of fm. and Smith coal (=Blue Gem coal) is basal memb. Named for occurrence of Jellico coal within the fm. as its most prominent economic feature.

Jelm formation.

Upper Triassic: Eastern and central Wyoming.

S. H. Knight, 1917 (Geol. Soc. Am. Bull., vol. 28, No. 1, p. 168). *Jelm fm.*—New name proposed for upper 250 ft. of Chugwater fm. in SE. Wyo., consisting of a pebble cgl. composed of small ls. pellets, wood fragments, and fragmentary remains of Triassic vertebrates. Is=Dolores fm. [Upper Tr. and Jurassic (?)] of SW. Colo. This peculiar cgl. is identical in lithologic and strat. habit with type Dolores cgl. and contains similar fragmentary remains. It rests discon. on Permocarbonic part of Chugwater fm., to which name *Chugwater* should be restricted. Named for good exposures of characteristic bone-bearing cgl. near E. base of Jelm Mtn [near S. line of Albany Co., Wyo.].

The U. S. Geol. Survey in 1923 adopted *Jelm fm.* for the reported Upper Triassic vertebrate-bearing beds previously included in top of Chugwater fm. in some areas in Wyo., and said to be same as *Popo Agie beds* of Williston, the type loc. of which is near E. end of Wind River Mtns. Although *Popo Agie* has priority, it was discarded because of objectionable pronunciation and inadequate definition. The U. S. Geol. Survey at present classifies this fm. as Upper Triassic, as have E. B. Branson (Jour. Geol., vol. 35, 1927, p. 610, and Jour. Geol. vol. 37, No. 1, 1929) and other writers. The Jelm, however, has been considered by most geologists to be=Popo Agie beds of Knight, which Branson in 1927 classified as Upper Triassic but as older than Jelm fm. Von Huene, also C. L. Camp, 1930 (Univ. Calif. Mem., vol. 10, p. 5, quarto), assign Popo Agie beds of Knight to Middle Triassic. There is therefore a possibility that Jelm fm. may be older than Upper Triassic, although the evidence now at hand does not seem to justify transferring it to Middle Triassic.

Jemez marl.

Tertiary: Central northern New Mexico.

A. B. Reagan, 1903 [See 1903 entry under *Albuquerque marl.*]

C. [R.] Keyes, 1932 (Pan-Am. Geol., vol. 58, No. 4, p. 289), substituted ***Jemez clays,*** 500 ft. thick, for Puerco fm. of current terminology, and applied ***Pueroan*** to the Torrejon and his Jemez.

Jemison chert.

Lower Devonian (Oriskany): Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 57, 145–147). ***Jemison chert.***—A calc. bed, ls. or dol., known only by much chert along its outcrop. The chert is generally light gray or iron-stained, of dense texture, greatly sheared, jagged, and rough in its contours. Thickness 20 to at least 500 ft. In places rests on Butting Ram ss. memb. of Talladega sl., and in other places lies a short distance above that memb. Is overlain by Yellow Leaf quartz schist. Contains Oriskany fossils. Mapped as Knox dol. on early geol. map of Ala.

Named for exposures at and near Jemison, Chilton Co.

Jenkins clay. (In Cimarron group.)

Permian: Central southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 27–28). ***Jenkins clay.***—Red clay sh., 7 to 10 ft. thick, separating Shimer gyp. above from Medicine Lodge gyp. below. Middle memb. of Cave Creek fm. [In 1897 (Am. Geol., vol. 19) Cragin gave thickness of this sh. as 30 to 45 ft. in Okla.]

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 47+). [See under ***Blaine gyp.***]

Named for former post office of Jenkins, Comanche Co., Kans.

Jennings formation.

Upper Devonian: Eastern West Virginia and northern Virginia and Maryland.

N. H. Darton, 1892 (Am. Geol., vol. 10, pp. 13, 17, 18). ***Jennings fm.***—Middle series of Dev. sediments in central Appalachian Va., consisting of light-colored shales (prevailingly olive, gray, and buff) with interbedded light-colored sss. Local sequence variable, but medial portion consists largely of aren. members. Contains Chemung and Portage fossils in middle beds, and also probably contains beds of Hamilton age. Thickness, 2,800 to 3,200 ft. Overlies Romney shales and underlies Hampshire fm.

According to G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg, Pa., folio, No. 170), E. O. Ulrich, 1911 (G. S. A. Bull., vol. 22), E. M. Kindle, 1912 (U S. G. S. Bull. 508), G. W. Stose, 1912 (Pawpaw-Hancock, Md., folio, No. 179), C. S. Prosser, 1915 (Jour. Geol., vol. 23), G. P. Grimsley, 1916 (W. Va. Geol. Surv., Rept. Jefferson, Berkeley, and Morgan Counties), G. W. Stose, 1922 (Va. Geol. Surv. Bull. 23), and W. F. Prouty, 1927 (W. Va. Geol. Surv. Rept. on Hampshire and Hardy Counties) the Jennings fm. included Chemung, Portage, and Genesee fms. as later differentiated and mapped by W. Va. Geol. Surv., and the Romney sh. included the Hamilton, Marcellus, and Onondaga. In 1932 (Va. Geol. Surv. Bull. 34, pp. 63, 64) and 1933 (map of Valley of Va. and accompanying text) C. Butts did not recognize the presence of any beds of unquestioned Genesee age, and divided the beds of Portage age into two parts, to the upper of which he applied the central Pa. name *Brallier sh.*, and the lower of which he included in a map unit (which he stated consisted "mainly of black sh.") which he designated *Romney sh.*

Named for exposures at Jennings Gap and on Jennings Branch, Augusta Co., Va.

Jennings sand.

A subsurface sand in Cook Mtn fm. (middle Eo.) of Duval Co., Tex.

Jerome formation.

Devonian (Upper): Central Arizona (Jerome region).

A. A. Stoyanow, 1930 (Pan-Am. Geol., vol. 53, No. 4, pp. 316–317). In Devonic time the NW. and SE. areas of deposition were separated by a land barrier toward which lss. grade into aren. sediments containing *Arthrodiran* fishes. The sequence in NW. area is altogether different from that of SE. Ariz., and *Jerome fm.* is proposed for former.

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 495–500), gave very detailed section of his Jerome fm. at Jerome, aggregating 505 ft., and stated that it is uncon. overlain by Redwall ls. (Miss.) and underlain by Tapeats ss. (Camb.). The section is almost wholly ls. A 4-ft. bed of ss. lying 146 ft. above base at Jerome is called *Arthrodiran ss.*, and said to be a valuable marker. "The name '*Sycamore Creek fm.*' was suggested for this ss. in 1925. As its thickness varies considerably and it gradually thins out to W. of Mazatzal land, it may be more appropriately termed *Sycamore ss. memb. of Jerome fm.*" Stoyanow states that in headwaters of East Verde River the *Arthrodiran ss.* is made up of a pink, compact, basal ss., succeeded upward by white, pink, and mottled aren. ls., brick-red ss., and pink and red hard qtzites, with thickness ranging from 50 to 75 ft. Also that the upper aren. part of Jerome fm. contains Upper Dev. fauna that correlates it with Martin ls.

Jerseyan stage of glaciation, also **Jerseyan drift** (Pleistocene).

Jerseyan drift is name applied to an old drift of Laurentide ice sheet in eastern part of United States; *Jerseyan stage* being applied to time during which this drift was deposited. The drift was named for its development in New Jersey. The name was originally proposed by T. C. Chamberlin and R. D. Salisbury (Geol., vol. 3, pp. 383–387, 1906).

†Jerseyian fauna.

Eocene: New Jersey.

S. Weller, 1907 (N. J. Geol. Surv., Pal., vol. 4, pp. 179, 184), applied *Jerseyian* to fauna of Rancocas group and Manasquan marl, and assigned it to late Upper Cret. This fauna was transferred to Eocene by C. W. Cooke and L. W. Stephenson in 1928 (Jour. Geol., vol. 36, pp. 139–148).

Jerusalem.

Cretaceous: Jamaica.

R. T. Hill, 1889 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

Jessamine series.

Middle Ordovician: Central northern Kentucky.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, p. 10). *Jessamine (Mohawkian) series.*—Approx.=Mohawkian of N. Y. Includes Lexington and Highbridge lss. Underlies Greendale bed of Cynthiana fm., and extends to base of Campnelson bed. [Type loc. not stated, but probably Jessamine, Jessamine Creek, or Jessamine Co.]

Jessamine limestone.

Middle Ordovician (Trenton): Central northern Kentucky.

A. M. Miller, 1919 (Dept. Geol. and Forestry Ky., ser. 5, Bull. 2, p. 25). *Jessamine substage* (of Lexington stage).—Rather thin-bedded grayish ls. with occasional thin shaly layers intercalated. Thickness 80± ft. Characterized by *Prasopora simulatrix* and *Dalmanella bassleri*. This is same bed named Wilmore by writer in 1905, but that name is preoccupied. Underlies Benson bed and overlies Hermitage substage. Named for Jessamine Creek, Jessamine Co.

R. S. Bassler, 1932 (Tenn. Dept. Ed., Div. Geol. Bull. 38, p. 80), placed this ls. btw. Bigby ls. and Hermitage and assigned it to Trenton epoch.

Jesse sandstone member (of Catron formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 41). *Jesse ss. memb.*—Coarse-grained ss., 20 to 70 ft. thick; in places cliff-making. Top memb. of Catron fm.

Named for Jesse Creek, Bell Co., Ky.

Jester dolomite. (In Blaine formation.)

Permian: Southwestern Oklahoma (Greer and Beckham Counties).

G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 49, pp. 29, 55–57, 63). North of Elm Fork a probable third dol. memb. of Blaine fm., the *Jester dol.*, was located at a number of places about midway btw. Haystack and Cedartop gypsums. This may eventually prove to be=Creta dol. S. of Elm Fork, or it may be older. It is a slightly platy medium- to fine-grained gray to brownish-gray dol. 9 to 24 in. thick. Exposed where road from Jester, Greer Co., crosses the heavy gypsums at SE. cor. sec. 25, T. 7 N., R. 24 W. [Mapped.]

Jester sand.

A subsurface sand in central western Okla. which has been correlated with part of Chickasha fm. (Perm.). But C. M. Becker, 1930 (A. A. P. G. Bull., vol. 14, No. 1, p. 56), placed it as older than Chickasha, as= lowest bed of Duncan ss. and as resting on Hennessey sh.

Jetmore chalk member (of Greenhorn limestone).

Upper Cretaceous: North central Kansas.

W. W. Rubey and N. W. Bass, 1925 (Kans. Geol. Surv. Bull. 10, pp. 16, 46, 51). *Jetmore chalk memb. of Greenhorn ls.*—Alternating thin beds of chalk and chalky sh., 20 ft. thick, lying 20 ft. below top of Greenhorn ls. and 28 to 40 ft. above Lincoln ls. memb. of Greenhorn ls. in Russell Co., Kans. Named for prominent exposures S. and E. of Jetmore, along S. side of Buckner Creek, Hodgeman Co. [The beds separating Jetmore chalk from Lincoln ls. are now known as *Hartland sh. memb.*]

Jett sand.

A subsurface sand, of Miss. age, in western Ky. and Hart Co., Ill., that has been identified as Tar Springs ss., of Chester group. (See A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932.)

Jewell phyllite. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198), mentioned *Jewell phyllite* as a fm. of Casco Bay group, but did not define it.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 171). *Jewell phyllite.*—An assemblage of alternating gray and bluish to black fine-grained sericite phyllites in thin beds (a few inches to a few ft. thick), containing also interbedded gray siliceous sl. and very thin layers of qtzite. In places is dominantly light-colored; in other places is dark, resembling the black phase of Scarboro phyllite, and heavily impregnated with small grains and crystals of pyrite. Estimated thickness 500 ft., but may be less. Belongs to Casco Bay group. Conformably overlies Spurwink ls. Probably underlies Mackworth sl. conformably. Named for development on Jewell Island, in Casco Bay. Assigned to Penn. (?).

Jewett sand and silt.

Name that has been applied to beds encountered in wells and loosely assigned to Temblor fm. (Mio.) on E. side of San Joaquin Valley, Calif. Immediately overlies Vedder sand. (See H. A. Godde, 1928, Calif. Oil Fields, Div. Mines and Min., vol. 14, No. 1, 1928, pp. 5–10.)

G. M. Cunningham and W. F. Barbat, 1932 (A. A. P. G. Bull., vol. 16, No. 4, p. 420). Unpublished ms. of A. R. May and J. D. Gilboe states that *Jewett sand and silt* of E. side of San Joaquin Valley underlies beds=Carneros ss. memb. of Temblor fm.

Jewett silt member.

Miocene: Southern California (Kern County).

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, pp. 16, 22, pl. 2). *Jewett silt memb.*—The sand facies of the micaceous silt memb. of the Lower Temblor [expanded use of *Temblor fm.*] first proved productive in Round Mtn oil field and was called *Jewett zone* (H. A. Godde, Calif. Oil Fields, vol. 14, No. 1, 1928, p. 9), from Shell Oil Co. well No. "Jewett" 1, sec. 29, T. 28 S., R. 29 E. Operators of Mount Poso field borrowed the name "Jewett" and applied it to the top of the oil shows in the micaceous siltstone memb. In some wells the oil shows occur practically at top of this memb.; therefore "Jewett" can be used to designate the entire thickness of the micaceous siltstone memb., which is separated from underlying Vedder sand memb. of the Lower Temblor by a bed of grit, and which includes the basal sand locally known as *Rench sand.*

A. Diepenbrock, 1934 (Calif. Oil Fields, vol. 19, No. 4, p. 7), divided his Lower Temblor of Round Mtn field (11 mi. NE. of Bakersfield) into (descending): (1) Ashy silt memb., 550 ft.; (2) *Jewett micaceous silt memb.*, 650 ft. of "brown, micaceous siltstone, containing sandy lenses and with a fine silty sand and pebble bed," resting on; (3) Vedder sand memb.

Jim Creek limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). [See under *Dover ls.*, Moore, 1932.]

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), replaced *Jim Creek ls.* with *Nebraska City ls.*

R. C. Moore, May 1, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14). *Jim Creek ls.* underlies French Creek sh. and overlies Friedrich sh.

G. E. Condra, late in 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 9–10), gave following downward sequence of members of his *Pony Creek sh. fm.*: Sh., 5½ ft.; Greyhorse ls., 1 ft.; Caneyville sh., 17 ft.; Nebraska City ls., 2± ft.; French Creek sh., 16 ft.; *Jim Creek ls.*, 6 in. to 1 ft.; and Friedrich-Dry sh., 17± ft. Latter shown as overlying Dover ls. fm., which rested on Table Creek sh., top memb. of McKissick sh. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 239). *Jim Creek ls.* is here applied to thin but persistent ls. that underlies French Creek sh., overlies Friedrich sh., and has been traced across Kans. and into Okla. and Nebr., although it is nowhere more than 2 ft. thick. It is fine-grained, hard, and bluish gray or bluish; weathers brown and gray. Type loc. on Jim Creek, sec. 29, T. 7 S., R. 11 E., Pottawatomie Co., Kans.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Joachim dolomite.

Lower Ordovician (Chazy): Eastern Missouri, southwestern Illinois, and northern Arkansas.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 352). *Joachim ls.*—Dark earthy mag. shaly brecciated ls., 100 ft. thick; upper layers hard and dense, no chert. Overlies Crystal City [St. Peter] ss. and underlies Trenton ls. in SE. Mo.

E. R. Buckley and H. A. Buehler, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser.). *Joachim fm.* or First Mag. ls. overlies Pacific or First ss. and underlies Trenton ls.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bulls. 260, 267). *Joachim ls.*—Yellow and buff to light-gray thin-bedded mag. ls. alternating with beds of compact, brittle ls., and with locally thin beds of ss. Thickness 0 to 150 ft. Overlies St. Peter ss. Is=First Mag. ls. and=Folley ls.

The overlying ls. has for many years been called ***Plattin ls.***

Named for exposures along Joachim Creek, Jefferson Co., Mo.

Joana limestone.

Mississippian: Eastern Nevada (Ely region).

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 24, 26, map, etc.). *Joana ls.*—Massive, uniformly bluish gray beds, which in a few places contain nodules of chert. Thickness 100 to 400± ft.; latter thickness on Pilot Knob Ridge. Underlies Chainman sh. and overlies Pilot sh. Named for Joana mine, on S. side of Robinson Canyon, 2 mi. above Ely.

†Joes Rock granite.

Devonian (?): Southeastern Massachusetts.

C. H. Warren and S. Powers, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 456 and map). *Joes Rock granite.*—Pinkish to purplish granites, aplitic and felsitic, including quartz porphyry, feldspar porphyry, fine granite, and felsite. [Mapped over large area, including Joes Rock, W. of Sheldonville, Mass.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped this granite as Dedham granodiorite.

Joggins formation.

Carboniferous: Nova Scotia.

W. A. Bell, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 334).

Johannesburg gneiss.

Pre-Cambrian: Southern California (Randsburg quadrangle, Kern and San Bernardino Counties).

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95, pp. 21–23, 28, map). *Johannesburg gneiss.*—Consists of a variety of rock types, the majority of them gneisses. In no case do they show true schistose cleavage. The most characteristic type represented may be termed hornblende-plagioclase gneiss; it shows a fine parallel banding of light and dark constituents. Another type, consisting entirely of coarsely crystalline black hornblende, may be termed hornblende gneiss. Interbedded with these varying types of gneisses there occur rather important quantities of massive and quite coarsely crystalline white marble in beds 1 to 20 ft. thick. In places thin layers of light-colored gneiss are intercalated with the ls. A subordinate amount of qtzite, which may be massive or coarsely banded, is interbedded with the marble and the gneisses. The fm. is predominantly if not entirely of sed. origin, and probably marine. The hornblende gneisses, however, may be derived from igneous rocks. A thickness of approx. 2,500 ft. outcrops, but neither top nor bottom was seen. Believed to uncon. underlie Rand schist. *Assigned to Archean. Named for exposures 2 mi. N. of Johannesburg, Kern Co.*

Johannian.

Upper Cambrian: New Brunswick and Nova Scotia.

G. F. Matthew, 1891 (Illustrations of fauna of St. John group No. 5, Trans. Roy. Soc. Canada, vol. 8, p. 129).

C. D. Walcott, 1891 (U. S. G. S. Bull. 81, p. 249). *Johannian* was proposed by G. F. Matthew [reference cited above] for a local series of strata in St. John Basin of New Brunswick that occur btw. *Paradoxides* zone, or Div. No. 1, and Upper Camb. zone, or Div. No. 3, which he calls *Bretonian.*

Johannian series.

Upper Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4), applied *Johannian series* to all of Upper Camb. of Newfoundland, represented by one fm., named *Elliott Cove fm.*

John Day formation.

Miocene (lower) and upper and middle Oligocene: Central northern Oregon (John Day country).

O. C. Marsh, 1875 (Am. Jour. Sci., 3d, vol. 9, p. 52). *John Day lake basin.*—Mio. lake, of which the Blue Mtns formed E. and S. shores, but its other limits are difficult to ascertain, as this whole country has since been deeply buried by successive outflows of volcanic rocks. It is only where latter have been washed away that the lake deposits can be examined. The typical localities of this Mio. basin are along John Day River, and this name may very properly be used to designate the lake basin. The strata of the basin are more or less inclined and of great thickness. One section near John Day River seems to indicate thickness of not less than 5,000 ft. The upper beds alone of this series correspond to deposits of White River Basin. The lower part also is clearly Mio., as shown by its vertebrate fauna, which differs in many respects from that above. Overlain by Plio. beds in a few places and underlain by Eocene beds, which are more highly inclined than the Mio. beds.

E. D. Cope, 1888 (Am. Geol., vol. 2, pp. 290–292). *Johnday fm.* is 4,000 to 5,000 ft. thick according to Marsh. It occupies a considerable tract on upper part of course of John Day River in Oreg.

J. C. Merriam, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 496–497, and Jour. Geol., vol. 9, pp. 71–72). *John Day fm.*, of John Day Basin, is uncon. overlain by Columbia [River] lava and rests (probably uncon.) on Clarno fm. The upper or buff beds correspond to *Meryoochoerus* beds of Wortman, but as *Merycochoerus* does not occur in the John Day, the upper beds will be called *Paracotylops* beds. They overlap the middle div. of the John Day and older fms. The middle John Day consists of blue-green beds, very fossiliferous, and corresponds to *Diceratherium* beds of Wortman. The lower John Day beds are usually of deep-red color, considerably contorted in places, and rarely contain fossils.

J. C. Merriam, 1901 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9, pp. 278–314), gave thickness of upper div. of *John Day series* as 300 to 400 ft., of middle div. as 500 to 1,000 ft., and of lower div. as 250–300+ ft., and described it as uncon. overlain by Columbia [River] lava and underlain, probably uncon., by Clarno fm. [Merriam included the beds at Bridge Creek in Clarno fm. and assigned them to upper Eocene.]

F. C. Calkins, 1902 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 3, No. 5, pp. 111–172). The principal material in all 3 divisions of *John Day series* is fine-grained tuff. A few thin flows of lava are intercalated in various sections, and water-worn gravels and sands occur near upper limit of the series.

J. C. Merriam and W. J. Sinclair, 1907 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 5, No. 11, p. 173). *Upper John Day* is mainly buff-tinted tuffs, with sands and gravels near top. *Middle John Day* is drab and bluish green tuffs. *Lower John Day* is red, white, and green tuffaceous sh. Rests uncon. on Clarno fm. and is uncon. overlain by Columbia [River] lava. [Their table shows upper part of upper John Day is Mio. and rest of fm. Olig.]

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 65), and 1919 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 8, 9, 12), assigned John Day fm. to lowermost Mio., upper Olig., and uppermost middle Olig. Some later repts, by other authors, assign it all to Mio. and others all to Olig. The U. S. Geol. Survey classifies it as lower Mio. and upper and middle Olig.

Johnnie formation.

Lower Cambrian: Southeastern Nevada (Spring Mountains region).

T. B. Nolan, 1928 (Am. Jour. Sci., 5th, vol. 17, pp. 461–472). *Johnnie fm.*—Lower 3,500 ft. chiefly fine-grained qtzites, of characteristically greenish or grayish-green color, with a few sh. zones, as much as 250 ft. thick, but containing a rather large amount of sand; locally cross-bedded. Upper 1,000 ft. distinguished by much larger proportion of sh. and by presence of 2 or 3 beds of dol., each about 10 ft. thick; many of shales are green, but beds of brown and gray sh. also occur. Is more than 3,500 ft. thick at head of Johnnie Wash, N. of Johnnie mine. Underlies, apparently conformably, Stirling qtzite, and is basal fm. in Spring Mtns section, Clark Co. No fossils found.

Johnsburg limestone.

Pre-Cambrian: Northeastern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Johnsburg ls.* is included in Grenville series. Thickness 30+ ft. Rests on Sacandaga qtzite and underlies Dresden amphibolite. Type loc., Johnsburg, Warren Co.

Johnson gravels.

Miocene: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 371–394). *Johnson gravels.*—Auriferous gravels of fluviatile origin, containing Mio. plants. Lie at altitude of 5,000 to 5,600 ft. Turner has traced these gravels S. of 40th parallel, through Cascade mine to vicinity of Haskell Peak, where they have elev. of 7,000 ft. The southerly inclination of the pebbles, the northerly slope of the deposits, and the distribution of pebbles containing Jurassic fossils afford strong evidence that the stream by which the gravels were laid down flowed from vicinity of Haskell Peak northwardly across Genesee Valley and northern arm of Indian Valley to Mountain Meadows. Lie uncon. on upturned edges of massive Jurassic and Triassic fms., and although not in contact with the valley alluvium (Pleist.) their uncon., due to erosion, is well marked. [Derivation of name not stated.]

In subsequent publications Diller did not use this name, but described the gravels simply as *auriferous gravels*.

Johnson shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 86, 88). *Johnson sh.*—Bluish argill. sh. modified by thin grayish sandy layers, calc. plates, some gypsiferous material and geodes. Thickness 16 to 25 ft. in Nebr. and 16 to 20 ft. in NE. Kans. Underlies Glenrock ls. and overlies Long Creek ls. Named for exposures 1½ mi. N. of Johnson, Johnson Co., Nebr.

G. E. Condra and R. C. Moore included these beds in Elmdale sh. in their 1932 classification, but Condra in 1935 (Nebr. Geol. Surv. Paper No. 8) discarded Elmdale and used *Johnson sh. fm.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Johnson granite porphyry.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, pp. 127–128, map). The most centrally located, most siliceous, and youngest rock of Tuolumne intrusive series. Is next younger than Cathedral Peak granite. Its major part resembles an aplite, but it is distinguished by widely scattered phenocrysts of microcline. Part of mass has texture of more typical granite porphyry.

Named for fact it forms Johnson Peak.

Johnson oil and gas sands.

Subsurface sands in midst of Penn. section in Graham field, NW. part of Carter Co., southern Okla., 250 to 500 ft. below Kirk gas sand and 75 to 244± ft. above Atlantic oil sand. Thickness 55 to 300± ft.

Johnson sand.

A subsurface sand, of Ord. age, in Oklahoma City oil field, NE. Okla., that has been correlated with basal part of Simpson fm. Named for a farm. See under *Kinter sand*.

Johnsonburg sandstone.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 139–140). In face of the 2d tier of lower cuttings of Yingling-Martin sh. quarry at Johnsonburg a thick flaggy to massive yellow ss. charged with plant material is believed to be on the horizon of Shenango ss. Until it can be checked it is suggested that it be known as

Johnsonburg ss. [On p. 110 he gives a detailed section at southern suburb of Johnsonburg, Pa., which shows *Johnsonburg fm.* as 24 ft. thick, and as lying 281 ft. below Johnson Run ss. and 111 ft. above Knapp fm.]

†Johnson Creek conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 527, 546, 554, 555). The *Johnson Creek cgl.* is that at the Shawmut, on Elm River property. Is same as Shawmut cgl. Younger than No. 8 cgl. [Bohemia cgl.].

Belongs in Central Mine group.

Probably named for exposures on Johnson Creek, Houghton Co.

Johnson Gulch porphyry.

Eocene: Leadville district, Colorado.

S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927 (U. S. G. S. P. P. 148). A gray porphyry very similar to Lincoln porphyry, but lacking the large phenocrysts of orthoclase and quartz. Is the "main mass" of Gray porphyry of Leadville monograph. Named for development in Johnson Gulch, Leadville dist.

Johnson River sandstone.

Misprint (on p. 211 of U. S. G. S. Bull. 191) for *Johnson Run ss.*, the name used by Ashburner in publication cited.

†Johnson Run sandstone. (In Pottsville formation.)

Pennsylvanian: Central northern Pennsylvania.

C. A. Ashburner, 1879 (2d Pa. Geol. Surv. geol. map of McKean Co.). The bottom of the Lower Productive Coal Measures is marked by the Twin Creek coal bed, which lies btw. Kinzua Creek and Johnson Run sss.

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R). The Johnson Run ss., 30 to 75 ft. thick, is without doubt=Homewood ss. The boldest outcrop of the rock is to be found in Johnson run coal basin, E. of Wilcox, Elk Co., Pa.

Replaced by Homewood ss. memb. of Pottsville fm.

Johnson Run sand.

A subsurface sand, of Penn. age, in SW. Pa. that is believed to lie at or near horizon of Homewood ss. (top memb. of Pottsville fm.).

Johnstown limestone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania.

H. M. Chance, 1880 (2d Pa. Geol. Surv. Rept. V_2). *Johnstown cement ls.*—Separated from overlying Kittanning Upper coal by 0 to 4 ft. of fire clay and sh. and from underlying Kittanning Middle coal by 40 to 50 ft. of shaly beds. Named for occurrence at Johnstown, Cambria Co.

†Johnstown cement bed.

Name applied in early Pa. and W. Va. repts to *Johnstown ls. memb.* of Allegheny fm.

Johnstown iron ore. (In Conemaugh formation.)

A name that has been applied to a bed occurring in strat. interval btw. Philson ls. above and Brush Creek coal below. (See J. D. Sisler, Pa. Geol. Surv., 4th ser., Bull. M_7, 1925, p. 268.)

Johnstown moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Johnstown and Johnstown Center, Rock Co.

Johns Valley shale.

Pennsylvanian: Southeastern Oklahoma (Ouachita region) and central western Arkansas (Scott County).

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, pp. 6, 21–23, 30, 36–37). *Johns Valley sh.* proposed for the boulder-bearing black Penn. sh. of Ouachita Mtns, which is typically exposed in center of Tuskahoma syncline, particularly in N. half of T. 1 S., R. 16 E., where it rests on Jackfork ss. and is overlain by sandy shales and sss. referred to Atoka fm. Its lower part contains abundance of large and smaller, often fossiliferous, erratics of ls. and other sed. rocks that were originally parts of older fms., found in place beyond northern and western limits of Ouachita area. It is, so far as known, confined to Ouachita area, and is not known to contain a fauna or flora of its own, but the boulders in this sh. contain fossils from Canadian, Ord., Sil., Dev., Miss. (Caney sh.), and early Penn. fms. of Arbuckle Mtns, and I regard them as transported from that area, while Miser believes that the Miss. Caney fauna that occurs in my Johns Valley sh. lived, died, and was buried where it is now found. The Johns Valley sh. also contains erratics of Wapanucka ls. of Arbuckle Mtns, which is of Penn. age, and it is therefore unquestionably of Penn. age and younger than Wapanucka. It has heretofore been included in Caney sh., but *Caney* is here restricted to the non-boulder-bearing black sh. which contains a Miss. (middle Meramec) fauna and is confined to N. and W. of Ouachita area. Named for settlement (on Cane Creek, in NW. part of Pushmataha Co., about 6 mi. N. of Eubanks) which is now called Johns Valley, but which, at time Taff named the Caney sh., was locally known as Caney, and which Taff in 1925 stated was type loc. of his Caney sh.

The introduction of this name into the literature, for the Penn. part of Caney sh. of previous repts, and restriction of Caney to the Miss. part of that fm., aroused considerable discussion among geologists, and resulted in several field trips to ascertain validity of the unit and its relations to neighboring fms. In 1934 the following sequence of fms. was adopted by U. S. Geol. Survey for the Penn. rocks of the area S. and E. of Ti Valley-Choctaw belt of Ouachita Mtns of Okla. and Ark. (descending order): Atoka fm., 6,000 ft.; Johns Valley sh. (boulder-bearing black sh., 0 to 1,000 ft.; Jackfork ss., 5,000 to 6,600 ft.; Stanley sh., 6,000 to 10,000 ft.; and (in western Ark. only) Hot Springs ss., 0 to 200 ft.; and Caney sh. was restricted to Miss. part of the strata formerly included under that name. (See H. D. Miser, 1934, A. A. P. G. Bull., vol. 18, No. 8.) According to Miser, Johns Valley is 10 mi. N. of Kosoma, Okla.

Joie. See *Madame Joie fm.*

Joins formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich. See *Joins Ranch fm.*

C. E. Decker, 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498–1505). *Joins fm.*—Chiefly ls., but some ss. and sh. Underlies Oil Creek fm. [Overlies Beekmantown (?) cgl., according to table on p. 1498, but in sections on pp. 1500 and 1501 this cgl. is included in Joins fm.] Occurs only in W., SW., and central parts of Arbuckle Mtns. Is of early Chazy age. Thickness 30 to 300± ft.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 11+). The *Simpson* is here raised to a *group*, divided into 5 fms. (ascending): *Joins*, Oil Creek, McLish, Tulip Creek, and Bromide. Fossils believed to be very basal Chazy.

See also 1933 entries under *Simpson fm.*

Named for exposures on Joins ranch, in Carter Co., T. 2 S., R. 1 W., N. and NW. of Woodford.

Joins Ranch formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle and Wichita Mountains).

Name used by E. O. Ulrich in ms. chart shown at N. Y. meeting of Geol. Soc. Am. in 1928, which he discarded (before publication) in favor of *Joins fm.* The part of Ulrich's chart containing this name was, however, published by C. E. Decker in Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, p. 1495). Ulrich later called the beds *Joins fm.* (See U. S. Nat. Mus. Proc., vol. 76, 1930, art. 21, pp. 73, 77; and Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 105, 1933.)

Joliet limestone.

Silurian (Niagaran): Northeastern and western Illinois.

G. A. Shufeldt, Jr., 1865 (Am. Jour. Sci., 2d, vol. 40, p. 389). *Joliet marble.*—Yellowish-white stone, very compact, 200 ft. thick, with no signs of oil. Overlain by 40 ft. of porous and much decomposed oil-bearing rock, and underlain by 200 ft. of gray oil-bearing lss. All included in Upper Sil.

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 515, 522, 530, 533). *Joliet ls.* is proposed to include all strata that occur above the weathered and pitted surface occurring 1 to 3 ft. above *Stricklandinia pyriformis* zone up to near top of quarry of Nat. Stone Co. at Joliet. At this quarry it consists of (1) 48 ft. of yellowish-gray dol., in rather thick layers that weather into layers 3 to 8 inches thick and contain several discontinuous bands of chert in middle part; underlain by (2) 32 ft. of gray to pink dol., somewhat granular, in rather thick layers, with greenish sh. partings and, in upper part, a few thin bands of chert. As here defined it includes strata lower than any exposed in vicinity of Waukesha, Wis. Overlies (probably uncon.) Kankakee (Brassfield) ls. and underlies, in Joliet region, a cherty ls. that is believed to correspond to Waukesha ls. of Waukesha, Wis. In Jersey and Calhoun Counties [SW. Ill.] it consists of 45 ft. of yellowish gray dolomitic ls., in layers 1 to 40 inches thick; overlies Kankakee (Brassfield) ls. and is overlain by Dev. In NW. Ill. it consists of 30 to 38 ft. of yellowish brown dol. overlying Kankakee (Brassfield) ls. and underlying Waukesha ls. Fossils. Correlated with Lockport dol.

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1), classified *Joliet* as of Lockport and Clinton age. On p. 27 is statement: It is now considered likely that the Joliet may prove to be time equiv. of the Clinton (oral communications from T. E. Savage and A. Foerste to A. C. T.). On p. 46 is statement that Clinton is absent or possibly represented by the Joliet, and that if Clinton is absent an important uncon. should separate the Joliet and the Kankakee.

Joliet conglomerate.

Pleistocene: Northeastern Illinois (Des Plaines Valley).

J. W. Goldthwait, 1909 (Ill. Geol. Surv. Bull. 11, p. 42). *Joliet cgl.*—Gravel firmly cemented by carbonate of lime into cgl. Thickness more than 18 ft. Uncon. overlain by Wisconsin till. Regarded as at least as old as Illinoian drift.

Named for Joliet.

Jolliff limestone member (of Dornick Hills formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

J. A. Waters, 1927 (Jour. Pal., vol. 1, p. 129). [See 1st entry under *Dornick Hills fm.*]

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 14). At base of Dornick Hills fm. is *Jolliff memb.*, a tan fossiliferous ls., 4 to 15 ft. thick, locally associated with a little cgl.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 29). *Jolliff memb.* is only about 4 ft. thick at type loc., but it is tentatively correlated with beds N. of Ardmore that attain thickness of 10 to 15 ft. Named for excellent outcrops in Jolliff Prairie, on allotment of Norman Criner Jolliff, in sec. 24, T. 5 S., R. 1 E., a trifle E. of axis of Overbrook anticline. Lies 300 to 1,000 ft. below Otterville memb. Was mapped by Goldston as Otterville ls.

Jolly limestone. (In McLeansboro formation.)

Pennsylvanian: Western Kentucky.

F. M. Hutchinson, 1912 (Ky. Geol. Surv. Bull. 19, pp. 30–125). *Jolly ls.*—Hard gray or grayish-blue ls., 3 to 6½ ft. thick, with abundance of crinoidal stems and brachiopod shells. Included in Lower Coal Measures of Central City quad., btw. coals Nos. 11 and 12.

L. C. Robinson (1931) replaced Jolly ls. of Hutchinson with *Providence ls.*, without giving his reasons. *Jolly* has priority, and *Providence* is preoccupied.

Probably named for Jolly, Webster Co.

Jolly limestone member (of Savanna sandstone).

Pennsylvanian: Central southern Oklahoma (Pontotoc County).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 74–75). *Jolly ls. memb.*—A thin ls. bed near bottom of Savanna ss., which is important in that it shows clearly the overlapping nature of itself and the strata above it, across the basal beds of the fm. This bed is very well exposed in road in front of J. S. Jolly's house, 300 yds. E. of NW. corner of sec. 8, T. 1 N., R. 7 E. [Pontotoc Co.]. It carries an abundant gastropod fauna, the most prominent species of which is *Bellerophon crassus* var. *wewokanus*. At point just mentioned the ls. is less than 100 ft. above top of McAlester fm. [on which Savanna ss. rests]. When followed SE. to W. side of sec. 10 of same twp and range, it is found to swing toward a more easterly direction, while the strike of underlying strata continues southeastward. In this way a greater and greater section is exposed btw. the diverging outcrops, until in area near E. edge of the outcrop the ls. is approx. 200 ft. above top of McAlester fm.

Jollytown limestone member (of Washington formation).

Permian: Southwestern Pennsylvania, western Maryland, and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 22, 23, 24, 29, 34). *Jollytown ls.*—Lies from 5 to 35 ft. above Jollytown coal, and 25 to 30 ft. below Dunkard coal, all of which are younger than Upper Washington ls. Ranges in thickness from 1½ to 10 ft. Included in Dunkard Creek series [Dunkard group]. Named for exposures in vicinity of Jollytown, Greene Co., Pa.

According to subsequent folios and repts of U. S. Geol. Survey and Pa. Geol. Survey the Jollytown ls. and Jollytown coal are older than Upper Washington ls.

Jollytown sandstone. (In Washington formation.)

Permian: Southwestern Pennsylvania (Washington County).

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, p. 2573). *Jollytown ss.*, massive ss., of irregular structure, weathering into fantastic forms. Overlies Middle Washington ls. and at Lantz's, ⅜ mi. below mouth of Hoover Run, on Dunkard Creek, it lies 70 ft. below Jollytown coal.

Jones sand.

Name applied to subsurface sands in different parts of country. (1) To two sands (Upper and Lower Jones) in Lee fm. of Pottsville group (Penn.) of Knox Co., SE. Ky.; (2) to a sand lying 325 ft. below top of Marble Falls ls. (Penn.) in central Tex., which was first found in Jones well at Ranger, Eastland Co.; (3) to two sands in Strawn fm. (Penn.) of Bryson oil field, Jack Co., Tex.; (4) to a sand, 75± ft. thick, in central northern Okla. that is in lower part of Coffeyville fm. (Penn.); (5) to a Miss. oil sand in western Ky. and Hart Co., Ill., that has been identified as Hardinsburg ss., of Chester group (see A. A. P. G. Bull., vol. 16, No. 3, p. 244, 1932), and as a part of underlying Golconda fm., of Chester group (see Ky. Geol. Surv. ser. 6, vol. 41, p. 221, 1931); and (6) to a Plio. sand in Townsite area of Huntington Beach oil field, Calif., that is probably=Upper Ashton sand (A. A. P. G. Bull., vol. 18, No. 3, pp. 330, 336, 1934).

Jonesboro limestone.

Mississippian: Southwestern Illinois (Union County).

H. Engelmann, 1868 (Ill. Geol. Surv., vol. 3, p. 43). Massive light-gray or nearly white subcrystalline or earthy ls. that breaks regularly into rectangular blocks and forms a good building stone. Comprises lowest portion of St. Louis group as here delimited. Thickness more than 30 ft. Well exposed ½ mi. W. of Jonesboro, Union Co., and is known in that region as *Jonesboro ls.* No well-defined fossils but is assigned to St. Louis group on strat. position and lithology.

†Jonesboro limestone.

Upper Cambrian: Northeastern Tennessee and southwestern Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 564, 637, 671–674, pl. 27). Thin to moderately thick-bedded, usually fine-grained and in part mag. ls. of Canadian age is found rather generally in eastern or Athens trough S. of Lexington, Va. In SW. Va. and in E. Tenn. as far S. at least as Greenville, this ls. rests on Upper

Camb. Nolichucky sh. and hitherto has always been described as a sparingly cherty representative of Knox dol. It is a great valley maker in this region and very thick. I have measured it at only one place, namely, Jonesboro, Tenn., where the fm. though incomplete above, reaches thickness of 1,850± ft. Total thickness in this vicinity is probably 400 ft. more, or in all 2,250± ft. As a rule the early Stones River Mosheim ls. succeeds it. Gastropods allied to *Maclurea oceana* and *M. affinis* and to *Seelya*—types so far wholly unknown in typical Knox or, indeed, in any Ozarkian fm.—occur at intervals in Jonesboro section to within 400 ft. of top of underlying Nolichucky. The upper 400 ft. of the ls. very commonly contains *Ceratopea keithi* and less frequently other gastropods and cephalopods. Mr. Arthur Keith found this same fauna E. of Knoxville in beds referred by him to upper Knox. As this fm. is a strat. and lithologic unit, and distinct from all others now recognized by name in Appalachian Valley, the term *Jonesboro ls.* is here proposed for it. [Pages 672–673.] According to these data it appears that Jonesboro ls. represents only lower half of Canadian system [Beekmantown group] as now constituted. [Page 674.] [Pl. 27 shows it uncon. below Mosheim ls. and uncon. above Lower Knox (?), and as correlated with Stonehenge ls., Nittany dol., and lower part of Axemann ls. of Beekmantown group of central Pa.]

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol., Bull. 28, p. 34). *Jonesboro ls.* of E. side of Athens trough is Upper Canadian and = Cotter dol. of central Tenn.

C. Butts, 1928 (Wash. Acad. Sci. Jour., vol. 18, No. 13, pp. 357–380). As defined by Ulrich the Jonesboro ls. was made to include beds corresponding to Nittany dol. and still higher beds to base of Mosheim ls. But it is now agreed that the Nittany is a distinct and easily separable unit in SW. Va., and *Jonesboro ls.* is here redefined and restricted to the ls. which near Jonesboro, Washington Co., Tenn., underlies Nittany dol. and rests on Nolichucky sh. Thickness 2,000± ft. Upper 500 ft. contains Beekmantown fossils. No fossils in lower 1,000 ft. Lower two-thirds of fm. may be a ls. facies of Copper Ridge dol. [which belongs to Ulrich's Ozarkian system].

Replaced by Conococheague ls. (an older name) in Dec. 1931, the ls. having been traced northward by C. Butts to typical areas of the Conococheague. (See C. Butts, 16th Int. Geol. Cong. Guidebooks of Va.)

Jonesburg sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County) and southern Kansas (Chautauqua County).

M. I. Goldman, 1920 (U. S. G. S. Bull. 686W, pp. 329–330). *Jonesburg ss.*—A persistent bed which forms rim of many minor ridges and plateaus in NW. part of T. 29 N., Rs. 11 and 12 E., Okla. Named for conspicuous exposure on top of ridge W. of Jonesburg, Chautauqua Co., Kans., a short distance N. of T. 29 N., R. 11 E. Probably is lowest bed of "Chautauqua ss." of Adams (1908). Physical appearance not sufficiently characteristic to distinguish it from other sss. of these twps, but it can be recognized by its relation to a thin ss. 12± ft. above it, which generally exhibits fossil imprints, mainly pelecypods and gastropods. Very rarely the fossils of this overlying ss. appear in the Jonesburg itself. In places the top of the Jonesburg shows a heavy stain of red to yellow ocher, and the tops of main beds display beautifully preserved ripple marks and current marks. Thickness 5 to 75 ft. Lies 125± ft. above Cheshewalla ss.

In Kans. is a memb. of Lawrence sh.; in Okla. a memb. of Nelagoney fm. and probably=basal part of Fourmile ss. memb. Some geologists have suggested it is=Bowhan ss.

Jones Point shale. (In Calhoun shale.)

Pennsylvanian: Southeastern Nebraska, eastern Kansas, and southwestern Iowa.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 51). *Jones Point sh.*—Bluish-gray argill. to calc. sh., with some carbonaceous material. Thickness 8 to 10 ft. Is basal bed of Calhoun sh. Overlies Ervine Creek ls. and underlies Meadow ls. Named for Jones Point, a spur in Missouri River bluffs E. of Union.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 47), stated that true Meadow ls. belongs in Stanton ls., and he applied *Sheldon ls.* to the ls. underlying Iowa Point sh. and overlying Jones Point sh.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), restricted Calhoun sh. to beds above Sheldon ls. and included Jones Point sh. and Sheldon ls. in Deer Creek ls. (redefined). Calhoun sh. restricted thus occupies interval previously named Iowa Point sh.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11), divided *Calhoun sh. fm.* into (descending) Iowa Point sh., Sheldon ls., and Jones Point sh. This classification was adopted by R. C. Moore, Aug. 31, 1936 (Kans. Geol. Surv. Bull. 22, p. 48), but on pp. 187–194 he proposed to redefine Ervine Creek ls., Jones Point sh., and Sheldon ls. on a cyclothem basis. (See 1936 entry under *Sheldon ls.*)

R. C. Moore, Sept. 4 to 7, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 41). Topeka ls. divided into (descending): Coal Creek ls., 16 ft.; Holt sh., 15 ft.; Du Bois ls., 14 ft.; Turner Creek sh., 36 ft.; Hartford ls., 40 ft.; *Jones Point sh.*, 5 ft. and *Dashner ls.*, 4 ft. Rests on Calhoun sh. [In above section *Jones Point sh.* is placed in Topeka ls. (instead of basal memb. of Calhoun sh.) and Dashner ls. is a new name for basal part of his Hartford ls. of p. 11 and pp. 194 and 195 of his Kans. Geol. Surv. Bull. 22, 1936.]

For Condra's latest interpretation of strat. position of this sh. see 1937 entry under *Topeka ls.*

Jordan sandstone.

Upper Cambrian: Southern Minnesota and Wisconsin, Iowa, and northern Illinois.

A. Winchell, 1872 (Rept of geol. survey vicinity of Belle Plaine, Scott Co., Minn., 16 pp.). A sandrock fm., exposed in beer vaults at Jordan and along Sand Creek, consisting of (descending): (F), Sandrock, buffish, quite ferruginous, thick-bedded, seen at mill 6 ft.; (E), sandrock, ferruginous, thin and irregularly bedded, friable and disintegrating, with many ferruginous seams, crusts and concretions, in the quarry 3 ft.; (D), sandrock, irregularly whitish or ferruginous, heavy-bedded, obliquely and beautifully banded with iron streaks and laminae, in quarry 12 ft.; (C), sandrock, buffish, similar to D, but thinner-bedded, in quarry 8 ft.; (B), sandrock, hard and ferruginous above, soft, friable, and buffish red below, Falls of Sand Creek 10 ft.; and (A), sandrock, whitish, compact, in the beer vaults 12 ft. seen. Overlain by Lower Mag. ls. of Owen. Occurs at considerable elevation above the mag. ls. at St. Lawrence. Regarded as Potsdam ss. [In two places is called *Jordan ss.*]

N. H. Winchell, 1874 (Minn. Geol. Nat. Hist. Surv. 2d Ann. Rept., pp. 127–156), gave (p. 149), as typical outcrop of Jordan ss., a section on Sand Creek, about ½ mi. above village of Jordan, Scott Co., Minn., which is same section as that given by A. Winchell in 1872, to which latter section reference is made, and credit for name *Jordan ss.* is also given to A. Winchell, 1872 rept cited above. In 1874 rept cited N. H. Winchell divided the rocks of Minnesota Valley into (descending) Trenton ls. and shales, St. Peter ss., Shakopee ls., Jordan ss., St. Lawrence ls., St. Croix ss., and Potsdam ss. Thickness of Jordan ss. (p. 147) 50 ft.

In subsequent early repts the fm. overlying Jordan ss. was called *Shakopee ls.*, *Lower Mag. ls.*, *Main body of Lower Mag. ls.*, and, since 1891, *Oneota dol.* In early repts the Jordan ss. was also confused with the younger New Richmond ss., which has been described as a fm. btw. Oneota dol. and Shakopee dol., and also as a memb. of the Shakopee.

In 1924 (Wis. Acad. Sci., Arts, and Lett., vol. 21, pp. 72–84) E. O. Ulrich restricted *Jordan ss.* to the wholly unfossiliferous ss., such as is found at Jordan type loc., and applied *Norwalk ss.* (which he treated as top memb. of his Trempealeau fm.) to the underlying fossiliferous ss. that had previously been assigned to the Jordan. He also defined Jordan ss. of eastern Wis. as overlain by a recently discovered fm., to which he applied the name *Devils Lake ss.*, and stated that in western Wis. the still younger Madison ss. intervenes btw. Jordan ss. and overlying Oneota dol. The U. S. Geol. Survey in 1927 adopted Norwalk ss. as a memb. of Jordan ss., since, according to C. R. Stauffer (Jour. Geol., vol. 33, pp. 699–713, 1925) and other geologists, it is the only part of the Jordan that outcrops at type loc. and it has always been included in the Jordan. (See A. C. Trowbridge and G. I. Atwater, Geol. Soc. Am. Bull., vol. 45, p. 60, 1934. Also see 1917 and 1925 entries under *Kasota stone.*)

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 1–25) included Jordan ss. in their Trempealeau fm.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 21–79). *Jordan ss.* is=Madison ss. and=Norwalk ss. The Norwalk is all of Jordan present at Jordan type loc. Jordan ss. should continue to be used for the beds overlying Lodi sh. memb. of St. Lawrence fm. and underlying Oneota dol. It seems best to leave the Jordan undivided at present.

A. C. Trowbridge stated (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, p. 61) that stratigraphers of Minn. and Iowa classify Madison ss. of Wis. merely as upper beds of Jordan ss. (For explanation see 1935 entries under *Madison ss.*) In this rept. Norwalk ss. was discarded by Trowbridge, Twenhofel, Raasch, and Thwaites, and the beds were restored to Jordan ss., of which they comprise the lower and major part.

E. O. Ulrich, 1936 (Geol. Soc. Am. Proc. 1935, p. 113). There are 3 sss. in Wis. that previously have been regarded as constituting an indivisible strat. unit. The Norwalk ss. is top memb. of Trempealeau fm., the Jordan is a separate final deposit of the Camb. of upper Miss. Valley, and the Madison is first deposit of Ozarkian of the region.

U. S. Geol. Survey at present follows the earlier and established definitions: Treats Jordan ss. as a distinct fm. from underlying St. Lawrence fm. and overlying Madison ss.; includes in it, at base, Norwalk ss. memb. of Ulrich; and has not adopted Trempealeau fm.

Named for exposures in Sand Creek at Jordan, Scott Co., Minn.

Jordan limestone member (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, pp. 38+, map, sections). *Jordan ls. memb. of Bingham qtzite.*—Calc. strata more or less altered by mineralizing agents and intrusive masses of monzonite. Most common unaltered rock is a pure fine-grained ls. of light to dark or even black color; light-gray and dove-colored beds also present. On slopes of West Mtn a ls. cgl. about 20 ft. thick is interbedded in the ls. 75± ft. above its base, but this cannot be traced far. Also contains small layers of qtzite, and considerable chert in nodules, layers, and masses. Thickness 20 to 300 ft. May possibly be same as Highland Boy ls. Named for occurrence in Old Jordan mine. [Sections show Jordan ls. as lying much lower than Commercial ls. and much higher than Lenox ls.]

Jornadan series.

A term introduced by C. [R.] Keyes to designate 25 ft. of Quat. adobe in N. Mex. In his Conspectus of geol. fms. of N. Mex., 1915, p. 8, he defined it as "Principal intermont plains soils and surface deposits."

Josephine formation.

Paleozoic: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60).

Jualin diorite.

Early Cretaceous (?): Southeastern Alaska (Berners Bay region).

A. Knopf, 1911 (U. S. G. S. Bull. 446, pp. 24–25, map). *Jualin diorite.*—Intrudes Berners fm. (Jurassic or Lower Cret.). Exposed at Jualin and in Jualin mine. Assigned to early Cret. (?).

Juana Diaz shales.

Juana Diaz marls.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 10, 17). Included in Arecibo fm.

Juan Ascencio chert beds.

Cretaceous (?): Puerto Rico.

D. R. Semmes, 1919 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 1, p. 65).

Juan Ascencio member (of Fajardo shale).

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 288).

Jubilee limestone.

Cambrian: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A2, p. 124).

Judique series.

Mississippian: Nova Scotia (Cape Breton Island).

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 323).

†Judith group.

See under *Judith River fm.*

†Judithian series.

A term applied by C. [R.] Keyes to Judith River fm. of other geologists.

Judith River formation. (Of Montana group.)

Upper Cretaceous: Central, northern, southeastern and southern Montana.

F. B. Meek and F. V. Hayden (Phila. Acad. Nat. Sci. Proc., vol. 8, p. 267, 1856; vol. 9, p. 123, 1858; vol. 13, p. 417, 1862; Am. Phil. Soc. Trans., n. s., vol. 12, 1862) described but did not name the fresh-water and brackish-water deposits near mouth of Judith River, Mont. They did, however, casually allude to them as *Judith deposit, Judith beds,* and *Judith River beds.*

F. V. Hayden, 1869 (U. S. Geol. and Geog. Surv. Terr. 3d Ann. Rept., pp. 89–92). To these groups (Fort Union, Wind River, White River, and Loup Fork) might be added the *Judith River beds,* a small basin in Missouri River, near foot of the mtns, about 15 to 20 mi. in width and 40 mi. in length. This group is probably of lower tertiary age, but I think it was always separated from the great lignite group.

F. V. Hayden, 1871 (U. S. Geol. and Geog. Surv. Terr. 4th Ann. Rept., p. 97). There is one other basin near sources of Missouri River which has already yielded many fossils of great interest but which seems to be isolated from the others. This is what I have called the Judith Basin, and inasmuch as it seems to be one of the ancient lake deposits, and characterized by a peculiar group of organic remains, I will designate the strata as *Judith group.* The sediments do not differ materially from those of Fort Union group, and they contain impure beds of lignite, fresh-water Mollusca, and a few leaves of deciduous trees. But the most remarkable feature of this group is the number and variety of the curious reptilian remains, of which we have only yet caught a glimpse.

F. B. Meek, 1873 (U. S. Geol. and Geog. Surv. Terr. 6th Ann. Rept., pp. 459, 460). We have always considered the *Judith River beds* to be Lower Tert., but there are some reasons for suspecting they may be Upper Cret.

E. D. Cope, 1874 (U. S. Geol. and Geog. Surv. Terr. 7th Ann. Rept., p. 434). From standpoint of writer the *Judith River beds* would be at top of Cret. and more or less related to Fort Union epoch.

F. B. Meek, 1876 (U. S. Geol. and Geog. Surv. Terr. Mon. 9), gave a section (p. xlviii) of *Judith River group* at mouth of Judith River, listed its fossils, and stated that it rested conformably on Fox Hills group, was overlain by Fort Union group, and was probably of Cret. age. Subsequent writers designated these beds as *Cretaceous No. 6 or Judith River group,* and called the underlying deposits *Cretaceous No. 5 or Fox Hills group.* In 1883 C. A. White included the Judith River deposits in Laramie "group."

J. B. Hatcher, 1896 (Am. Nat., vol. 30, pp. 112–120), showed *Judith River beds* to be older than Ceratops beds of Converse Co., Wyo. In 1902 (Sci., n. s., vol. 16, pp. 831–832) he stated that they are overlain by 300 to 400 ft. of sh. similar to Pierre sh. and which he had little doubt really represented the Pierre.

J. B. Hatcher and T. W. Stanton, 1903 (Sci., n. s., vol. 18, pp. 211–212), divided the Montana group of Mont. and adjoining parts of Canada (all of which they suggested was probably of Pierre age) into (descending): (1) Bearpaw sh. (600 ft. of dark clay sh. with many calc. concretions); (2) *Judith River beds* (500 to 600 ft. of light-colored, mostly nonmarine beds); (3) Claggett fm. (400 ft. of marine sh. and sss.); and (4) Eagle fm. (250 to 300 ft. of coarse, light-colored sss. with beds of clay sh. and lignite).

T. W. Stanton and J. B. Hatcher, 1905 (U. S. G. S. Bull. 257). *Judith River beds.*—Mostly fresh water, but occasionally contain intercalated brackish water layers, the most persistent of which is near top of fm. More rarely there are local marine deposits in upper part. The beds are prevailingly light-colored and tend to weather into "badlands" forms. Little more than 500 ft. thick near Judith. The Judith River beds in original area consist of light ash-colored sss. alternating with usually darker colored and more friable shales and clays mingled with frequent seams of lignite. The early use of Judith River by Meek and Hayden was in a general untechnical sense to include all the fms. occurring near mouth of Judith River. The Judith River beds as here defined underlie Bearpaw sh. and grade into underlying Claggett fm., which is well exposed in neighborhood of Judith, where it is 400 ft. thick. At many places in Bearpaw Mtns and at other favored localities the Bearpaw sh. is seen resting conformably on Judith River beds. It is not yet determined whether Bearpaw includes equiv. of Fox Hills. [This is present generally accepted definition of Judith River fm.]

T. W. Stanton, 1919 (U. S. G. S. P. P. 120, p. 167), correlated overlying Bearpaw sh. with upper part of Pierre sh. and lower part of Fox Hills ss.

Judith River sand.

Name locally applied to the first gas sand (subsurface) in Pierre sh. of Cedar Creek anticline, SE. Mont., which appears to lie at approx. horizon of Judith River fm.

Julian schist.

Triassic or older: Southern California (San Diego County).

F. J. H. Merrill, 1914 (Geol. and Min. Res. San Diego and Imperial Counties: Calif. State Min. Bur., pp. 11–12). *Julian group.*—Metamorphic fms. of mica schists, slates, qtzites, and ls., the first being especially well exposed near Julian and the latter occurring in small areas at several points. Age uncertain. May be Triassic, Carbf., or older.

F. S. Hudson, 1922 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 13, No. 6, pp. 181, 182–190, map). *Julian schist.*—In Cuyamaca region consists of quartz-mica schists, quartz two-mica schists, quartz-muscovite schists, and some thin-bedded qtzites. The metamorphosed product of shales, fine clayey sss., and nearly pure quartz sss., with subordinate layers of basic volcanic rock. Thickness more than 6,600 ft. Named for village of Julian, San Deigo Co., which occurs in midst of the mass. Of Triassic age, or late Paleozoic, or both.

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 120–121). *Julian schist* of Southern Peninsular Range is same as Julian group of Merrill and *Julian schist of Hudson.* No fossils found. May include rocks of Triassic, late Paleozoic, or even older ages. Evidence obtained strongly suggests it is largely or wholly metamorphosed Triassic sediments.

Julian group.

See under *Julian schist*, 1914 entry.

†Julian limestone.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 37, pp. 252–255, 1922) to replace the well-established name *Galena dol.*, which he does not consider well founded. Named for Julian Twp, Iowa.

†Julian series.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 47, pp. 146–148, 1927) as a designation for the Middle Ord. sequence of Dubuque region, Iowa, extending from top of Galena dol. down to base of Glenwood sh.

Juliand member.

Upper Devonian: Southeastern New York (Greene County).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 99, 285). East of Ithaca both Enfield and Ithaca become divisible, the latter separating into Otselic sh. below and Cincinnatus flags above; the Enfield into Kattel sh. below, a middle memb. I have been calling the *Juliand*, from exposures in Juliand Hill, just E. of village of Greene, N. Y., and at top Van Etten sh. ("First *Tropidoleptus* zone").

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862). Eastward from Canandaigua Lake the Enfield splits into (descending): Van Etten ("First *Tropidoleptus*") zone, *Juliand zone,* and Kattel (*"Leiorhynchus globuliforme"*) zone.

Jumbo volcanics.

Mesozoic or late Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 95, map). *Jumbo volcanics.*—Greatly altered and metamorphosed lavas and intrusive igneous rocks of apparent andesitic composition. Lie on S. border of Rossland volcanics. As a rule much more altered than lavas of Rossland volcanic group, but possibly are in part correlative with Rossland. Appear to rest uncon. on Mission argillite and Northport ls. On NE. appear to pass beneath lower members of Rossland volcanic group, but contact may be fault contact. Occur at headwaters of Fifteen Mile Creek, at E. end of Jumbo Mtn, and occupy 11± sq. mi. Assigned to Tert. [The Rossland volcanic group is now assigned to Carbf. (?), Triassic (?), Jurassic (?).]

Jumbo dolomite member (of Talladega slate).

Probably Paleozoic: Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 53). *Jumbo dol. memb. of Talladega sl.*—Apparently lies several thousand ft. above the ferruginous ss. memb. of the Talladega, and several thousand ft. below top of the Talladega, being both underlain and overlain by ordinary phyllite of Talladega type. In at least one place this memb. consists of an upper dol. bed 60 ft. thick and a lower dol. bed 20 ft. thick, the two separated by a 40-foot bed of phyllite. Thickness at least 120 ft. Extends from NE¼ sec. 4, T. 23 N., R. 16 E., S. and W. to half a mile W. of old Jumbo post office.

Named for exposures and quarries at and near Jumbo, Chilton Co.

Juncos gabbro.

Age (?): Puerto Rico.

C. R. Fettke, 1924 (N. Y. Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 2, p. 153, and Am. Inst. Min. and Met. Engrs. Trans., vol. 70, pp. 1026–1042).

Junction limestone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 301). *Junction fm.*—Lss., 200 ft. thick, underlying Brush sh., overlying Bishop sss., and composing a middle fm. of Flaming Gorge series in Utah. Assigned to late Jurassic. [But Keyes also stated that it may correspond to Minnewaste ls., which is Lower Cret. Derivation of name not stated.]

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 40), these lss. are Curtis fm. (Upper Jurassic).

Junction City quartzite.

Pre-Cambrian (middle Huronian): Central northern Wisconsin (Portage County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 91). *Junction City qtzite.*—Several separated areas of qtzite and qtzite schist exposed in vicinity of Junction City, Portage Co. The fm. varies rapidly from qtzite to sh. Approx. 200 to 500, possibly 1,000 ft. thick. Base not exposed. May be same as Rudolph qtzite. Assigned to lower Huronian (?).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned the qtzites and slates of north-central Wis. to middle Huronian.

June Bell rhyolite.

Tertiary: Central northern Nevada (western part of Elko County).

E. H. Rott, Jr., 1931 (Univ. Nev. Bull., vol. 25, No. 5). *June Bell rhyolite* (Tert.) on surface is limited to small area on June Bell claim in Gold Circle or Midas mining dist. but underground it is more extensive. If extrusive it is older than Elko Prince rhyolite; if intrusive it is younger.

Juniata coal measures.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii-xxx), applied this name to the rocks in SW. Pa. underlying the Genesee black sh. and overlying his Marcellus black sh.

Juniata formation.

Upper Ordovician (Richmond): Central southern and eastern Pennsylvania, western Maryland, western Virginia, and eastern West Virginia.

N. H. Darton, 1896 (U. S. G. S. Piedmont folio, W. Va.-Md., No. 28, and Franklin folio, W. Va.-Va., No. 32). *Juniata fm.*—Brownish-red sss. alternating with red shales. Thickness 685 to 1,125 ft. Underlies Tuscarora qtzite and overlies Martinsburg sh. Is basal part of Medina of early repts on this region. Assigned to Sil. [Derivation of name not stated.]

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 172–188). *Juniata fm. (red Medina ss.)* of western Md. is best developed in Wills Mtn, NW. of Cumberland, where it is 550 ft. thick. Consists of alternating shales and sss. of deep red color. Named for typical occurrence on Juniata River in Pa. Assigned to Sil.

This fm. continued to be universally assigned to Sil. (as was Medina group of N. Y.) until 1908, when R. S. Bassler (Econ. Geol., vol. 3, p. 510) classified the fm. in Va. as Ord. and of Lorraine age. In 1909 (Sci., n. s., vol. 29, pp. 353, 355, 415) A. W. Grabau correlated Juniata with Queenston sh. of western N. Y. ("of late Lorraine and Richmond age"), and assigned both of those fms. to Upper Ord. The Tuscarora, however, he placed in Sil. Although no fossils were obtained from the rocks, the Juniata fm. of U. S. G. S. Mercersburg-Chambersburg folio, No. 170, 1909, was classified as Upper Ord.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), assigned the Juniata to Upper Ord. and the Richmond to Sil.; and, although no fossils were obtained, this classification of the Juniata was followed by G. W. Stose in U. S. G. S. Pawpaw-Hancock folio, No. 179, 1912.

In 1913 (12th Int. Geol. Cong., pp. 593–666) E. O. Ulrich assigned Juniata fm. (=Queenston sh.) to Richmond epoch and assigned the Richmond to Sil. Grabau, however, the same year (Geol. Soc. Am. Bull., vol. 24, pp. 408-410) assigned Juniata (=Queenston and=Richmond) to Upper Ord. Ulrich still classifies the Richmond group (and equiv. fms. in other parts of the country) as Sil. In this he is followed by R. S. Bassler, R. Ruedemann, and the present N. Y. State and Pa. State Surveys. The U. S. Geol. Survey and geologists and paleontologists in general assign the Richmond group and its equivalents to Upper Ord. Although the Juniata is nonfossiliferous, its correlation with Richmond group appears now to be accepted by all writers.

Juniata moraine.

Pleistocene (Wisconsin stage): Eastern Michigan (The Thumb). Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Juniata, Tuscola Co.

Juniata River series.

Name proposed by F. Platt (2d Pa. Geol. Surv. Rept. H, pp. 6, 8, 1875) for the Dev. coal beds of No. VIII, which he included in his Hamilton series.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. xxiii), applied *Juniata River coal group* to part if not all of his *Hamilton sss.*, which occupied interval btw. Genesee black shales above and Marcellus black shales below.

Juniper andesites.

Age(?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 21, No. 8, pp. 214–376, map). *Juniper andesites.*—Pale-gray and dark bluish-gray platy and slabby pyroxene andesites. Surround Juniper Lake on all but S. side and extend W. a distance of 4 mi. Overlie Willow Lake basalts.

Juniper Hill formation.

Upper Devonian: Central northern Iowa.

A. O. Thomas, 1925 (Iowa Geol. Surv. vol. 30, p. 116, footnote). *Juniper Hill fm.* introduced to replace *Sheffield fm.* of Fenton, 1919, Sheffield being a misnomer for the rocks to which Fenton applied it, because the shales at Sheffield are much younger than the Upper Dev. beds which Fenton named *Sheffield fm.*

Named for fact that Juniper Hill, about 1 mi. NW. of Rockford Brick and Tile Plant, Floyd Co., is in midst of numerous good exposures of the fm.

See also under *Sheffield fm.*

Jupiter formation.

Silurian: Quebec (Anticosti Island).

W. H. Twenhofel, 1928 (Canada Geol. Surv. Mem. 154, p. 26).

Jupiter River formation.

Silurian: Quebec (Anticosti Island).

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 713).

Jura.

Same as *Jurassic.* Chiefly employed by Europeans.

Jurassic period (or **system**).

The time (and the rocks) of the middle period of the Mesozoic era, succeeding Triassic and preceding Cretaceous. For definition see U. S. G. S. Bull. 769, pp. 62–64.

Jurasside revolution.

A. Knopf, 1924 (U. S. G. S. Bull. 762, p. 11). As has long been recognized and generally accepted, the folding of the Triassic and Jurassic rocks of Star Peak Range, Nev., took place in post-Jurassic time, most probably at end of Jurassic, contemporaneously with the revolution that affected Sierra Nevada region at this time—the great crustal disturbance that will here be termed *Jurasside revolution.*

†Juratrias.

A term employed in early geologic repts to include rocks of Jurassic and Triassic age.

Jurupa series.

Paleozoic(?): Southern California (Riverside County).

J. W. Daly, 1935 (Am. Min., vol. 20, No. 9, pp. 638–647, map). *Jurupa series.*—Oldest rocks of Jurupa Mtns. A thick series of recrystallized sedimentaries, divided into (descending): Sky Blue Quarry ls., 500+ ft.; Chino Quarry qtzite, 75+ ft.; Chino Quarry ls., 470+ ft.; and an undiff. complex consisting of 3,700+ ft. of qtzites, schists, and gneisses with small ls. lenses. Age undet.; tentatively assigned to *Paleozoic(?)*.

Jutten volcanics.

Pre-Cambrian: Ontario (Savant Lake area).

G. Rittenhouse, 1936 (Jour. Geol., vol. 44, No. 4, p. 456).

Kaaterskill formation.

Upper Devonian: New York.

B. Willard, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 3, p. 498), suggested the use of *Kaaterskill* to replace Chadwick's restricted Catskill, for the red beds underlying the Catawissa and overlying the Oneonta, and advocated the continued use of Catskill in the broad sense, which "is synonymous with Dev. red beds, continental."

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 480–484). [See this entry under *Catskill fm.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 26). [See this entry under *Catskill fm.*]

B. Willard, Jan. 1936 (N. Y. State Mus. Bull. 307, p. 74, letter to G. H. Chadwick, dated Mar. 4, 1935). *Kaaterskill* is proposed for red sss. and shales now thought to be of Tully age, which make up a part of original Catskill group of Mather in Catskill Mtns, N. Y. Their type is the principal reddish and olive-gray ss. ledges and associated red shales overlooking the Kaaterskill clove on N. and making the falls of the Kaaterskill. Further field work may be necessary precisely to determine the strat. boundaries of this memb., which is a conspicuous element in the succession. [Chadwick, on p. 99, shows *Kaaterskill* as underlying Onteora, as overlying Kiskatom, and as=Tully.]

Kaau volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kaau volcanics.*—Tuff and basalt erupted from Kaau Crater. Included in lower part of Honolulu volcanic series [q. v.].

Kachess rhyolite.

Eocene: Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Kachess rhyolite.*—Thick flows of white or yellow rhyolite aggregating 0 to 4,000 ft. Well exposed on NE. side of Kachess Lake. Is in part younger than Naches fm. and in part contemp. with the Naches, so that a heavy flow of Kachess is interbedded with the Naches ss. and basalt.

Kaegel fanglomerate.

See *Kagel fangl.*

Kagawong beds.

Upper Ordovician: Ontario (Manitoulin Island).

A. F. Foerste, 1912 (Ohio Nat., vol. 13, p. 46), divided Richmond strata on Manitoulin Island into Waynesville beds or Lower Richmond and *Kagawong beds or Upper Richmond*, the former being correlated with Waynesville of Ohio and northern Ky., the Kagawong faunas being distinctly younger than Waynesville of Ohio. The fossil zones are described. Total thickness of this upper part of Richmond, from Stromatocerium reef to base of Clinton, varies apparently from 45 to 60 ft. on Manitoulin. Exposed at Kagawong, Maintoulin Island.

In 1924 (Canada Geol. Surv. Mem. 138) Foerste correlated his Kagawong memb. of Richmond fm. with Whitewater and Saluda of SW. Ohio.

†Kagawong member (of Cataract formation).

Silurian (early): Ontario (Georgian Bay region).

M. Y. Williams, 1913 (Ottawa Nat., vol. 27, pp. 37–38). *Kagawong member.*—Red clay sh., which forms upper memb. of Cataract fm. in Georgian Bay region. Well exposed along road btw. villages of Kagawong and West Bay, at a locality NE. of Kagawong Lake, on Manitoulin Island. Is overlain by about 6 ft. of green sh., which appears to grade upward into the argill. dol. of Lockport fm. At Cabot Head probably 16 ft. of firm red shales underlie soft red clay sh. similar to that on Manitoulin Island. Firm red sh. containing Bryozoa overlie Manitoulin dol. along S. side of Georgian Bay. According to interpretation of writer, all the red shales are to be included in Kagawong memb. The age and complete strat. relations of a considerable thickness of gray to green shales, occurring above the red shales at Cabot Head, are not yet definitely determined, although they may, in part at least, represent a later phase of Kagawong sedimentation. They are overlain by about 6 ft. of green sh. beneath argill. dol. of Lockport age, as is the case with the Kagawong sh. on Manitoulin Island.

In 1914 (Canada Geol. Surv. Summ. Rept. for 1913, pp. 179-188) M. Y. Williams used Grabau's name *Cabot Head sh.* to replace *Kagawong*, "preoccupied by Foerste's use of the name for an upper Richmond member."

Kagel fanglomerate.

Quaternary: Southern California (San Gabriel Mountains).

M. L. Hill, 1930 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 19, No. 6, pp. 141, 144). *Kagel fm.*—The younger and topographically lower Quat. fangl., in which Kagel Canyon is being dissected. Composed of subangular and poorly sorted fragments of gneiss and granitic rocks up to 2 ft. diam. Is not so brown in color as the older Lopez fangl. Overlies Saugus fm. with angular uncon.

Kagey sand.

A subsurface sand, of Penn. (?) age, in Stephens Co., southern Okla., lying at 2,300 ft. depth in Empire pool, the Blaydes sand lying at 2,200 ft. and the Maloney at 2,600 ft.

Kaibab limestone. (Of Aubrey group.)

Permian: Northern Arizona, southern Utah, and southeastern Nevada.

N. H. Darton, 1910 (U. S. G. S. Bull. 435, pp. 21, 28, 32). *Kaibab ls.*—Top fm. of Aubrey group. Heretofore called "Aubrey" ls. Overlies Coconino ss. and underlies "Moencopie fm." of Ward. Caps Kaibab Plateau, on N. side of Grand Canyon. According to Walcott (G. S. A. Bull., vol. 1, 1890, p. 50) the ls. is 805 ft. thick on E. side of Kaibab Plateau, and according to Gilbert (Rept. U. S. Geog. Surv. W. 100th Mer., vol. 3, Geol., 1875, p. 177) it reaches its max. of 820 ft. on lower part of Kanab Creek, where it contains much chert, which locally in upper beds amounts to half of the rock. At Grand Canyon Station it is nearly 675 ft. thick; at other places 100 to 410 ft.

L. F. Noble, 1928 (U. S. G. S. P. P. 150, p. 41). Complete section of Kaibab ls. is exposed in Kaibab Gulch (a deep canyon cut entirely across N. part of Kaibab Plateau), 8± mi. SW. of abandoned settlement of Paria, Utah, about 6 mi. N. of Ariz. line. Here the Kaibab beds can be seen resting on Hermit sh. and overlain by Moenkopi fm. The section in Kaibab Gulch is therefore proposed as the type section, because it is only section of Kaibab ls. in type area that is known to be complete. [This is now recognized by U. S. G. S. as type section.]

Kailua volcanic series.

Tertiary and possibly early Pleistocene: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kailua volcanic series.*—Composed of amygdaloidal basalt and its feeding dikes or dike complex. The basalt flows are of pahoehoe and aa basalt up to 60 ft. thick. The clinker beds in the aa flows have been cemented into hard breccia. Quartz geodes are not uncommon and numerous semiprecious gems have been cut from its minerals. The rocks are distinctly metamorphosed; and the vesicles filled with secondary minerals. The source of the flow is a little NE. of the rift that supplied the Koolau volcanic series, which overlies Kailua series without any apparent uncon. The Kailua series is never in contact with Waianae volcanic series, but it is correlated with lower basalt memb. of Waianae series. It forms the low hills surrounding Kailua btw. Kaneohe and Waimanalo.

Kaimuki volcanics.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 40, 42, 44). *Kaimuki basalt.*—Varies from a dense rock nearly free from vesicles to very scoriaceous material with abundant cavities 2 centimeters in diam. Extruded from small crater that occupies center of Kaimuki spur and no part of flow extended more than 1¼ mi. from rent. Seems to be younger than Diamond Head tuff.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kaimuki volcanics.*—Chiefly basalt; some cinders and spatter. Overlies Diamond Head tuff. Included in middle part of Honolulu volcanic series [q. v.]. Forms Kaimuki Hill. Assigned to late Pleist.

†Kainozoic. See *Cenozoic*, the modern name.

Kaiparowits formation.

Upper Cretaceous: Central southern Utah (Kaiparowits Plateau region).

H. E. Gregory and R. C. Moore, 1931 (U. S. G. S. P. P. 164). *Kaiparowits fm.*—Chiefly fine-grained drab arkose ss., composed of quartz, orthoclase, albite and biotite cemented by lime. Within and btw. the ss. beds lie thin, flat lenses and stub-ended lenses of slightly more firmly cemented sand grains, commonly of lighter color, some of them buff or yellow. The fm. also contains lenses, pancakes, flattened balls, and irregular beds, some traceable 100 ft., of brown, gray-green, and white sandy ls.; some thin lenses of nearly pure ls.; also lenses of ls. cgl. of concretionary balls and irregular chunks of ls. mingled with sand. Thickness 2,000± ft. Uncon. underlies Wasatch fm. (Eocene) and overlies Wahweap ss. on Kaiparowits Peak and Table Cliff.

Kakabeka formation.

Pre-Cambrian: Ontario.

T. L. Tanton, 1931 (Canada Geol. Surv. Mem. 167, p. 25).

Kalama volcanics.

Latest Pleistocene or Recent: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kalama volcanics.*—Basalt (aa lava, petrographically an olivine basanite) and pyroexplosion deposits erupted from Kalama Crater. Included in upper part of Honolulu volcanic series [q. v.].

Kalamazoo morainic system.

Pleistocene (Wisconsin stage): Southern Michigan, northern Indiana, and possibly northern Illinois. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53 and on moraine map in P. P. 106. Named for Kalamazoo, Mich. In some earlier repts called *Kalamazoo moraine.*

Kalihi volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kalihi volcanics.*—Chiefly basalt. Included in lower part of Honolulu volcanic series [q. v.]. Occurs near head of Kalihi Valley.

Kalkberg limestone.

Lower Devonian: Eastern and east-central New York.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). *Kalkberg ls.* is proposed to cover certain layers heretofore included variously by writers with the beds above (New Scotland) or below (Coeymans), and carrying a mixed fauna, highly developed and excellently silicified on Catskill Creek [Greene Co.], where the beds show numerous thin parallel seams of black flint nodules. The name *Kalkberg* (lime hill) is local Dutch designation for the Helderbergian ridge, and is pronounced Collak-barrakh. [Thickness not stated.]

The commonly accepted classification of Helderberg group in N. Y. is (descending) Becraft, New Scotland, Kalkberg, and Coeymans lss.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 373), gives thickness of this ls. at type loc. as 25 to 40± ft., and as 20 ft. in Helderberg area.

Kalorama member.

Pleistocene: Southern California (Ventura County).

E. D. Pressler, 1929 (Univ. Calif. Pub. Bull. Dept. Geol. Sci., vol. 18, No. 13, pp. 325–345). *Kalorama memb.* (also *Kalorama horizon*).—Lower part of Las Posas fm. Contains a marine Pleist. fauna, but of cooler water than overlying Long Canyon memb. Correlated with Saugus fm. Is of approx. same age as or slightly older than Lower San Pedro Pleist.

[Derivation of name not stated.]

T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 3, p. 492). Pressler's *Kalorama memb. of Las Posas fm.* contains a typical Santa Barbara fauna, and is here included in Santa Barbara fm., which is now tentatively classified as Lower Pleist. and Upper Plio.

Kaltag formation.

Upper Cretaceous: Southwestern Alaska (Nulato-Norton Bay district, Lower Yukon River region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 395–412, chart opp. p. 474). Upper Cret. of lower Yukon region divided into 4 conformable fms. (descending), *Kaltag fm.*, Nulato fm., Melozi fm., and Ungalik cgl. The Kaltag consists of 800+ ft. of coal-bearing rocks (fresh-water ss., sh., and coal beds with possibly some thin marine members) containing fossil plants, fresh-water invertebrates, and perhaps a few marine invertebrates. Named for exposures on NW. bank of the Yukon btw. Kaltag and the Williams mine.

See under *Skaktolik group*. Also see U. S. G. S. P. P. 159, 1930.

Kamanaiki basalt.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kamanaiki basalt.*—Fresh, dark-gray, slightly vesicular basalt. Forms a V-shaped fill in Kamanaiki Valley SE. of Kamanaiki triangulation station at altitude of 750 ft., and occurs in patches at other localities in this and adjacent valleys. Included in middle part of Honolulu volcanic series [q. v.].

Kamehame basalt.

Recent and late Pleistocene (?): Hawaii (Mauna Loa and Kilauea).

H. T. Stearns, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 151) and 1930 (U. S. G. S. W. S. P. 616, p. 69). *Kamehame basalt* assigned to Recent and late Pleistocene (?).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kamehame basalt.*—Comprises all lava flows and ash deposits from Mauna Loa and Kilauea which lie above the ash memb. at top of Pahala basalt. Thickness 5 to 800 ft. The lower part was deposited in prehistoric times, the upper part in historic times. The ash beds vary in thickness from a few inches to several ft. The lavas consist of approx. equal amounts of aa and pahoehoe. Named for Kamehame Hill, 3½ mi. S. of village of Pahala, where a prehistoric lava flow entered the sea.

Kamiah volcanics.

Tertiary (probably Miocene or Oligocene): Northern Idaho (Orofino region).

A. L. Anderson, 1930 (Idaho Bur. Mines and Geol. Pam. 34). *Kamiah volcanics.*—A thick series of andesitic and latitic lava which heretofore had not been recognized in this part of Idaho, although rocks of apparently similar character are widely distributed over south-central part of state. In other localities these rocks have been assigned to Mio., with lower part probably Olig., but their age in this region cannot be accurately fixed. They rest on eroded surface of quartz diorite, of probable late Jurassic age, and were much eroded before Columbia River basalt (upper Mio.) welled up about them. They are represented in outline and area by Kamiah Buttes, about 12 mi. S. of town of Kamiah. The Buttes cover about 22 sq. mi. and rise to max. height of 1,000 ft. above plateau surface. The rocks are essentially horizontal. Most of flows of Kamiah Buttes have composition of andesite with at least one of quartz latite. Most of the andesites are grayish and vesicular, but some are reddish.

Kaminis granite.

Pre-Cambrian: Manitoba.

E. L. Bruce, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. D, p. 6).

Kaministikwia group.

Pre-Cambrian: Canada (Rainy River district).

T. L. Tanton, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 114, abstract). The *Kaministikwia group* (Upper Copper-bearing series of Logan), a granite intrusive, is divisible into following 3 series (descending) *Osler series, Sibley series,* and *Animikie series.* Rests with great uncon. on Basement Complex. [All of definition. Type localities not stated.]

See also *Kaministiquia fm.*

T. L. Tanton, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 739), and 1931 (Canada Geol. Surv. Mem. 167, p. 57), gave additional information.

Kaministiquia formation.

Age (?) : Western Ontario.

Cambrian according to Chapman (Canada Inst., n. s., vol. 8, pp. 186–190, 1863) ; Algonkian (Huronian) according to Walcott (Geol. Soc. Am. Bull., vol. 10, p. 222, 1899) ; same as Keweenawan according to W. G. Miller and C. W. Knight (Ontario Bur. Mines Rept., vol. 22, pt. 2, chart opp p. 126, 1914).

See also *Kaministikwia group.*

Kamishak chert.

Upper Triassic: Central southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 485, p. 47, table opp. p. 80, map, etc.). *Kamishak chert.*—Thin-bedded chert, black calc. sh., and impure ls.; the chert and ls. generally black, green, or dark red when fresh, but weather to lighter shades. Complexly crumpled and faulted, cut by small calcite veins, and intruded by quartz diorite. Typically exposed on W. shore of Kamishak Bay, especially in vicinity of Bruin Bay. Total thickness unknown; at Ursus Cove it probably exceeds 2,000 ft. and may be much greater. Contains Upper Triassic invertebrates.

Kamloops volcanic group.

Miocene or Oligocene: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 118), and C. W. Drysdale (p. 241 of book cited).

Kamouraska formation.

Cambrian (?): Quebec.

J. A. Dresser, 1912 (Canada Geol. Surv. Mem. 35, p. 14). [Assigned to Camb., but later repts by others question the age.]

†Kanab sandstone.

Jurassic (?) and Upper Triassic: Southwestern Utah (Kane County).

E. Huntington and J. W. Goldthwait, 1903 (Jour. Geol., vol. 11, pp. 46–63), divided the rocks btw. Colob [Navajo] ss. above and Shinarump cgl. below into *Upper Kanab* (red ss.) and *Lower Kanab* (red sss. and sh), and also designated the Upper Kanab as *Kanab ss.* In 1904 (Harvard Coll. Mus. Comp. Zool. Bull., geol. ser., vol. 6, p. 203, pl. 7) they restricted *Kanab ss.* to their *Upper Kanab* (which they described as consisting of 1,750 ft. of hard red ss., often cross-bedded, with a thin series of weak beds at base) and named their Lower Kanab (Upper Triassic) the *Painted Desert shales.*

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 33), show Kanab ss. of Huntington and Goldthwait's 1904 rept. is=lower part of Navajo ss. and upper part of Chinle fm.

Kanab limestone.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 66, 1936, p. 216) to replace *Kaibab ls.*, which was introduced in 1910 to replace "Aubrey ls.," the term *Aubrey* being adopted in the broader sense in which it had been used for many years. Derivation of name not stated.

Kanaka formation.

Mississippian: Northern California (Colfax region).

H. G. Ferguson, 1929 (Am. Inst. Min. and Met. Engrs. Pub. 211, p. 4). *Kanaka fm.*—Chiefly interbedded dark-colored slates and chloritic greenstones (the latter largely andesitic tuffs and breccias), with a cherty memb. [200 to 300 ft. thick] toward middle of fm., and a basal conglomeratic memb. [200 to 350 ft. thick]. Contains some beds that are interpreted as flows, and possibly in part intrusive sheets, of andesite and dacite. Thickness of fm. probably nearly 2,000 ft. Conformably underlies Relief qtzite and overlies, probably uncon., Tightner fm. Named for exposures in valley of Kanaka Creek, Sierra Co. Extends from Oregon Creek to South Yuba.

Kanawha black flint. (In Kanawha formation.)

Pennsylvanian: Northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 98). *Kanawha black flint.*—Beneath Mahoning ss., and forming basal beds of Elk River series, are shales, 0 to 50 ft. thick, containing (along Great Kanawha River, on Elk River, and at other places) a peculiar deposit known locally as "Black Flint." It is usually of dark or bluish color, but in places is light-colored; is 5 to 15 ft. thick, and contains marine fossils.

This bed is in upper part of Kanawha fm., lying 80 to 150± ft. below Homewood ss. memb.

Kanawha formation. (In Pottsville group.)

Pennsylvanian: West Virginia and adjacent parts of Virginia and Kentucky.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2). *Kanawha fm.*—Great mass of coals, shales, and sss., 1,150 to 1,200 ft. thick, underlying Charleston ss. and overlying Fayette ss. Includes [Kanawha] black flint at top. Complete section exposed in hills N. of Kanawha Falls, W. Va.

M. R. Campbell, 1901 (U. S. G. S. Charleston folio, No. 72). *Kanawha fm.* underlies Charleston ss. and overlies Sewell fm.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Kanawha fm.* is overlain by Charleston ss. and underlain by Nuttall ss. lentil of Sewell fm.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A). *Kanawha series or Upper Pottsville.*—Includes all beds btw. top of Roaring Creek (Homewood) ss. and top of Nuttall ss. [This is definition of Kanawha "group" that is still followed by W. Va. Geol. Survey.]

†Kanawha series.

†Kanawha River series.

†Kanawha River Coal Series.

†Kenawha Coal Measures.

†Kenawha River system.

In some early repts the name "Kenawha River system" was applied to rocks in W. Va. and Pa. that included Pottsville group, Mauch Chunk sh., and Greenbrier (†Mountain) ls. of present repts; the name "Kanawha series" was applied to Allegheny fm. and most of Pottsville group of present terminology; and the names "Kanawha River series," "Kenawha Coal Measures," and "Kanawha River Coal Series" were applied to middle part of Pottsville group as now recognized in W. Va., or to approx. the New River "group" of the present W. Va. Survey classification. These usages of *Kanawha* were, however, long ago abandoned.

†Kanawha Falls rock.

A name that has been applied locally to Homewood ss. memb. in southern W. Va., because it forms the Kanawha Falls in Kanawha River.

Kandik formation.

Lower Cretaceous: Northeastern Alaska (Eagle-Circle district).

J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 816, p. 136). *Kandik fm.*—Name applied (by E. Blackwelder in unpublished notes) to the Lower Cret. rocks of the upper Yukon, which are typically exposed in valley of Kandik River from the Yukon NE. probably to the bdy. Mainly a monotonous sequence of black argill. sl. and thin sss. No calc. sh., ls., chert, or silicious sl. seen. Lies everywhere uncon. on pre-Jurassic rocks, the Jurassic being absent. Believed to underlie uncon. the Upper Cret. rocks. Name is intended to include all Lower Cret. sed. rocks of the region, but it seems highly probable only ss., sl., and cgl. are represented. Thickness 2,400+ ft. Lower Cret. fossils.

Kane limestone. (In Allegheny formation.)

Pennsylvanian: Central northern Pennsylvania (Elk County).

C. A. Ashburner, 1885 (2d Pa. Geol. Surv. Rept. R_2, pp. 72, 73). *Kane ls.,* also *Kane Quarry (Ferriferous) ls.*—Rotten greenish-gray ls., 3 ft. thick, forming upper bench of Ferriferous. Quarried at Gen. Kane's quarry, W. of road leading from Catholic Church to J. Pistner's, Elk Co. Separated from bottom bench of Ferriferous ls. by 8 ft. of gray sh. and 1 ft. of iron ore.

Kane sand.

A subsurface sand of Upper Dev. age in western Pa. Is older than Bradford sand group, and has been placed below Elk sand in some repts, but Pa. Geol. Surv., 4th ser., Bull. M19, 1933, plates, places 1st Kane, 2d Kane, and 3d Kane sands of McKean Co., Pa., higher than 1st Elk, 2d Elk, and 3d Elk. J. D. Sisler stated (p. 28 of Bull. M19) "the Kane of Bradford dist. does not correlate with Kane sand of Kane dist." [McKean Co.]. In W. Va. the name has been applied to sand said to be of Portage age.

Kanektok silts and gravels.

Pleistocene: Central southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, p. 177). *Kanektok silts and gravels,* Pleist., extend along lower course of Kanektok River to Oklune Mtns and farther up Kanektok River.

Kaneohe volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kaneohe volcanics.*—Chiefly basalt. Included in lower part of Honolulu volcanic series [q. v.]. Type loc. on main highway 2 mi. S. of village of Kaneohe.

Kangaroo formation.

Permian and Pennsylvanian (?): Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 70). *Kangaroo fm.*—Qtzites, cgls., and metamorphosed shales; generally gray, often with brown, blue, or light-green tones; cgl. at base. Thickness 3,000 ft. Includes all sed. rocks in dist. above Garfield fm., upon which it lies with uncon. Named for Kangaroo Gulch, Monarch dist.

Kankakee limestone.

Silurian (early): Northeastern, central, and western Illinois, and eastern Missouri (north of St. Louis).

T. E. Savage, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 305–324). *Kankakee ls.,* new name for 20 to 39 ft. of hard gray to brown ls., of Brassfield age, in NE. Ill., western Ill., and eastern Mo. N. of St. Louis. Contemp. with Sexton Creek ls. of SW. Ill. and eastern Mo., but deposited in separate basin. Uncon. overlies Edgewood ls., which includes *Platymerella manniensis* zone at top. Well developed and clearly exposed along Kankakee River about 5 mi. S. of Richey [Macon Co., *central* Ill.].

T. E. Savage and M. L. Nebel, 1923 (Ill. Geol. Surv. Bull. 43, pp. 22–72). *Kankakee ls.,* relatively pure nonmag. ls. 0 to 50 ft. thick, was deposited at about same time as Sexton Creek ls. of SW. Ill. but in a sea that invaded from E. or NE. and extended as far as Calhoun and Jersey Counties, Ill.

D. J. Fisher, 1925 (Ill. Geol. Surv. Bull. 51). *Kankakee fm.,* 20 to 70 ft. thick in Joliet quad., NE. Ill., includes all rocks lying above *base* of *Platymerella manniensis* zone and below Niagaran dol. Rests uncon. on Edgewood fm. Is top fm. of Alexandrian series. [This definition placed *Platymerella manniensis* zone in Kankakee. It had previously been included in Edgewood ls.]

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 517–526, 533). *Kankakee (Brassfield) ls.* of NE. Ill. includes *Platymerella manniensis* zone, rests uncon.

on Edgewood ls. and is overlain uncon. by Joliet ls. (of early Lockport age), Clinton being absent. Is same as "Waucoma ls." [*which has priority over Kankakee*, and is an Iowa name].

T. E. Savage, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 286–287). *Sexton Creek* (*Brassfield*) *ls.* extends as far N. as Belvidere, near N. border of State [in McHenry Co.].

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 48). Savage determined his Waucoma to be same as Kankakee, the earlier name, and Kankakee is now applied in NW. Ill. [Waucoma has priority, but is an Iowa name, while Kankakee is an Ill. name.]

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 270–274). *Kankakee fm.*, top fm. of Alexandrian series in NE. and NW. Ill. Consists of 20 to 70 ft. of purplish-gray, white, buff, brownish, or yellowish-brown ls. and dol. in layers 3 to 36 in. thick. Commonly cherty in NW. Ill. and Iowa. Includes *Platymerella manniensis* zone at base. Overlies Edgewood ls. and underlies Joliet ls. Is correlated with *Waucoma* (*Kankakee*) of Iowa, the Byron of Wis., the Brassfield of Ind., Ohio, Ky., and Tenn., and the Sexton Creek of southern Ill.

See also under *Sexton Creek ls.*

Kankakee torrential deposits.

Pleistocene: Illinois. See L. F. Athy, 1928 (Ill. Geol. Surv. Bull. 55, p. 66).

Kano quartz diorite.

Jurassic (?): British Columbia.

J. D. MacKenzie, 1916 (Canada Geol. Surv. Mem. 88, p. 51).

Kanouse sandstone.

Middle Devonian: Northern New Jersey and southeastern New York.

H. B. Kümmel, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). *Kanouse ss.* introduced to replace [objectionable] name "New Foundland grit." Thick-bedded fine-grained cgl. below and greenish ss. above. Thickness 215 ft. Underlies Pequanac [Cornwall] sh. and rests on Decker ls. Carries Onondaga fauna. Exposed in valley W. of Kanouse Mtn [Passaic Co.], N. J.

Kansan stage of glaciation, also **Kansan drift** (Pleistocene).

Kansan drift is name applied to second drift of eastern, as well as western, part of area covered by Laurentide ice sheet; the name *Kansan stage* being applied to the time during which this drift was deposited. The drift was named for its development in Kansas. The name *Kansan* was originally applied by T. C. Chamberlin (Geikie's Great ice age, 3d ed., 1894, pp. 724–775, and Jour. Geol., vol. 3, pp. 270–277, 1895) to *oldest* drift of western or Keewatin part of Laurentide ice sheet, the name "*East Iowan*" being applied to the second drift; but in 1896 (Jour. Geol., vol. 4, pp. 872–876) Chamberlin, as the result of further studies, shifted the name *Kansan* to the *second* drift (which is the drift that covers NE. Kansas), and shifted the name Iowan to a younger drift. The Kansan drift overlies Aftonian soil and interglacial deposits and underlies Yarmouth interglacial deposits.

Kansan period.

Pennsylvanian: Kansas.

L. C. Wooster, 1906 (Kans. Acad. Sci. Trans., vol. 20, pt. 1, pp. 75–82), divided Carbf. of Kans. into (descending) Permian period, *Coal Measures or Kansan period*, and Mississippian period; and divided his *Kansan period* into Upper Coal Measure or *Upper Kansan epoch* (from top of Elmdale fm. to top of Iola ls.) and Lower Coal Measure or *Lower Kansan epoch* (from top of Iola ls. to base of Cherokee sh.).

†Kansas onyx.

Popular name for Medicine Lodge gyp. where quarried in Barber Co., Kans.

†Kansas City oolite.

Pennsylvanian: Northwestern Missouri.

G. C. Broadhead, 1886 (St. Louis Acad. Sci. Trans., vol. 4, p. 483). The oolitic ls. in Coal Measures of Miami and Franklin Counties, Kans., very much resembles *Kansas City oolite*, but is probably a different stratum, higher in the series.

Is upper part of Drum ls. memb. of Kansas City fm. and same as Kansas City ls. of Gallaher, according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13), but is older than Drum ls., according to N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 35, 40), and is upper part of Westerville ls., the lower (nonoolitic) part being called "Bull ledge" at Kansas City.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 95, 100, 252). †Kansas City oolite of Broadhead refers to beds now classed as Westerville ls. and is abandoned.

†Kansas City limestone.

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Geol. Surv. Bien. Rept., p. 51), and 1900 (Mo. Geol. Surv. vol. 13, p. 206), used *Kansas City ls.* for a bed of ls. in Upper Coal Measures of Mo. btw. coals Nos. 5 and 6, which is same as †Kansas City oolite of repts, and composes upper part of Drum ls. memb. of Kansas City fm. of Hinds and Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), who divided Drum ls. into two beds separated by thin sh., the upper bed being the "oolitic ledge" and the lower bed the "Bull ledge" of repts. According to R. C. Moore (1936), however, the Drum of Hinds and Greene is Westerville ls., and true Drum is younger. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Kansas City group. (In Kansas.)

Kansas City formation. (In Missouri and Iowa.)

Pennsylvanian: Northwestern Missouri, eastern Kansas, southeastern Nebraska, and southwestern Iowa.

H. Hinds, 1912 (Mo. Bur. Geol. and Mines vol. 11, p. 7). *Kansas City ls.*—Basal fm. of Missouri group, extending from top of Iola ls. memb. down to base of Hertha ls. memb. Underlies Lansing fm. and overlies Pleasanton fm., of Des Moines group. Thickness 225 ft. at Kansas City, 200 ft. in Harrison Co. and at Leavenworth, and 165 ft. near St. Joseph. Very thick lss. interbedded with sh. [See also Hinds and Greene, Mo. Bur. Geol. and Mines vol. 13, 1915.]

The foregoing was commonly accepted definition of Kansas City group until 1932.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 91, 97). In reclassification of Penn. system of Kans. the term *Kansas City group* is tentatively proposed to apply in a *restricted* sense to the mainly sh. unit which occurs btw. top of Winterset ls. and base of Wyandotte ls. It includes (descending) Lane sh. [restricted], Iola ls., Chanute sh., Drum ls., and Cherryvale sh. [This definition excluded from lower part the Winterset ls., Galesburg sh., Bethany Falls ls., Ladore sh., and Hertha ls.]

R. C. Moore and G. E. Condra, Oct. 1932 (Revised classification chart of Penn. rocks of Kans. and Nebr.), again redefined *Kansas City group*, by drawing its top at base of Plattsburg ls. and its base at top of Winterset ls., the Winterset and underlying beds formerly included in the Kansas City being included in their Bronson group. This restricted definition of Kansas City was followed by Moore in his 1935 and 1936 classifications. According to Moore the so-called Iola ls. of Hinds and Greene is not true Iola but is Argentine ls.; according to Newell (1935) it is = Frisbie and Argentine lss.

For Moore and Condra's modified definitions see Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. The U. S. Geol. Survey has not yet considered, for its publications, these modified definitions.

The 1933 (57th) Bien. Rept. of Mo. State Geol. continued to draw top of Kansas City fm. at top of Iola ls. and base at base of Hertha ls.

Named for Kansas City, Mo., at and near where its full thickness of 225 ft. is exposed, in the bluffs on which the city is located.

Kanuti group.

Paleozoic: Northern central Alaska (Kanuti River region).

W. C. Mendenhall, 1902 (U. S. G. S. P. P. 10, p. 37, pl. 5). *Kanuti series.*—Youngest rocks of series are basalts, basaltic tuffs, and diabases, in some instances intrusive into the serpentines of the series. Oldest members are greenstones of doubtful origin and hornstones, which are succeeded by massive gabbroic rocks, and serpentines derived from them, which are regarded as intrusive into the greenstone members. Kanuti River flows for 30 mi. through canyon cut in these Paleozoic rocks. May belong to same period as Spurr's Rampart series.

P. S. Smith, 1936 (U. S. G. S. Bull. in process of publication). Kanuti series of Mendenhall probably includes rocks of diverse ages. The bulk of them appear to be Dev. or Carbf., but H. M. Eakin suggests that some he studied may be as old as Ord.

Kanuyak formation.

Pre-Cambrian: Arctic Canada.

J. J. O'Neill, 1924 (Canadian Arctic Expedition 1913–18, Rept., vol. 11, pt. A, p. 22).

Kanwaka shale (in Shawnee group), in Kansas.

Kanwaka shale member (of Shawnee formation), in Missouri.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

J. W. Beede, 1902 (Kans. Univ. Sci. Bull., vol. 1, p. 163). *Kanwaka shales* proposed by G. I. Adams, in unpublished ms., for sh., at least 97 ft. thick, divided into 65 ft. of clay sh. at base, overlain by 16 ft. of aren. sh. succeeded by 5 ft, of sandrock, with 11 ft. of sandy buff sh. at top. Overlies Oread ls. and underlies Lecompton ls.

Was for years treated as basal memb. of Shawnee fm. (In Kans. the Shawnee is treated as a group and the Kanwaka sh. as a fm.) Since 1931, however, R. C. Moore has drawn base of Shawnee group at base of Oread ls., instead of at base of Kanwaka sh. When Condra introduced *Kereford ls.* in 1927 he included it and an underlying sh. in Kanwaka sh., and treated Plattsmouth ls. as top memb. of Oread ls. But in 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 89–97) R. C. Moore transferred Kereford ls. and underlying sh. (Heumader sh.) to Oread ls.; and Condra's 1935 and Moore's 1936 classifications followed latter definitions of Kanwaka sh. and Oread ls.; but Moore stated (p. 169) that where Kereford ls. is absent Kanwaka sh. extends down to top of Plattsmouth ls. The U. S. Geol. Survey has not considered, for its publications, these modified definitions.

Named for fact it forms a large part of surface of Kanwaka Twp, Douglas Co., Kans. R. C. Moore stated (Kans. Geol. Surv. Bull. 22, 1936, p. 169) type loc. is exposures E. of Stull, 9± mi. due W. of Lawrence. Also that it is well exposed near SE. cor. sec. 26, T. 12 S., R. 18 E.

Kaohikaipu volcanics.

Latest Pleistocene or Recent: Hawaii (Kaohikaipu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kaohikaipu volcanics.*—Basalt (black pahoehoe) and pyro-explosion deposits (bedded red cinders, spatter, and bombs cut by irregular dikes) composing Kaohikaipu Island. Included in upper part of Honolulu volcanic series [q. v.].

†Kappa subdivision.

A Greek name applied by F. W. Cragin (U. S. G. S. Bull. 266, 1905) to upper 40 ft. of Malone fm. of Malone Mtn, El Paso Co., Tex.

Karmutsen volcanics.

Triassic: Vancouver Island.

H. C. Gunning, 1933 (Canada Geol. Surv. Summ. Rept., pt. A2, p. 33).

†Karquines series.

†Karquinez series.

See *Carquinez*, the spelling adopted by U. S. Geog. Board.

Kasaan greenstone.

Probably Lower Cretaceous: Southeastern Alaska (Ketchikan region).

A. H. Brooks, 1902 (U. S. G. S. P. P. 1, pp. 40–52, map). *Kasaan greenstone.*—Largely effusive rock, of general character of andesite, but shows great local variations and probably includes some intrusive rocks. Occurs in peninsula lying btw. Clarence Strait and Kasaan Bay. The peculiar copper deposits of Kasaan Peninsula are associated with this rock.

Kashong member. (In Moscow shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 218, 231, etc.). *Kashong memb. of Moscow fm.*—Soft sh. characterized by *Adolfia marcyi* and great abundance of unusually large and well preserved specimens of *Tropidoleptus carinatus*, capped by 3 to 5 ft. of sh. containing grotesquely shaped calc. concretions. This concretionary bed is succeeded by 4 ft. of hard sandy rock, at base of which *Leptostrophia junia* occurs in great abundance. The sandy rock is top bed of Kashong memb. Thickness 39 ft. W. of Canandaigua Lake and 80 to 85 ft. in Genesee Valley. Thins to W. and disappears W. of Spring Brook. Writer believes the Kashong correlates with *Orthonota* zone of Cleland in Cayuga Lake region and that it thins eastward by nondeposition. In W. part of State it is overlapped by Windom sh. The Kashong sh. of Genesee Valley and westward is partial equiv. of Portland Point memb. Type section is on Kashong Creek, Seneca Lake, where it is 24 ft. thick.

Kaskapau member.

Cretaceous: Alberta.

F. H. McLearn, 1926 (Canada Geol. Surv. Bull. 42, p. 119).

†Kaskaskia limestone.

†Kaskaskia formation.

†Kaskaskia group.

Mississippian: Western Illinois, eastern Missouri, and western Kentucky.

J. Hall, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pp. 55–56). *Kaskaskia ls. or Upper Archimedes ls.*—Extensive and important ls. fm., constituting the lss. of Kaskaskia and Chester, Ill., and those below Ste. Genevieve, Mo. Consists of beds of ls., of greater or less thickness, alternating with thin seams of marl or sh., and in some parts heavy-bedded ls. of considerable thickness, without shaly partings or with very thin ones. Also embraces one or more heavy ss. beds and mass of green sh. or marl, more than 50 ft. thick in places. Overlain by Coal-measures and underlain by Ferruginous [Aux Vases] ss.

Replaced by more widely established term *Chester group*, used by A. H. Worthen (who first correctly interpreted the true relations of the rocks) in manuscripts as early as 1853. The type loc. of Chester group is Chester, Randolph Co., Ill., at mouth of Kaskaskia River.

Named for Kaskaskia, Ill., near mouth of Kaskaskia River.

Kaskaskian series.

A term used by C. R. Keyes to cover same rocks as Chester group. (See his broadside sheet of geol. fms. of Ill., 1923.)

Kaslo volcanics.

Carboniferous: British Columbia.

M. F. Bancroft, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. B, pp. 29, 36).

Kaslo schists.

Jurassic: British Columbia.

M. F. Bancroft, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 43).

Kaslo series.

Triassic: British Columbia.

C. E. Cairnes, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. A, p. 98), and J. F. Walker, p. 127 of same rept. Also J. F. Walker and M. F. Bancroft, 1929 (Canada Geol. Surv. Mem. 161, p. 14).

Kasota sandstone.

Lower Ordovician: Southeastern Minnesota (Lesueur County).

L. H. Powell, 1935 (St. Paul Inst. Sci. Mus., Sci. Bull. 1, pp. 2–16). The fauna of the sand bed (6½ ft. thick) btw. Jordan ss. and Oneota dol. is unique, and on basis of fauna the bed is here described as *Kasota ss. fm.* and tentatively correlated with Eminence dol. of Mo. The fauna is believed to be Ord. [This ss. and the overlying "siltstone" were included in Oneota dol. by Stauffer, 1925, 1934.] Named for characteristic exposure in bluff of Minn. River at Kasota, Minn. Consists of white, medium- to coarse-grained sand, grains well rounded, bedding somewhat irregular. Can only be separated from underlying Jordan ss. by its fauna, which is known to occur at St. Peter in bank of Minn. River beneath W. end of highway bridge, at Kasota in upper sand beds in a sandpit in bluff of Minn. River, and at Rapidan, Blue Earth Co. The bed is apparently reworked Jordan ss., reworked at a later age, and contains a fauna of that age. It is overlain, seemingly conformably, by Blue Earth siltstone bed. [Fossils described and discussed. On p. 17 he said: From Ottawa to Mankato, along Minn. River, the Kasota ss. seems to be everywhere overlain by a thin bed of white to greenish (sometimes red) laminated siltstone (the Blue Earth siltstone), which seems to spread beyond the limits of Kasota ss. and in places to rest directly on Jordan ss. On p. 21 he said Kasota ss. and Blue Earth siltstone intervene btw. Oneota dol. and Jordan ss. only in limited region from Ottawa, Minn., to Mankato.]

A. C. Trowbridge. 1917 (Proc. Iowa Acad. Sci., vol. 24, pp. 177+), stated that Oneota dol. of Upper Miss. Valley rests conformably on Jordan ss. through 20 ft. or more of transition beds.

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, pp. 706–707), published a section of Oneota dol. and Jordan ss. in Minn. River Bluff and at adjacent quarries at Kasota, Minn., in which he stated that floor of the quarry lies 10 ft. above top of Jordan ss.; this 10-foot interval consisting of (descending): (1) ls., dolomitic, gray to buff, mottled, thin-bedded, base very uneven, 3 ft.; (2) clay or clay sh., gray to greenish, 6 in.; (3) ss., white, medium- to coarse-grained, with numerous specimens of *Raphistoma minnesotensis* together with several species of same genus, several species of *Ophileta*, and a trilobite, bedding somewhat irregular, 6½ ft. He stated (p. 706) that this basal 6½ ft. had always been included in Jordan ss., but that it was probably reworked after deposition and should be included with the Oneota (p. 713), where its fauna seemed to belong (p. 712).

The Kasota ss. of L. H. Powell is an older rock than the Kasota stone of the trade, lying 3½ to 6 ft. lower in the section.

A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1), show *Blue Earth and Kasota, local fms. in Minn.*, as equiv. to basal part of Oneota dol.

The U. S. Geol. Survey at present recognizes Oneota dol. as resting on Jordan ss.

Kasota stone.

A trade name applied to a stone quarried from Oneota dol. at Kasota, Lesueur Co., Minn., according to O. Bowles (U. S. G. S. Bull. 663, 1918).

Katahdin granite.

Carboniferous (?): Western Maine (eastern part of Piscataquis County).

C. H. Hitchcock, 1861 (Maine Bd. Agric. 6th Ann. Rept., p. 259), mentioned *Katahdin granite.*

F. W. Toppan, 1932 (Geol. of Maine, Contr. Dept. Geol. Union Coll., Schenectady, pp. 68–69). *Katahdin granite.*—Lying on E. bdy of Piscataquis Co. and extending into Penobscot Co. is a great mass of granite that represents a denuded batholith of which Mount Katahdin, 5,267 ft. A. T., is most conspicuous feature.

In hand specimen it is medium-coarse, even-grained granite tinted slightly pink by the orthoclase feldspar. Intrudes Ripogenous series (Sil.).

On the 1933 geol. map of Maine, by A. Keith, this granite is assigned to Carbf.

Katalla formation.

Tertiary (Miocene ?): Southeastern Alaska (Katalla district, Controller Bay region).

G. C. Martin, 1905 (U. S. G. S. Bull. 250, p. 13). *Katalla fm.*—Series of dark, argill. and carbonaceous shales, with occasional bands of ss., ls., cgl., and volcanic ash. Petroliferous. Typically exposed in region NE. of Katalla, along banks of Katalla River, and in range of hills to SE., whence it extends eastward, occupying whole of peninsula btw. Bering Lake and Controller Bay and cropping out in most of hills S. and E. of Bering River. Good exposures on W. shore of Bering Lake. The few fossils indicate Tert. age, probably Eo. Is probably overlain by Kushtaka fm., of probable Olig. age. Thickness undet.

G. C. Martin, 1908 (U. S. G. S. Bull. 335, pp. 24, 27), gave thickness of the 5 members of Katalla fm. in Controller Bay region, which aggregate 6,500 ft., and stated that "position of the fm. with reference to the other Tert. fms. is not definitely established," but in columnar section he placed a new fm., named *Stillwater*, btw. the Katalla and the Kushtaka fm. The Katalla fm. occurs to S. of Bering Lake, the Stillwater, Kushtaka, and Token to N. of Bering Lake.

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 771–782). *Writer has divided the marine Katalla fm. of Martin into 2 fms.*, largely on basis of lithology. There is no strat. break btw. the 2 fms., but a decided change in lithology. The *lower*, 3,600+ ft. thick, is here called *Katalla fm.*; the upper, 5,100± ft. thick, is here named *Redwood fm.* The Katalla is further divided into Burls Creek sh. memb. above and Split Creek sh. and ss. below. It occupies fully 85 percent of Katalla dist.; the Redwood is restricted to a broad, steeply plunging syncline btw. Redwood and Burls Creeks and to ridge btw. Cave and Hey Points. Fossils rare and as a rule poorly preserved, but the sediments are similar lithologically to the fossiliferous beds of Yakataga dist., which are pronounced by B. L. Clark to be upper Olig., and they are therefore here assigned to upper Olig. The Katalla and Redwood fms. are also well developed in Nichawak dist.

The U. S. Geol. Survey classifies typical Katalla fm. as Mio. (?).

†Katemcy series.

Upper Cambrian: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxi, 289–293). *Katemcy (Potsdam) series.*—Consists of (descending): (1) Cgl. and ls. called Potsdam ls; (2) greenish shales and sandy lss. called Potsdam flags; (3) greensand 20 ft, white ss. 10 to 20 ft., and red ss. 50 to 100 ft., together known as Potsdam ss. or Lingula grits. Uncon. overlies Riley series and underlies Leon series.

Includes most if not all of Camb. (Upper Camb.) of central Tex.

Named for Katemcy Creek, Mason Co.

Katherine granite.

Pre-Cambrian: Northwestern Arizona (Katherine district, Mohave County).

C. Lausen, 1931 (Ariz. Bur. Mines Bull. 131, map (pl. 2) and pp. 22–27). *Katherine granite.*—The prevailing rock in Katherine dist. A coarse-grained, somewhat porphyritic granite; weathers brownish, due to decomposition of ferromagnesian constituents.

†Katmai series.

Term applied by W. C. Mendenhall (U. S. G. S. 20th Ann. Rept., pt. 7, 1900, table on p. 317) to Jurassic rocks described by Spurr. In essentially the same table published by Spurr on p. 187 of book cited the name *Naknek series* appears instead of *Katmai series*, and on p. 169 Spurr described the rocks at Katmai, Katmai Point, and on Katmai River as *Naknek series*. Spurr appears to have changed his ms. name *Katmai series* without informing Mendenhall of the change.

Katsberg red beds.

Upper Devonian: Eastern New York (Catskill Mountains).

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 480, 482–483, 484). *Katsberg red beds.*—Upper or Enfield part of Catskill fm., as I proposed (16th Int. Geol. Cong. Guidebook 9A, p. 4, 1933) to restrict that name, but proposed restriction now seems questionable. I therefore now propose the old Dutch name for these mtns miscalled "Catskills" by the English (kill is creek), namely *Katsberg* (pronounced cots-barrakh). Grades down into red beds, of Tully to Oneonta age, here named *Onteora red beds.* Type section of *Katsberg fm.* will be taken in steep slopes of highest peak, Slide Mtn, exclusive of the capping Slide Mtn cgl. (possibly of Chautauquan age).

K. E. Caster, 1934. (See 1934 entry under *Catskill fm.*)

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862). *Katsberg red-beds fm.*, of Enfield age, includes (descending) Van Etten, Julland, and Kattel.

Kattel shale.

Upper Devonian: Southeastern New York (Otsego County).

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7). The lower Enfield (*Kattel*) extends E. to Delhi as the "Chemung" of N. Y. map before reddening. Overlies Oneonta.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 191, 192). *Kattel sh.*—Marine sh. of lower Enfield age. Underlies Katsberg beds (partly red) and overlies Oneonta red beds.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862). The Enfield splits into (ascending): *Kattel* ("*Leiorhynchus globuliforme*") zone and the Julland and Van Etten ("First *Tropidoleptus*") zones. The Kattel persists as a marine deposit (600 ft. thick) far E. btw. Oneonta reds below and Enfield beds above, and forms a recognizable band of grey flagstones clear through the continental mass of Catskill Mtns. The continental Kattel and later beds, of Enfield age, constitute Katsberg red-beds fm. or upper half of restricted Catskill.

G. H. Chadwick, 1936 (letter dated Jan. 2). Type loc. of Kattel is Kattel Hill, especially the long Lackawanna railway cut around its E. base, btw. Chenango Bridge and Chenango Forks.

Kaupo basalt.

Latest Pleistocene or Recent: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Kaupo basalt.*—Pahoehoe basalt, on which the abandoned village of Kaupo is located. Included in upper part of Honolulu volcanic series [q. v.].

†Kawishiwin agglomerate.

†Kawishiwin greenstones.

†Kawishiwin series.

Pre-Cambrian (Keewatin): Northeastern Minnesota (Vermilion district).

N. H. Winchell, 1889 (Minn. Geol. Surv. 17th Ann. Rept., for 1888, pp. 41–42, 45–46, 68, 70). *Kawishiwin.*—Name proposed for the greenstone stage of the Keewatin, because Kawishiwi River and some of its tributaries run for many mi. over rock belonging to this epoch of the Keewatin.

N. H. Winchell, 1892 (Am. Geol., vol. 9, pp. 359–368). *Kawishiwin aggl.* (also *Kawishiwin greenstones*).—The youngest memb. of the Keewatin, the pronounced "greenstone" stage in which occur the iron ores of Vermilion iron range in Minn.

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 546). It is now known that the greenstone terrane or *Kawishiwin* contains the oldest known rocks in Minn. It is proposed to continue the use of this term and to include in it both massive and fragmental portions of the greenstones of the Lower Keewatin.

N. H. Winchell, 1900 (Minn. Geol. Surv. Final Rept., vol. 5). Lower Keewatin or *Kawishiwin series* consists of massive and fragmental greenstones uncon. underlying Upper Keewatin.

J. M. Clements, 1903 (U. S. G. S. Mon. 45, p. 131). "Kawishiwin" was proposed by Minn. Geol. Surv. to comprise Ely greenstone and Soudan fm. of this vol.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52). Winchell's "Kawishiwin greenstones" is same as Ely greenstone, and his "Kawishiwin aggl." is an ellipsoidal phase of the Ely greenstone.

Kayenta formation. (In Glen Canyon group.)

Jurassic(?): Southeastern and southern Utah, northeastern Arizona, and southwestern Colorado.

A. A. Baker, C. H. Dane, and E. T. McKnight, June 1931 (U. S. G. S. prel. map showing geol. structure of parts of Grand and San Juan Counties, Utah). *Kayenta fm.*—Irregularly bedded gray to red ss. with subordinate sh. Thickness 200 to 320 ft. Name adopted to replace *Todilto (?)*, field studies by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., having shown that Todilto ls. at its type loc. is much younger than Kayenta fm. Type loc. for Kayenta fm. is 1 mi. N. of Kayenta, Ariz. Underlies Navajo ss. and overlies Wingate ss.

This fm. is more fully described and mapped by A. A. Baker, 1933 (U. S. G. S. Bull. 841), and by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183).

Kearsarge conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 114 and chart). Is cgl. No. 11 of Keweenaw Co.

Belongs to Central Mine group.

Named for occurrence in old Kearsarge mine, Houghton Co.

Kearsarge andalusite group.

Paleozoic (?): Central southern New Hampshire (Mount Kearsarge quadrangle, Merrimack County).

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 585–588, 674, pl. 24). *Kearsarge andalusite group.*—A mass of strata similar to Monadnock area of andalusite rocks. Occurs upon Mounts Kearsarge and Ragged, constituting a band 12 mi. long and from 3 to 4 mi. wide in towns of Warner, Sutton, Andover, and Salisbury. The strata display large contortions, while the gneisses below do not seem to have been greatly disturbed. Clearly these schists are granitic masses, approx. similar to those so common in the Rockingham country. The crystals are smaller than on Monadnock or E. side of Mt. Washington, but are well defined in certain localities, sufficiently so to render probable the reference of all the elongated prisms to the mineral andalusite, rather than fibrolite. The Kearsarge area is more sandy than the Monadnock, or especially the Mount Washington, which carries a great deal of argill. matter. All these areas are believed to be of same age. Thickness of Kearsarge andalusite group is 1,300 ft. Of Paleozoic (?) age. Older than Coos group and Calciferous mica schist, and younger than Lyman, Lisbon, and Swift Water groups. [On map placed above his Merrimack group.]

C. H. Hitchcock, 1879 (Macfarlane's Geol. Ry Guide, p. 56), included his *andalusite schists* in Camb.

C. H. Hitchcock, 1884 (Bull. Am. Mus. Nat. Hist., vol. 1, pl. 17), placed *Kearsarge group* below his Coos group and above his Huronian. On other pages he placed it higher than his Merrimack group and higher than his Rockingham mica schists.

C. H. Hitchcock, 1896 (Jour. Geol., vol. 4, pp. 44–62), placed *Kearsarge group* below his Merrimack group and above his Rockingham mica schists, and assigned all to Huronian [pre-Camb.].

F. J. Katz, 1917 (U. S. G. S. P. P. 108 I). The Kearsarge group of Hitchcock as mapped by him in this part (the coast dist.) of SE. N. H. and SW. Maine is approx. = Rindgemere fm. (Penn.?) of this rept.

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, No. 3). In North Conway quad., N. H., Hitchcock mapped certain clay slates as "Kearsarge andalusite group." In opinion of writer the clay slates of this quad. do not belong to Hitchcock's "Kearsarge andalusite group," and for this reason they are here mapped as a new fm., named *Intervale clay slates*, of Sil. (?) age.

On 1932 geol. map of U. S. these rocks are mapped as pre-Camb.

M. Billings, 1935 (letter dated Aug. 27). I am unfamiliar with Kearsarge andalusite group in type loc., but on Mount Monadnock it is very similar to our katazonal Littleton (Dev.).

Kearsarge amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1895 (Mich. Geol. Surv. vol. 5, pt. 1, p. 117, footnote). Kearsarge amygdaloid lies 1,250 ft. below Kearsarge cgl. at the Kearsarge location [Houghton Co.]. [The amygdaloid is described by C. Rominger on pp. 117–118 of book cited, but he did not call it Kearsarge amygdaloid. The mineralized part is the Kearsarge lode.]

Belongs to Central Mine group.

Kearsarge flow.

Includes Kearsarge amygdaloid and underlying trap.

Kearsarge trap.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name applied to the trap bed beneath Kearsarge amygdaloid. Forms basal part of Kearsarge flow.

Kearsarge West amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. The fm. is younger than Kearsarge amygdaloid. Belongs in Central Mine group. The mineralized part is the Kearsarge West lode. Named for fact that it lies W. of Kearsarge amygdaloid.

Kearsarge West flow.

Includes Kearsarge West amygdaloid and the underlying trap.

Keasey shale.

Eocene: Northwestern Oregon (Columbia County).

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 457, 459). *Keasey sh.*—In Columbia Co., underlying the ss. at Pittsburg Bluff, are sandy shales that contain, among other fossils, *Turcicula columbiana* Dall, a new species of *Conus*, numerous diminutive (dwarfed?) naticas, and a few acilas. The fauna of this sh., which is typically exposed on railroad at Keasey station, Rock Creek drainage, suggests it should be regarded as lower Olig. [Thickness not mentioned.]

H. G. Schenck, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 1, pp. 35–39). *Keasey sh.*—Sandy, tuffaceous, bluish and black, fossiliferous sh. that outcrops on banks of Rock Creek near Keasey. Best exposures in railroad cuts btw. Tara and Keasey stations. Assigned to lower Olig.

H. G. Schenck, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 217). Recent investigation shows clearly that *Keasey sh.* rests on Cowlitz Eocene beds and underlies Pittsburg Bluff fm. [Thickness not stated.]

H. G. Schenck and R. M. Kleinpell, 1935 (Pan-Am. Geol., vol. 64, No. 1, p. 76). Microfossils and strat. relations suggest Keasey sh. is late Eo.

†Keddie formation.

Pennsylvanian: Northern California (Lassen Peak and Taylorsville regions).

Name used in prel. proof-sheet edition of U. S. G. S. Lassen Peak folio, 1892, for rocks forming "a narrow belt upon NE. slope of Keddie-Dyer Ridge," in Plumas Co. In published Lassen Peak folio (No. 15), by J. S. Diller, 1895, the rocks are mapped as *Robinson fm.*

Keechelus andesitic series.

Miocene and post-Miocene (?): Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Keechelus andesitic series.*—Extensive lava flows and tuffs of andesite, with some basalt and rhyolite. Thickness 0 to 4,000 ft. Exposed on both sides of Keechelus Lake. Mainly Mio. but contains some material that is almost certainly post-Mio. Is later than Guye fm. (Mio.).

Keechi Creek shale and sandstone. (In Mineral Wells formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, p. 78). *Keechi Creek ss. and sh.*—A series of light-gray cross-bedded calc. sss. and light-gray sandy shales underlying Palo Pinto ls. Top memb. of Mineral Wells fm. of Strawn group. Thickness 100 to 150 ft. Typically exposed along Keechi Creek W. of Mineral Wells [Palo Pinto Co.].

Above is definition still in use. (See F. B. Plummer and J. Hornberger, Jr., Univ. Tex. Bull. 3534, 1936.)

Keefer sandstone member (of Clinton formation).

Silurian: Central Pennsylvania to northeastern West Virginia, and western Maryland.

See under *McKenzie fm.*

Keene limestone.

Middle Devonian and Upper Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 438, 505). *Keene ls.*—In part argill.; is slightly aren., and though devoid of fossils is believed to include Yogo ls. (Camb.) and Jefferson ls. (Dev.). Lower part is bluish-gray ls., usually altered to fine-grained marble; upper part is more thickly bedded and of lighter color. Thickness 500 ft. in Elkhorn min. dist. Underlies Union sh. and overlies Elkhorn sh. The Keene mine, which lies about 1,000 ft. N. of Elkhorn mine, occurs along the bedding plane btw. an underlying ls. (the Keene ls.) and an overlying argill. bed.

Keene gneiss.

Pre-Cambrian: Northern New York (Essex County).

W. J. Miller, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 400–462 and map). *Keene gneiss.*—True transition rocks. Probably little more than 1,000 ft. thick. One of most interesting rock types of Adirondack region. Locally developed as belts or irregular bodies along portions of borders btw. the anorthosite and the syenite-granite series. Both Marcy and Whiteface types of anorthosite show such border rocks. Very strong evidence this is really a transition rock btw. anorthosite and syenite or granite due to actual digestion or assimilation of anorthosite by the invading syenite-granite magma along portions of its borders. It is here proposed to call this rock *Keene gneiss,* because fine exposure of typical fresh rock occurs by side of the State road just N. of village of Keene, in Lake Placid quad. [Essex Co.].

H. L. Alling, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 27–29). *"Keene" gneiss* is composed of two intrusives of slightly different ages—an unfortunate procedure.

Keener sand.

Subsurface sand in western Pa., SE. Ohio, and northern W. Va.; believed to lie in upper part of Burgoon ss. memb. of Pocono fm. (Miss.). Named for discovery well on Keener farm, near Sistersville, Tyler Co., W. Va.

Keepalloo iron formation.

Pre-Cambrian: Canada (Belcher Islands).

E. S. Moore, 1918 (Jour. Geol., vol. 26, p. 429).

Keeseville sandstone.

Upper Cambrian (?): Northern New York.

E. Emmons, 1841 (N. Y. Geol. Surv. 5th Rept., pp. 130, 131). The *Potsdam and Keeseville ss.* is lowest of Transition series. Extends from Keeseville to Hopkinton, embracing and extending around the primary in a somewhat circular manner.

In 1842 (Geol. N. Y., pt. 2) Emmons treated *Keeseville ss.* as a variety of Potsdam ss. (See 1842 quotation under *Potsdam ss.*) The same year L. Vanuxem (Geol. N. Y., pt. 3) also treated *Keeseville ss.* as a variety of Potsdam ss. In 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 289–291) G. H.

Chadwick doubtfully identified the "*Upper Potsdam white ss.*" of St. Lawrence Valley as *Keeseville* (*?*), and stated that the underlying typical *Potsdam sss.* are mostly red. In 1919 (N. Y. State Mus. Bull. 207, 208) H. I. Alling stated that the "*white Potsdam ss.*" is Keeseville ss. of many geologists, but recent work indicates it is not same as Potsdam. In 1920 (N. Y. State Mus. Bull. 217, 218) G. H. Chadwick again doubtfully identified "White Potsdam ss." (mostly white) of Canton quad., N. Y., as *Keeseville* (*?*) *ss.*, and stated that the underlying *typical red Potsdam ss. and cgls.* are possibly separated from it by an uncon.

Keeseville granite.

See under *Ausable granite.*

Keewatin series (or **epoch**).

As used for many years this term applied to the oldest provincial series of the "Archean system" in Great Lakes region and the time covered by its formation. (For definition see U. S. G. S. Bull. 769, pp. 128–132.) The U. S. Geol. Survey, however, no longer uses "Archean system," and the Keewatin is therefore now classified as the oldest pre-Camb. series of rocks in Lake Superior region.

Keewatin till.

Keewatin drift.

Names that have been applied to the gray drift of Keewatin ice sheet (Wisconsin stage of Pleist.) in Lake Superior region.

†Keg Creek sand.

Eocene (upper): Coastal Plain of eastern Georgia.

S. W. McCallie, 1919 (Jour. Geol., vol. 27, p. 176). [Name used, in table only, for beds underlying Vicksburg fm., including, at base, Twiggs clay memb., and assigned to Eocene Jackson group. As thus defined it is a synonym of Barnwell sand.]

Named for exposures on Keg Creek, Washington Co.

Kekekabic granite.

Pre-Cambrian (lower Huronian): Northeastern Minnesota (Vermilion district).

N. H. Winchell, 1900 (Minn. Geol. Surv. Final Rept., vol. 5, pt. 1, p. 32). *Kekequabic granite.*—A small isolated area of reddish-gray gneissoid granite rising domelike in midst of the Keewatin along S. side of Kekequabic Lake.

The spelling of this lake adopted by U. S. Geog. Bd. is *Kekekabic.* It has also been spelled *Cacaquabic* and *Kekequabic.*

Kekequabic.

See *Kekekabic.*

Keld beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 118).

Kelligrew Brook formation.

Cambrian: Newfoundland.

B. F. Howell, 1925 (Bulls. Am. Pal., vol. 11, No. 43, p. 59).

Kelly limestone.

Mississippian: Central New Mexico (Magdalena district).

C. L. Herrick, 1904 (Am. Geol., vol. 13, pp. 310–312). [See under †*Graphic-Kelly ls.*]

C. H. Gordon, 1907 (Jour. Geol., vol. 15, p. 807, and Am. Jour. Sci., 4th, vol. 24, pp. 62–63). *Kelly ls.*, of Magdalena Mtns, consists of 125 ft. of subcrystalline ls. with compact 5-foot layer near middle called "Silver Pipe ls." by miners. Most important ore bodies are just beneath "Silver-Pipe ls." It underlies Sandia fm.

and overlies pre-Camb. rocks. Is same as Herrick's Graphic-Kelly ls. So far as known is confined to Magdalena dist. Cannot yet be correlated with Lake Valley ls.

Named for Kelly, Magdalena dist.

Kelly Hill facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 186, etc., 1931) to a lithologic development of his Carwood fm. in a part of southern Ind.

Kelly Island formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Kelly Island fm.*—Sss. and shales carrying *Lingula howleyi*, and forming basal beds of Bell Island series. Overlain by Little Bell Island fm. and discon. underlain by Riders Brook fm. [Derivation of name not stated.]

Kelso sand.

A subsurface sand, of Penn. age, in Cleveland pool, Pawnee Co., Okla., which lies at 500 ft. depth, the Layton sand lying at 1,300 ft. depth.

Kelvin conglomerate.

Upper Cretaceous: Central northern Utah (central Wasatch Mountains).

A. A. L. Mathews, 1931 (Oberlin Coll. Lab. Bull., n. s., No. 1, Feb.). *Kelvin cgl.*—A basal cgl. of very coarse, well-rounded, well-polished boulders cemented with a rather resistant cement; the boulders from a few in. to 2 ft. diam., averaging 6 to 8 in.; somewhat variable in color, being locally red, reddish gray, and, in places, pure gray; roughly stratified, indicating still-water origin. Crosses Emigration Creek at Kelvins Grove, a rather prominent and well-established locality in Emigration Canyon. Thickness variable. Age early Upper Cret. Appears to occupy position of Dakota sss. farther S. and E. Underlies marine sss. of Colorado age and uncon. overlies Morrison fm.

Kemp clay. (In Navarro group.)

Upper Cretaceous (Gulf series): Northeastern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 342–344). *Kemp clay beds.*—Yellow clay, containing nodules carrying supposedly Cret. fossils. Extends from Trinity River N. of Chatfield to W. of Stranger, Falls Co. Uppermost part of Navarro fm. Overlies Corsicana beds. Cannot be defined with accuracy, nor can Cret. age be asserted with positiveness.

W. S. Adkins and L. W. Stephenson, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 488, 495, 516). *Kemp fm.* here restricted to upper clay memb. of Hill's Kemp beds, the name *Corsicana fm.* (restricted) being applied to the underlying chalky marl memb., which rests on Nacatoch sand. The presumable type loc. of Kemp beds of Hill is the faulted inlier near Kemp [Kaufman Co.]. The Kemp fm. has been in part correlated by many writers with Arkadelphia clays of Ark.

The Navarro group is now divided by U. S. Geol. Survey into (descending) *Kemp clay (restricted)*, Corsicana marl (restricted), Nacatoch sand, and Neylandville marl.

Kenai formation.

Eocene (upper): Central southern Alaska (Kenai Peninsula).

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 234). *Kenai group* (*Mio.*).—Consists of (1) Unga cgl., resting conformably on (2) coal-bearing beds. Thickness 2,000 to 3,000 ft. Laid down in lakes or marshes. Is early Mio. or latest Eo. [Also called it *Kenai series*, and on map (pl. 3) applied the name in all parts of Alaska.]

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 345), assigned the Kenai to Eo., and stated that it is most fully displayed on NW. slope of Kenai Peninsula, Cook Inlet, but that it extends along coast and in interior, from Norton Sound on N. to B. C. and perhaps Oreg. on S.

In subsequent repts the name *Kenai fm.* was, for many years, applied generally to the Tert. coal-bearing rocks of Alaska, but that practice was later discontinued, and the name has for several years been restricted to the Eo. coal-bearing rocks of Kenai Peninsula.

Kenawha.

See *Kanawha.*

Kendall tuff.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 41, etc.). ***Kendall tuff.***—Of uniform character and as a rule easily distinguished from the much younger tuffaceous beds of Siebert [Esmeralda] fm. [upper Mio.] with which it is in places in contact. Is rather dark gray, has andesitic appearance, and is flecked with irregular spots of pale green (usually less than ½ in. diam.), of a soft waxy material that sometimes contains small scales of biotite. Microscope shows it to be everywhere more or less altered and to consist of fragments of glassy rhyolite and of latite or andesite. Closely associated with Sandstorm rhyolite, with which it is regarded as practically contemp. Greater part of the tuff is near or at base of the rhyolite. One body of this tuff is enclosed in Sandstorm rhyolite in Kendall mine. Thickness of 200+ ft. of the tuff was found beneath Sandstorm rhyolite in 2 mines. Is much older than Siebert [Esmeralda] fm. [which is upper Mio.].

Kendall moraine.

Pleistocene (Wisconsin stage): Southwestern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Belongs to Kalamazoo morainic system. Named for Kendall, Van Buren Co.

Kendall Green slate.

Pre-Cambrian: Eastern Massachusetts (Boston Basin).

W. E. Hobbs, 1899 (Am. Geol., vol. 23, pp. 109–115). *Kendall Green sl.*—In the main a schistose sl. (using term *sl.* in widest sense), consisting of hornblende, quartz, and many other constituents. Thickness probably 5,000 ft. Grades into underlying Stonybrook qtzite, and is overlain by Lincoln sl.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks of Kendall Green area, Middlesex Co., as Marlboro fm. The Marlboro includes considerable sl.

Kendrick shale. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky (Floyd County).

W. R. Jillson, 1919 (Ky. Dept. Geol. and Forestry, ser. 5, vol. 1, pp. 96–104). *Kendrick sh.*—Fossiliferous limy sh., generally soft blue-gray calc. sh. carrying many calc. and magnesium nodules. [Thickness not stated.] Fossils (listed by C. Schuchert) are new and unmatched as a collection either in or outside of Ky. Fauna is clearly Pottsville. Local strat. suggests the Kendrick should be placed in lower part of Wise fm. or Upper Pottsville, with Norton fm. just below it. Lies about 170 ft. above Prestonburg, Miller's Creek, or Van Lear coal. Type fossiliferous outcrop is 150 yds. above Kendricks homestead, on headwaters of Cow Creek, Floyd Co. Rests on blue sandy calc. sh. and is overlain by 15 to 20 ft. of massive, somewhat cross-bedded ss.

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, p. 298). ***Kendrick shales*** named by Jillson from exposures at Dr. Kendrick homestead. [Gives detailed section at type loc., where they are 19⅓ ft. thick.] They form roof shales of Thacker coal and lie 221 ft. below "Taylor" or Copeland coal.

†Kennedy gravels.

Pleistocene (pre-Wisconsin): Northwestern Montana (northwestern part of Teton County).

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 315, 328–330). *Kennedy gravels.*—Well-rounded or subangular high-level gravel of local origin; rarely boulders 2 ft. across occur; those 6 to 12 inches diam. are common. Finer gravel and gravelly soil make up the mass. Obscurely stratified; glacial striae absent. Thickness 100+ ft.; base not seen. Believed to be a remnant of an alluvial cone of Kennedy Creek. Type loc. a gravel mesa, 5,800 ft. high, 5 mi. E. of Chief Mtn, N. of Kennedy Creek and 900 ft. above it. Rest on Benton sh. Description largely compiled from notes by G. I. Finlay.

W. C. Alden (personal communication June 1932), who found glaciated material in typical †Kennedy gravels on Kennedy Ridge, regards the deposit as of glacial origin, and includes it in his pre-Wisconsin glacial drift. (See also W. C. Alden, U. S. G. S. P. P. 173, 1932.)

Kennetcook limestone.

Mississippian: Nova Scotia.

W. A. Bell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 166).

Kenneth limestone.

Silurian (Cayugan): Northern central Indiana (Cass County).

E. R. Cumings and R. R. Shrock, 1927 (Ind. Acad. Sci. Proc., vol. 36, pp. 76–77). *Kenneth ls.*—Very cherty ls., from 1 to 20 ft. thick in outcrops, resting on Kokomo ls. of Foerste with possible uncon. Top of fm. not known. Exposed in quarries at Kenneth Station and vicinity, Cass Co.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 117–135), explain that their *Kenneth ls.* is upper part (brachiopod-bearing beds) of Kokomo ls. of Foerste (1904). (See under *Kokomo ls.*) Thickness few ft. at Kokomo to over 35 ft. near type section. Fossils listed. Fauna has Cayugan affinities, but much work is needed to establish its correlation.

M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. 133, mimeographed thesis, pp. 89–90). *Kenneth ls.* is found only in structural sag btw. Peru and Logansport. Cumings (Ind. Acad. Sci., Proc., vol. 39, 1929, p. 208, 1930) has expressed opinion fauna of Kenneth ls. of northern Ind. is comparable with early Dev. faunas (Keyser) of Md., Pa., and N. J. The Kenneth is therefore probably Lower Dev.

Kennett rock.

Pre-Cambrian: Southeastern Pennsylvania (Chester County).

P. Frazer, 1883 (2d Pa. Geol. Surv. Rept. C_4, pp. 307–308). *Kennett rock,* upper memb. of Potsdam ss. A thin-bedded rock composed of fragments of white limpid qtzite, generally coarse-grained. Named for borough of Kennett Square. The lower memb. of Potsdam ss. is Toughkenamon rock.

The qtzite at and around Kennett Square is mapped as Setters qtzite (pre-Camb.) in U. S. G. S. West Chester-Coatesville folio, No. 223, 1932.

Kennett formation.

Middle Devonian: Northern California (Redding region).

J. P. Smith, 1894 (Jour. Geol., vol. 2, pp. 591–593, 598). *Kennett lss. and shales.*—A thick series of dark contorted siliceous shales, with occasional masses of ls. that contain Dev. fossils, probably Middle Dev. Exposed btw. Squaw and Backbone Creeks, about 4 mi. W. of Kennett, on Sacramento River. Compose Sacramento fm. (H. W. Fairbanks ms.). We do not know age of the rocks immediately underlying the Baird shales, but the siliceous shales of Sacramento River lie some distance below them, and are probably in part of Carbf. age.

According to J. S. Diller (U. S. G. S. Redding folio, No. 138, 1906) the Baird sh. is underlain by Bragdon fm. (Miss.), which rests uncon. on Kennett fm.

Kennett limestone.

Pre-Cambrian: Southeastern Pennsylvania.

T. D. Rand, 1900 (Phila. Acad. Nat. Sci. Proc. 1900, pt. 1, pp. 235–242). *Kennett ls.,* Camb. according to Mr. Walcott. [Seems to be named for Kennett Square Station, Chester Co.]

The ls. at and around Kennett Square Station is mapped as Cockeysville marble (pre-Camb.) in U. S. G. S. West Chester-Coatesville folio, No. 223, 1932.

Kennicott formation.

Lower Cretaceous: Alaska (Copper River region).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 424–440, pl. 52). *Kennicott series.*—Light-colored arkoses, shales, and lss. occurring on Bear and Fourth of July Creeks btw. Fohlin Creek and Kennicott Glacier. Of late Jurassic or early Cret. age. Uncon. (?) overlies McCarthy Creek shales (Triassic).

F. H. Moffit and S. R. Capps, 1911 (U. S. G. S. Bull. 448, pp. 31–43), applied *Kennicott fm.* to all the supposedly Jurassic sed. rocks of Nizina dist. and several areas of ss. N. of upper Chitina River which are now considered to be Cret.

G. C. Martin, 1926 (U. S. G. S. Bull. 776), restricted *Kennicott fm.* to the Lower Cret., that being the age of the rocks in type region.

F. H. Moffit (rept on Chitina Valley and adjacent area, in process of publication). The rocks of type loc. of Rohn's Kennicott fm., in Fourth of July Pass, are now considered to be Lower Cret., and consist of (descending): (1) Black sh. or sl., intruded by many light-colored porphyry dikes, 3,000± ft.; (2) crumbly gray sh. with concretions, 50 (?) ft.; (3) massive brown ss., 100 to 200 ft.; (4) cgl. with angular and subangular fragments, few ft. They rest uncon. on Upper Triassic sh.

Kenogami River formation.

Silurian: Ontario.

W. S. Dyer, 1930 (Ontario Dept. Mines 38th Ann. Rept., pt. 4, p. 54).

Kenosha shale. (In Tecumseh shale.)

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 47, 52). *Kenosha sh.* is proposed in this rept. for the 6 or 7 ft. of sh. at base of Tecumseh sh. memb., and underlying Ost ls. Type loc. in Missouri River bluff near Kenosha landing at mouth of second small valley S. of King Hill, Cass Co., Nebr.

Kent bed.

Lower Cretaceous (Comanche series): Southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, p. 383). *Kent bed* proposed for an *Ostrea quadruplicata* zone which occurs below Fort Worth zone, to distinguish it from *Ostrea quadruplicata* zone above the Fort Worth. Occupies position near that of Duck Creek chalk of NE. Tex. and above that of Tucumcari zone.

Derivation of name not known. Above is only record of this name.

Kent formation.

Upper Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, map, p. 487). *Kent fm.*—Cgl., 3,000 ft. thick, of Upper Jurassic age. Underlies Agassiz Prairie fm. (Upper J.) and uncon. overlies Billhook fm. (Upper J.).

Kentucky shale.

Mississippian: Eastern Kentucky.

N. S. Shaler, 1877 (Ky. Geol. Surv., n. s., vol. 3, pp. 183–186, bottom pagination). In eastern Ky. the amount of sh. in the Carbf. rocks succeeding the Sub-carbf. ls. is much greater than in western Ky. As this period is set apart by physical and vital conditions from anything that came before or afterward, it deserves a special designation. I shall therefore give it the name *Kentucky sh.*, which is especially fitting, inasmuch as in region about headwaters of Ky. River we have best exemplification of the Sub-cgl. coal series which has yet been examined. Is uncon. overlain by Millstone Grit.

†Kentucky marble.

†Kentucky River marble.

†Kentucky River limestones.

Names that have been loosely applied to many Ord. lss. of Ky.

Kentville formation.

Silurian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 203).

Kenwood beds.

Middle Devonian: Eastern Iowa.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, p. 23). *Kenwood beds.*—Massive argill. and ferruginous shales, buff and reddish-brown lss., irregularly bedded, passing horizontally and vertically beneath into buff thinly laminated or shaly ls. weathering into marly clay. Thickness 40 ft. Underlie Lower Davenport beds and overlie 5 ft. of bluish or greenish sh. believed to represent Independence shales, but latter term may readily be extended to include all the ls. and sh. of

Kenwood beds, a term which is therefore used only as a local synonym for Independence shales. [Discarded by U. S. G. S. in 1911, *Independence sh. memb. of Wapsipinicon ls.* being adopted instead.]

Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, shows Independence sh. as much younger than *Kenwood.* (See 1935 entry under *Wapsipinicon ls.*)

Named for Kenwood, Linn Co. According to M. A. Stainbrook (p. 251 of 1935 rept cited above) this unit is typically developed in right bank of Indian Creek, back of the country club at Kenwood Park, a suburb of Cedar Rapids. He redefined Kenwood by removing from its top 20 ft. of beds which he named *Spring Grove memb. of Wapsipinicon fm.*

Kenwood sandstone. (In Osage group.)

Mississippian: Western and northern Kentucky and southern Indiana.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, p. 148). *Kenwood ss.*—Thin sss. alternating with sh. Thickness 40 ft. Contains Keokuk fossils. Underlies Rosewood sh. and overlies New Providence sh.; all belonging to Osage group.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 29). *Kenwood ss.* extends southward perhaps only to Lebanon Junction, Bullitt Co., Ky.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 491). *Kenwood ss.* does not persist very far into Ind.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 52, 54, 92, 93, 94, 111, etc.). At top of New Providence sh. in Floyd Co., southern Ind., usually within an interval of 20 ft. or less, are occasional resistant ss. beds up to 2 ft. thick. These ss. layers are Indiana's sole representative of what in Jefferson Co., Ky., has been named "Kenwood ss." by Butts. Uppermost limit of New Providence fm. is nicely marked in east-central and south Floyd Co., Ind., and in Jefferson Co., Ky., because of presence of abrupt ss. layers (Kenwood ss. of Butts); but northward as far as Brown and Bartholomew Counties the upper limit is conjectural in most places as a consequence of a remarkably gradual transition into overlying rocks. [On pp. 93–94 he proposes to modify definition of *New Providence fm.* so as to include Kenwood ss. as a memb., and he names the overlying beds *Locust Point fm.* On p. 93 he says Kenwood ss. is "generally 40 ft. thick, 30 ft. of which appear on Kenwood Hill." On p. 94 he says: "In this rept. the ss. layers will be referred to as the *Kenwood beds of the New Providence fm.*"] [See also under *New Providence fm.*]

Named for Kenwood Hill, near Louisville, Ky.

Keokuk limestone. (Of Osage group.)

Mississippian: Iowa, Illinois, eastern Missouri, and western Kentucky.

D. D. Owen, 1852 (Rept. Geol. Surv. Wis., Iowa and Minn., pp. 91, 92). *Keokuck cherty lss.*—Gray cherty lss., forming wall of rock washed by the Mississippi below Keokuck Landing, Iowa. Overlain by Shell beds and underlain by Hannibal beds (brown Encrinital lss. alternating with bands of chert), which rest on Burlington beds (the Encrinital group of Burlington). [According to later Iowa repts the Keokuck cherty lss. of Owen are the "cherty beds of passage" separating the Keokuk and Burlington lss. of Hall.]

J. Hall, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pt. 2, pp. 53–56). *Keokuk or lower Archimedes ls.*—Highly fossiliferous ls., separated from overlying Warsaw or Second Archimedes ls. by "Geode bed" (a mass of shales or marls with impure lss. containing geodes), overlain, locally, near Warsaw, Ills., Appanoose, Iowa, and other places, by 10 ft. of mag. ls. Separated from underlying Burlington ls. by 60 to 100 ft. of beds of passage, consisting of cherty layers with intercalated beds of light-gray ls.

The "cherty beds of passage" were treated as a distinct unit and excluded from both Keokuk and Burlington by Hall in 1858, 1859, 1864; by Worthen in 1858; by C. R. Keyes in 1894; by J. A. Udden in 1901; by H. Hinds in 1909; and by C. R. Keyes in 1914. They were included in the Burlington by C. A. White; by Wachsmith; by C. H. Gordon (1892 and 1895); by

C. R. Keyes in 1895 (under the name "Montrose chert"); by W. H. Norton and H. E. Simpson in 1912; and by F. M. Van Tuyl in 1912. They were included in Keokuk by A. W. Vodges in 1888 and by F. M. Van Tuyl in 1925 (Iowa Geol. Surv. vol. 30, pp. 47, 146), who stated that in them appear for first time several Keokuk types of brachiopods. The "geode bed" referred to by Hall has in subsequent repts been both included in and excluded from Keokuk ls.

The present accepted definition of Keokuk ls. excludes the "geode bed" (which is now included in the overlying Warsaw, because its fauna and lithology are said to be more closely allied to that of the Warsaw ls.) and includes the cherty beds at base. The U. S. Geol. Survey treats the Keokuk as top fm. of Osage group.

Named for exposures at Keokuk, Iowa, especially good exposures occurring along Soap Creek and in a quarry in Miss. River bluff near mouth of the creek.

†Keokuk group.

A term applied in some early Miss. Valley repts to rocks now called *Osage group.*

Keosauqua sandstone.

Mississippian: Southeastern Iowa.

C. H. Gordon, 1895 (Jour. Geol., vol. 3, pp. 304–305). ***Keosauqua ss.***—Coarse brown ss., few ft. to 25 ft. thick, near top of St. Louis group in SE. Iowa. Underlies compact granular lss. forming top memb. of St. Louis group and overlies brecciated ls. of the St. Louis.

According to F. M. Van Tuyl (Iowa Geol. Surv. vol. 30, p. 259, etc., 1925) this ss. is of basal Ste. Genevieve age, is overlain by ls. of Ste. Genevieve age, *underlain* by true St. Louis ls., and was included in Verdi beds by Gordon, but belongs in Pella beds.

Named for exposures in S. bank of Des Moines River about 2½ mi. below Keosauqua, Van Buren Co.

Keota sandstone member (of Savanna sandstone).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). ***Keota ss. memb. of Savanna ss.***—Gray to brown ss., regularly bedded, blocky, ripple marked. Thickness in Muskogee-Porum area 10 ft. Lies 70± ft. above Tamaha ss. memb. and 50± ft. below Spiro ss. memb. Named for exposures at Keota, Haskell Co.

Keowee zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1907 (Summary of mineral resources of S. C., p. 12). [In table on page cited this name is placed opposite Tyger zone, but there is no definition. Probably named for Keowee River, bdy btw. Oconee and Pickens Counties.]

Keppel dolomite.

Silurian (early): Ontario.

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 438, 460). ***Keppel dolomites.***—Marine lss. and dolomites, 0 to 36 ft. thick. Underlie Cabot Head beds and overlie, probably discon., Queenston sh. Named for their nearly continuous exposure along lake front in Keppel Twp, from Owen Sound to Cape Commodore.

These beds appear to be same as Manitoulin memb. of Williams, 1914, and Manitoulin ls. memb. of Schuchert, 1914, a name that has had considerable usage, while above-cited rept is only record of Keppel.

Kerber formation.

Pennsylvanian: Southern Colorado (Bonanza district, Saguache County).

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Kerber fm.*—Series of coarse-grained sss. or grits and black carbonaceous shales which overlie, with possibly a strat. break, the Leadville ls. and extend up to base of lowest red-colored micaceous sediments or sandy shales of Maroon fm. Thickness 200± ft. Basal memb. is a ss. 70 to 75 ft. thick. Named for exposures along Kerber Creek.

Kereford limestone. (In Oread limestone.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 45). Near Lecompton and Atchison, Kans., and at Amazonia, Mo., the lower part of Kanwaka sh. memb. contains one or more lensing lss. for which name *Kereford ls.* is proposed. Heretofore this ls. has been known as *"Waverly Flagging,"* a nongeographic name, and has been loosely correlated as top part of Oread memb. It is not persistent enough to serve as a horizon marker. The stone is dense, somewhat aren., in part oolitic, and fossiliferous. In writer's opinion this bed belongs in Kanwaka sh. memb. and not in Oread ls., where Hinds and Greene placed it.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). Writer has modified Condra's classification slightly by including *Kereford ls.* as top div. of Oread fm. (instead of basal div. of Kanwaka sh.). The *Kereford* exhibits characteristics of the "super" divisions of the cycle. The thin underlying sh. is termed *Heumader sh.* [The Oct. 1932 revised classification of Penn. rocks of Kans. and Nebr. by Moore and Condra placed *Kereford ls.* as top memb. of Oread ls., and Condra in 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12) followed this classification, also R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22).]

Type loc., Kereford quarry at S. edge of Atchison, Kans.

Kerens member (of Wills Point formation).

Eocene (lower): Northeastern Texas (Brazos River to Trinity River region).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 535, 559, 562). *Kerens memb.*—Forms upper two-thirds of Wills Point fm. Dark gray silty or sandy clay; 300 ft. thick in Brazos River Valley; 450 or possibly 500 ft. thick in Trinity River Valley. [On p. 535 thickness of Kerens memb. is given as 225 ft.] Overlies Wortham aragonite lentil of Wills Point and underlies Seguin fm. Type loc. comprises the exposures along Trinity River N. of St. Louis & Southwestern R. R., E. of Kerens, Navarro Co.

The U. S. Geol. Survey includes in Kerens memb. the 8- to 10-inch bed called *Wortham aragonite lentil* by Plummer. The Kerens as thus defined rests on Mexia memb.

Kern River group.

Kern River formation.

Kern River series.

Pliocene and later (?): Southern California (Kern River region).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 187–188, 191). *Kern River beds.*—Mainly sands and sandy clays, dipping gently to W. The locality is on Kern River, 2 to 6 mi. E. of Oil City, Kern Co. Entire thickness of strata exposed along the river aggregates about 3,000 ft., of which lower two-thirds belongs to Mio. Toward base they become very fossiliferous. [Lists many fossils.] Most complete and most typical fauna of Lower Mio. of Calif. interior is that of Kern River beds on SE. border of San Joaquin Valley.

F. M. Anderson, 1911 (Calif. Acad. Sci. Proc., 4th ser., vol. 3, pp. 95, 111). *Kern River group.*—Green and brown beds, gravels, sands, and clays, almost without fossils, but includes Kern oil measures. Well exposed 1 or 2 mi. E. of Kern River oil field and elsewhere. Beds of gravel and cgl. and frequently large boulders are characteristic of the group. Is a terrigenous rather than an organic deposit. Called *Kern River group* because the productive oil measures of Kern River dist. are confined to it. The oil measures make up about half of volume of the beds. Uncon. overlies Temblor group. Assigned to Neocene.

J. B. Stevens, 1924 (A. A. P. G. Bull., vol. 8, No. 1, p. 33). *Kern River series.*—Gravel, sand, and clay, 2,000 ft. thick. Is uncon. overlain by alluvium and terrace deposits and uncon. underlain by Monterey group (Mio.). Probably includes at base equiv. of Santa Margarita Miocene. Rest of fm. assigned to Plio.

L. S. Fox, 1929 (A. A. P. G. Bull., vol. 13, No. 2, p. 103). *Kern River series.*—Unconsolidated sands and clays of fresh-water origin, and, in its more basinward phase, of interstratified marine Etchegoin sediments. At numerous places along E. fringe of the valley these beds are lacking, but farther W. they increase in thickness to several thousand ft. within a short distance. These Kern River beds represent entire series of deposits from early Plio. to Recent time.

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, pp. 12–29). *Kern River series* has been used for all beds (*Plio. and Pleist.*) in Bakersfield area that are younger than Mio. For convenience the group has been divided into 3 members, which have been popularly named (descending) *"Kern River fm."* (50 to 850 ft. thick), "Etchegoin fm.," and Chanac fm.

Kernville series.

Jurassic or older: Southern California (Kernville quadrangle).

W. J. Miller, 1931 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 20, No. 9, pp. 335–343). *Kernville series.*—Oldest rocks in this part of Calif. Constitute a meta-sedimentary series. Largely composed of three kinds of rocks—phyllite, qtzite, and crystalline ls. Phyllite is most abundant; varies locally to mica schist, particularly close to its contacts with the granite; is highly foliated and generally of greenish-gray color. Thin-bedded, generally light-gray to dark bluish-gray qtzites are usually interbedded with the phyllite, the qtzite in some places making up about half of the combination. A number of lenses of crystalline ls. are interbedded with the phyllite-qtzite series. Thickness 12,000 ft. Named for many excellent exposures in vicinity of Kernville. All these metamorphosed strata are presumed to belong to a single series. They are lithologically similar and no strat. break was found. But careful search failed to yield fossils and the areas are widely scattered, so that it must be admitted the Kernville series may represent more than one fm. It is evident the scattered areas of Kernville series represent merely remnants of once very widespread strata with a conservatively estimated thickness of at least 3 mi. Actual age unknown, but it is Jurassic or older. It may be Miss. It is cut by gabbro-diorite and its facies.

Kerrick morainic system.

Pleistocene (Wisconsin stage): Northeastern Minnesota and northwestern Wisconsin.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Includes Cromwell and Wright moraines. Named for Kerrick, Pine Co., Minn.

Kessler limestone member (of Bloyd shale).

Pennsylvanian (Pottsville): Northwestern Arkansas.

F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. 26, 103–105). *Kessler ls.*—Thin-bedded shaly ls., gray to reddish brown, with occasional light streaks. Thickness 10 to 15 ft. Uppermost bed of Lower Carbf. or Miss. Underlies Coal Measures and overlies the coal-bearing sh. in Washington Co.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24), included this ls. in Morrow fm., of Penn. age. Later the Morrow was made a group, divided into Bloyd sh. above and Hale fm. below, and this ls. is now treated as a memb. of Bloyd sh. It lies 0 to 190 ft. below top of the Bloyd.

Named for Kessler Mtn, Washington Co.

†Ketchikan series.

Upper Triassic and Carboniferous: Southeastern Alaska (Ketchikan region).

A. H. Brooks, 1902 (U. S. G. S. P. P. 1, pp. 40–52, map). *Ketchikan series.*—Argill. and aren. schists, argillites, and some lss. and aren. beds. Occurs along E. margin of Gravina Island and along W. margin of Revillagigedo Island, and in vicinity of Ketchikan, on both sides of Tongass Narrows, on Cleveland Peninsula, along George Inlet, on E. arm of Behm Canal. Believed to be in part Mesozoic (Triassic?) and in part Upper Paleozoic.

T. Chapin, 1919 (U. S. G. S. P. P. 120, p. 88). Brooks' "Ketchikan series" included Upper Triassic and Carbf. rocks, as suggested by him.

Ketchum Bluff conglomerate.

Pennsylvanian: Central southern Oklahoma (Jefferson County).

See under *Oscar ss.*

Ketona dolomite.

Cambrian (Upper): Northern central Alabama.

C. Butts, 1910 (U. S. G. S. Bull. 400, p. 14; U. S. G. S. Birmingham folio, No. 175, p. 3). *Ketona dol. memb. of Knox dol.*—Nearly pure dol., with but little chert. Is thick-bedded, of crystalline texture, and light-gray color. Basal memb. of Knox dol. Thickness 600 ft.

Later work by E. O. Ulrich resulted in discovery of beds in Knox dol. of Ala. older than Ketona dol. (to which older beds he applied the name *Brierfield dol.*), also to subdivision of post-Ketona beds of Knox into (ascending) Bibb dol., Copper Ridge dol., and Chepultepec dol. The Ketona dol. is therefore now treated as a fm., underlain by Brierfield dol. and overlain by Bibb dol. (See C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1926.)

Named for exposures at Ketona, Jefferson Co.

Kettle meta-andesite.

Pennsylvanian: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Kettle meta-andesite.*—An extended series of lava flows and products of volcanic explosions. The principal rock is decidedly porphyritic, with many small phenocrysts of feldspar, some of hornblende, and, rarely, round grains of quartz, all embedded in a reddish-brown or gray partially crystalline groundmass containing small grains of plagioclase and quartz. Also includes considerable pale greenish-gray generally nonporphyritic rock. Both types are intimately associated with fragmental rocks, mainly tuffaceous, but locally passing into fine cgl. and ss. Appears to have been erupted about the time Robinson fm. was deposited, but to be older than Reeve meta-andesite.

Named for development around Kettle Rock, NE. of Taylorsville.

Kettle interlobate moraine.

Pleistocene (Wisconsin stage): Southeastern Wisconsin. See T. C. Chamberlin, Wis. Acad. Sci. Trans., vol. 4, pp. 201–234, map, 1878. Also shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Potash Kettle Range, a term applied in early Wisconsin repts to the region occupied by the moraine, as explained in U. S. G. S. P. P. 106, p. 13.

Kettleman lake bed.

Probably Pliocene: Southern California (Tulare Lake region).

J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 167). *Kettleman lake bed.*—A fossiliferous fresh-water deposit about 10 mi. W. of Tulare Lake, on edge of what was probably a Plio. lake about 20 mi. long and 5 mi. wide, or half as large as Tulare Lake is now, and S. of W. from it, in W. corner of Tulare Co. Lies 600 ft. above sea level. [Type loc. not stated, but the beds are probably the fresh-water deposit mentioned as occurring on W. border of Kettleman Plains.]

†Kettle River sandstone.

Name locally applied in some early Minn. repts to Hinckley ss., from exposures on Kettle River.

Kettle River formation.

Tertiary (Oligocene?): Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 10, 11, 118° 30′ to 119°30′). *Kettle River fm.*—Olig. ss., cgl., sh., arkose. Underlies Midway volcanic group. [Mapped along Kettle River, B. C., N. of 49th par.]

C. W. Drysdale, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 135); and O. E. LeRoy, 1912 (Canada Geol. Surv. Mem. 21, pp. 20, 27, 42). [LeRoy called it Olig. (?).]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 394). *Kettle River fm.*, Olig., Wash. and B. C., 0 to 2,100+ ft. of ss., cgl., sh., traces of lignite. Patches. Fossil plants identified by Penhallow as Olig. Uncon. overlies Rock Creek granodiorite (Jurassic), also Anarchist series (Carbf. ?).

C. W. Drysdale, 1915 (Canada Geol. Surv. Mem. 56, p. 62). *Kettle River fm.*, Eocene or Olig., B. C.

Keuka flagstone.

Upper Devonian: Western central New York (Keuka-Seneca Lake region).

I. W. Fox, 1932 (A. A. P. G. Bull., vol. 16, No. 7, pp. 677, 683, 687). *Keuka flagstone.*—Hard dark-gray flag, 2 to 4 inches thick, lying 85 to 90 ft. below top of Standish fm. in Keuka-Seneca Lake region. Is easily recognized by its position btw. dense black shales or a thin layer of light-gray sh. intervening btw. it and the black stratum beneath. Named for excellent exposures on all shores of Keuka Lake.

†Keweenaw group.

†Keweenaw series.

Same as Keweenawan series.

Keweenawan series (or **epoch**).

As used for many years the term applied to the upper provincial series of Algonkian rocks of Great Lakes region and the time covered by their formation. (For definition see U. S. G. S. Bull. 769, pp. 104–105.) But the U. S. Geol. Survey no longer uses "Algonkian system." The Keweenawan is therefore now classified as the youngest series of pre-Camb. rocks in Lake Superior region, and as separated from the overlying Upper Camb. sss. by a great structural and erosional uncon. The Keweenawan, however, is regarded by A. C. Lane as partly Camb. and partly pre-Camb.

†Keweenawian.

†Keweenian.

†Kewenaw series.

†Kewenawic.

†Kewenian.

Variants of *Keweenawan.*

Kewstoke conglomerate.

Mississippian (?): Nova Scotia (Cape Breton Island).

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 324).

†Key sandstone.

Lower Ordovician: Northern Arkansas.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 20, 95–97). *Key ss.*—Ss. locally known as "sand ledge" or "sand cap." Also called "saccharoidal ss.," because when struck with hammer it crumbles into fine white sand very similar in appearance to granulated sugar. Outer surface usually brownish as result of iron oxide coating. Occasionally, when unweathered, small masses of pyrite occur in it and it has a water-green color. When weathered the green color disappears and the pyrite is oxidized and transferred to the surface, forming a ferruginous coating. Thickness of strata varies from few inches to several ft. and bedding changes materially in short distance. Frequently exhibits ripple marks and false-bedding. Weathered surfaces have peculiar rounded appearance. Ledges are beveled so that layers have fluted edges. Appears to have been deposited under shallow-water conditions, in which quartz sand was worn into more or less rounded grains. Thickness few ft. to over 100 ft. Same as St. Peter ss., "First Saccharoidal," Crystal City ss., and Cap au Gres ss. Underlies Izard ls. and overlies Yellville fm.

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville folio, No. 119). Sylamore ss. memb. of Chattanooga sh. is the ss. present at type loc. of "Key" ss., but the ss. to which *Key* was applied in the section is St. Peter ss.; so Key will have to be abandoned.

Later work in northern Ark. has shown that several sss. (Kings River ss., Newton ss., and Sylamore ss.) have been mistaken for true St. Peter ss.

Named for Key, near Rogers, Benton Co.

Key Largo limestone.

Pleistocene: Southern Florida.

S. Sanford, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 209, 214–218). *Key Largo ls.*—Marine ls., extremely variable in appearance and structure, being solid ls. of coral origin, in some parts a coral cgl., over much larger areas a fine white ls. It is often free from any proofs of an organic origin. It breaks with a conchoidal fracture, a splintery surface, and rings under the hammer. Other portions are made of standing corals with the intervals filled in by reef debris and the whole cemented solid. In places the rock is a typical breccia composed of angular and cherty fragments in a limy cement, the cement and many of the fragments being bright red. Thickness, judged from well records, 69 to 130 ft. This ls. represents only known fossil coral reef in southern Fla. In places the Key West oolite apparently rests on Key Largo ls.; the relations to Miami oolite and Lostmans River ls. are less certain.

C. W. Cooke aud S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept., p. 208). *Key Largo ls.* believed to be contemp. with Miami oolite.

Named for exposures in cuts and borrow pits on Key Largo, at frequent intervals from S. shore of Lake Surprise to W. end of the island at Tavernier Creek, a distance of 15 mi.

Keys sand.

A subsurface sand, of Penn. age and 15 to 20 ft. thick, in Cotton Co., Okla. Lies 95 to 100 ft. below top of Priddy sand and higher than Zypsie sand.

Keyser limestone member (of Helderberg limestone).

Lower Devonian: Pennsylvania, western Maryland, northern West Virginia, and western Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 563, 590, 591, pl. 28). *Keyser ls.*—Basal fm. of Helderberg of N. Y., Pa., Md., Va., and W. Va. Underlies Coeymans ls. and uncon. overlies upper Cayugan deposits (including (?) Manlius of N. Y.).

C. K. Swartz et al., 1913 (Md. Geol. Surv. Lower Dev. vol., pp. 82, 85). *Keyser memb. of Helderberg fm.*—Ls., massive and very nodular in lower part, more shaly and thin-bedded above. Thickness 270 to 290 ft. Rich coral and brachiopod fauna. Basal memb. of Helderberg fm. Underlies Coeymans memb., probably uncon., and overlies Tonoloway fm. Is clearly transitional btw. Sil. and Dev. Accepting the principle that the age of the fm. is that of its youngest fauna, the Keyser is here referred to the Helderberg, although the majority of its species are distinctly Sil. The Helderberg fauna thus appears to have invaded Md. before its advent in N. Y. in Coeymans time. Fauna of Keyser memb. as a whole shows pronounced relations to Helderberg, to which it is referred.

Named for exposures at Keyser, W. Va.

Keystone sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 237). *Keystone ss.*—Massive, medium grained, micaceous buff; 0 to 25 ft. thick. Underlies Landgraff coal and overlies Keystone coal. Exposed at Keystone, McDowell Co.

Lies near base of Pottsville group.

†Key West oolite.

Pleistocene: Southern Florida.

S. Sanford, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50, and pp. 209, 218–221). All oolite outcropping on keys S. of Florida Bay is here designated *Key West oolite.* Typically it is a soft white or light-colored fossiliferous oolitic ls., the ovules being scattered through amorphous carbonate of lime or surrounded by crystalline cement that develops most freely along bedding planes. Is less sandy than Miami oolite, but resembles latter in general appearance and physical qualities, there being little difference btw. hand specimens of the two. Is of marine origin. Apparently overlies Key Largo ls. Relations to nonoolitic Lostmans River ls. not determined. Is overlain by recent marls and calc. sands and in places along shores of the Keys may have a thin veneer of beach rock. Thickness probably less than 50 ft. Covers the islands W. of Bahia Honda Channel to Key West. Outcrops on shores of Harbor Key and Content Key and on most of keys to S. and SW. Underlies Bay of Florida for at least 3 mi. SE. of Big Bahia Honda Key, and forms surface of Boca Grande, 10 mi. W. of Key West.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Same as Miami oolite, and name "Key West" abandoned. Only difference btw. Miami oolite and "Key West" oolite is that the Miami contains a little more sand than the "Key West."

Kialagvik formation.

Jurassic (Middle?): Southwestern Alaska (Cold Bay district, Shelikof Strait).

S. R. Capps, 1923 (U. S. G. S. Bull. 739, pp. 90, 91, 94, map). *Kialagvik fm.*—A few hundred ft. (500+) of ss., sandy sh., and cgl. that form bluffs along beach of NW. shore of Kialagvik Bay from near mouth of Pass Creek to SW. end of bay and extend short distance inland. Underlies Shelikof fm. (Upper Jurassic), uncon. Very fossiliferous. Fauna is Middle Jurassic. [The fauna is now considered either early Middle Jurassic or late Lower Jurassic.]

Kiamichi formation. (In Washita group.)

Lower Cretaceous (Comanche series): Northeastern Texas and central southern and southeastern Oklahoma.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 515). *Kiamitia clays or Schloenbachia beds.*—Marly clays, often stiff and black before oxidation, alternating with firm, hard, thin dimension layers of yellow lime. Basal fm. of Washita div. Underlies Duck Creek chalk and overlies Goodland ls. of Fredericksburg div.

In southern Okla. overlies Goodland ls. and underlies Caddo ls. C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 98), stated that thickness in Okla. is variable up to 150 ft. Some authors now include this fm. in Fredericksburg group. For history of name, see under *Fredericksburg group*.

Named for historic plains of Kiamitia (correctly spelled Kiamichi) River near Fort Towson, Choctaw Co., Okla.

†Kiamitia clay.

Lower Cretaceous (Comanche series): Northeastern Texas and southeastern Oklahoma.

See *Kiamichi fm.*, approved spelling.

Kiask series.

Pre-Cambrian: Ontario.

H. C. Cooke, 1919 (Canada Geol. Surv. Mem. 115, p. 19).

Kibbey sandstone member (of Quadrant formation).

Mississippian (upper): Central northern Montana (Great Falls-Fort Benton region).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). Lowest beds of Quadrant fm. in this quad. are reddish and yellow clayey sss., often holding interbedded layers of gyp. and constituting *Kibbey ss.*, which is 153 ft. thick near Riceville. These are overlain by Otter shales, holding interbedded lss., and forming upper memb. of Quadrant in this quad. The Kibbey ss. rests on Madison ls. [Quadrant fm. mapped over large area at and around Kibbey, which is on Little Otter Creek, in SW. corner of quad.]

The U. S. Geol. Survey adopted *Kibbey ss. memb. of Quadrant fm.* in 1907. See under *Big Snowy group* of Scott (1935), who treats this as basal fm. of his Big Snowy.

†Kickapoo marl.

Upper Cretaceous (Gulf series): Northeastern Texas.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 308). Glauconitic marls, called *Brownstown marls* in Ark. and *Kickapoo marls* in Tex., which bear a growth of hardwood, including Bois d'Arc. Overlie White Cliffs or Anona chalk and underlie the Glauconitic sands. [Derivation of name not stated.]

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 1916, No. 44, p. 74). In NE. Tex. the Taylor is probably represented by Marlbrook marls, which have also been called *Kickapoo marls.*

†Kickapoo limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1, p. 81). *Kickapoo ls.*—Thin ls., extending entirely across Kans., from State line in Chautauqua Co. to Doniphan Co. Underlies Lawrence shales and overlies LeRoy shales.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13). "Kickapoo ls." discarded; is same as Iatan ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 139, 140). Kickapoo ls. of Haworth and Bennett (1908) included Iatan ls. and Haskell ls.

Named for Kickapoo, Leavenworth Co., 5 mi. S. of Iatan.

Kickapoo beds.

Pleistocene (Wisconsin stage): Central western Illinois.

C. O. Sauer, 1916 (Ill. Geol. Surv. Bull. 27). *Kickapoo beds.*—Gravels, sand, and silt, 20 to 70 ft. thick, well developed about mouth of North Kickapoo Creek, Illinois Valley, Ill. Belongs to Wisconsin glacial deposits.

Kickapoo sand.

A subsurface sand in McLeansboro fm. (Penn.) of Clark Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Kickapoo Falls limestone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, p. 138). *Kickapoo Falls ls.*—Top memb. of Millsap div. Outcrops in Parker Co. Best exposures of the Millsap are at Kickapoo Falls, 10 mi. S. of Weatherford, Parker Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), replaced *Millsap fm.* with *Millsap Lake fm.*, and described Kickapoo Falls ls. as next to basal memb. of the fm. (See 1933 entry under *Millsap Lake fm.*)

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15, 16). *Kickapoo Falls ls.* was named by Plummer and Moore from prominent exposures at Kickapoo Falls on Kickapoo Creek, in N. edge of Hood Co. It is treated as basal bed of Lazy Bend memb. of Millsap Lake fm.

Kiddville limestone.

Middle Devonian: East-central Kentucky.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 92, 93). *Kiddville bed or layer.*—Dense light-gray ls., blue argill. gritty ls., and reddish-brown ls. Thickness 0 to 3 ft. Characterized by fish remains. Bottom layer of Boyle ls. (Dev.). Underlain by Crab Orchard fm. (Sil.).

Named for small hamlet 1 mi. N. of Indian Fields, Clark Co.

Kiefer sandstone.

See *Keefer ss. memb.*

Kiester moraine.

Pleistocene (Wisconsin stage): Western Minnesota and North Dakota.

W. Upham, 1888 (Minn. Geol. and Nat. Hist. Surv., vol. 2, pp. 415, 625). The 4th or *Kiester moraine.* Named for occurrence in vicinity of Kiester, Faribault Co., Minn.

Kiewitz shale. (In Stanton limestone.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 55). Howard ls. memb. of Shawnee fm. in Nebr. consists of 2 lss. separated by a sh. bed of variable thickness here named *Kiewitz sh.*, from Kiewitz quarry, W. of Meadow, Nebr. This sh. is bluish to gray, argill. to quite calc., fossiliferous, and 2 or more ft. thick. The upper ls. of Howard memb. was named "Louisville ls." by Condra and Bengston, from Louisville, Nebr., and that name, although preoccupied, is in use for this unit in Nebr. The lower ls. of Howard memb. is here named *Church ls.*

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 27, 31). The units called Louisville ls., Kiewitz sh., Du Bois ls., Severy sh., Topeka ls., and Meadow ls. in Bull. 1 are parts of Stanton ls. The name *Louisville ls.* is preoccupied hence *Stoner ls.* is proposed for this unit, to include also *Kiewitz sh.* and so-called Du Bois ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 134). †*Kiewitz sh.*, a part of Stoner ls., is abandoned.

Kiger division. (In Cimarron group.)

Permian: Central southern Kansas and northwestern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 39). *Kiger div.*—All rocks [250 ft. thick] of so-called "red beds" that lie above Medicine Lodge gyp. on central plains N. of Ouachita Mtns. In southern Kans. it is divided into (descending) Big Basin ss., Hackberry shales, Day Creek dol., Red Bluff sss., and Dog Creek shales. Upper div. of Cimarron series. Overlies Salt Fork div., from which it is chiefly characterized by bright-red color of its major fm. (Red Bluff sss., 175 to 200 ft. thick). [In 1897 (Am. Geol., vol. 19, pp. 351–363) Cragin excluded Dog Creek sh. from his Kiger div. and included it in top of his Salt Fork div.]

E. Haworth and J. Bennett, 1908 (Univ. Geol. Surv. Kans., vol. 9, p. 77). *Kiger stage* includes (descending) Taloga fm., Day Creek dol., and Red Bluff fm. Overlies Dog Creek fm. of Salt Fork stage.

This name is not used in subsequent repts.

Named for Kiger Creek, Clark Co., Kans.

Kigluaik group.

Early Paleozoic or older: Northwestern Alaska (Seward Peninsula).

A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901 (Reconn. in Cape Nome and Norton Bay regions, Alaska, in 1900: U. S. G. S. Spec. Pub., p. 27, map). *Kigluaik series.*—Highly crystalline lss., interbedded with gray mica schists, also some amphibole schists. The ls. usually massive, pure, generally white but sometimes bluish. Intruded by granites. More metamorphosed than overlying Kuzitrin series. First found in heart of Kigluaik Mtns, and later identified at other places.

F. H. Moffit, 1913 (U. S. G. S. Bull. 533, pp. 20–23, maps). *Kigluaik group* divided as follows (descending): Tigaraha schist, several thousand ft.; coarsely crystalline ls., 800 to 1,000 ft.; biotite gneiss. All except upper siliceous part of Tigaraha schist were included in Kigluaik series as originally defined and heretofore used. Assigned to Paleozoic, possibly in part pre-Paleozoic.

Kilbuck conglomerate lentil.

See *Killbuck cgl. lentil*, the approved spelling.

Killarney granite.

Pre-Cambrian (post-Keweenawan): Western Ontario (north shore of Lake Huron).

W. G. Miller and C. W. Knight, 1914 (Ontario Bur. Mines Rept., vol. 22, pt. 2, p. 125). Assigned to Algoman interval. Intrusive.

See also A. C. Lawson, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 361–383); also C. K. Leith, 1933 (16th Int. Geol. Cong. Guidebook 27, pp. 1–10), who placed it in Huronian, tentatively, but stated it may be as late as Keweenawan.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), classified Killarney granite as post-Keweenawan pre-Camb., but stated that there is some doubt as to its position.

Killarney revolution.

A period of granitic intrusion believed by some geologists to have immediately followed the formation of the Keweenawan rocks and to constitute the closing episode of pre-Camb. time. Other geologists have assigned the Killarney granite to lower part of Huronian epoch. For definition see U. S. G. S. Bull. 769, pp. 121–123. See also *Killarney granite.*

Killbuck conglomerate lentil (of Cattaraugus formation).

Devonian or Carboniferous: Southwestern New York (Cattaraugus County).

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, p. 977) and 1904 (Geol. Soc. Am. Bull., vol. 14, pp. 522–531). *Kilbuck cgl. lentil.*—Massive flat-pebble cgl. that weathers into large flat blocks. Thickness 10 to 15 ft. Best developed NE. and E. of Kilbuck, Cattaraugus Co. [The village and post office are now spelled *Kill Buck.*] Occurs in upper part of Cattaraugus beds, being separated from underlying Salamanca cgl. lentil by 50 to 70 ft. of sh. and overlain by soft sh. forming top memb. of Cattaraugus.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 426). *Kilbuck cgl.* lies 50 to 70 ft. above Salamanca cgl.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 91). *Killbuck lens* of Glenn is same as "Tuna" or Tunangwant cgl.

Killians limestone.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Killians ls.*—Dark gray to black ls. with black sh. layers. Overlain by gray and brown granular beds of Alpena ls. and underlain by gray shales and lss. of Genshaw fm. Is the "black Alpena" zone of Ver Wiebe's Alpena ls. Greatest measured thickness, 23 ft. Is top fm. of Long Lake stage [as here redefined]. Type loc., exposures along French road, ½ mi. S. of Killians resort, Long Lake, Alpena Co.

Kiln shale.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 294, 296, 300). *Kiln sh.*—Black fissile sh.; large concretions; 200 ft. thick. Best exposed at the old limekilns S. of Disaster Point. Overlies Fiddle ls. and underlies Bedson ls. (Miss.).

Kimball sand.

Drillers' name for an oil, water, and gas-bearing ss., 50 ft. thick, in upper part of Mowry sh. in Basin oil field, Bighorn Co., Wyo. Lies 45 ft. above Octh Louie sand. (See U. S. G. S. Bull. 621, Jan. 21, 1916, pp. 167, 169, etc.)

†Kimball or †Madder dirt.

Name applied by drillers to a bed of sh., 10 to 20 ft. thick, underlying Raytown ls. bed and overlying Cement City ls. bed of Chanute sh. memb. of Kansas City fm. of Mo.

Kimberling shale.

Upper Devonian: Southwestern Virginia and southeastern West Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 177, Pl. 4). *Kimberling sh.*—Includes all shales above Walker black sh. and beneath Carbf. Price ss. Its base is the transition series [at top of Walker black sh.]; these pass upward into green, argill. shales, which grow more sandy as we ascend, until in upper portion it carries many thinly bedded sss. and some cgls.

On some early maps the top and base of Kimberling sh. were drawn at different places. In some areas beds as high as lower part of Maccrady fm. and as old as Portage appear to have been included.

Named for Kimberling Creek, Bland Co., Va.

Kimberly moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, p. 51). Named for occurrence at Kimberly, Aitken Co.

Kimbrel bed.

Eocene (upper): Northwestern Louisiana (Grant County).

T. L. Casey, 1902 (Sci., n. s., vol. 15, p. 716). *Kimbrel bed.*—Greenish black and brick red clays, not so rich in species as Montgomery bed and more limited horizontally. Outcrops on estate of T. W. Kimbrel. Is well above Moody's Branch beds. Is characterized by same fossils as Young's Bluff beds, and in addition immense numbers of extremely minute *Lucina*, which is characteristic fossil of Kimbrel horizon. Is older than Youngs Bluff bed and younger than Montgomery bed. Belongs to horizon noticeably distinct from Montgomery outcrop. Impossible at present to state number of ft. of strata separating Kimbrel horizon from Montgomery bed, but there are several changes in fossils that indicate considerable lapse of time. Included in Jackson stage. Named for outcrops on estate of T. W. Kimbrel, S. of Montgomery, Grant Co.

Kimmswick limestone.

Middle Ordovician (Trenton and Black River?): Eastern Missouri, southwestern Illinois, and northern Arkansas.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 111). *Kimmswick ls.*—More or less crystalline ls. quarried at Graysboro, Cape Girardeau, Glen Park, Kimmswick, and other localities in SE. Mo. The thin bed, 2 to 5 ft. thick, generally found at top, which holds the Fernvale Richmond fauna, is not included. Overlies Plattin ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), defined *Kimmswick ls.* as consisting wholly of beds of late Black River age, uncon. overlain, in eastern Mo., by what he called "Upper Prosser," which in turn was overlain, in places uncon., by McCune dol., of Trenton age. This definition of Kimmswick ls. was repeated by R. S. Bassler in 1915.

A. F. Foerste, 1920 (Denison Univ. Bull. Jour. Sci. Lab., vol. 19, pp. 175+). *Kimmswick ls.* (broad sense) is = McCune ls. of Keyes (1898). [This same statement was made by Keyes, 1923 (Pan-Am. Geol., vol. 39, pp. 67–70).]

J. H. Bradley, Jr., 1925 (Jour. Geol., vol. 33, pp. 53–54, 65, 69). Beds that have been included in Kimmswick ls. are McCune or *Fusispira* zone at top; *Comarocystites* or *Echinosphaerites* zone (which forms top bed of Kimmswick at Cape Girardeau) 30 ft.; *Receptaculites oweni* zone, 68 to 80 ft.; and basal beds, 50 ft. It seems likely Kimmswick ls. in its type exposures does not rise above *base* of *Fusispira* or McCune zone, which is here only provisionally included in Kimmswick. The Kimmswick of Ralls Co. is probably 100 to 125 ft. thick; total thickness of fm. probably approaches 200 ft. The presence of certain [listed] species of fossils is strong evidence that Kimmswick is at least as young as Lower Trenton of type section.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 104–110), restricted Plattin ls. by removing the shaly beds at top, which they designated as *Decorah sh.* The Kimmswick ls. of Mo., SW. and central western Ill. has, therefore, for several years been defined as resting on Decorah sh. (See under *Decorah sh.*, last entry.)

The Kimmswick ls. is now classified by U. S. Geol. Survey as of Trenton age, but possibly including at base some beds of Black River age.

Named for exposures at Kimmswick, Jefferson Co., Mo.

Kincaid formation. (In Midway group.)

Eocene (lower): Eastern Texas.

Julia Gardner, 1933 (A. A. P. G. Bull., vol. 17, No. 6, p. 744). *Kincaid fm.*—Probably 100± ft. thick in Frio River section. Lower fm. of Midway group. Includes beds 7 to 5 of Vaughan's section of "Myrick fm." on Frio River, about ½ mi. above Myrick's lower apiary (now Bob Evans apiary), as given in U. S. G. S. Uvalde folio, No. 64, 1900. The Kincaid fm. in that section consists of (descending): (7) Rather soft yellowish ss., 22 ft. 6 in.; (6) soft yellow sandy clay with bluish streaks, some pebbles in lower part, 2 ft. 6 in.; (5) nodules of glauconitic ss. containing considerable number of small pebbles, 6 in. Underlies Wills Point fm. [restricted] and uncon. overlies Escondido fm. (Upper Cret.). Type exposures are on old Kincaid ranch (Lewis ranch) ¾ mi. above Bob Evans' apiary to ¼ mi. below it.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 532, 535, etc.), divided Kincaid fm. into Pisgah memb. above and Littig memb. below, and included Tehuacana ls. in Pisgah memb. He stated: Some geologists place the upper glauconite of Midway group in Kincaid fm. and draw dividing line btw. Wills Point and Kincaid at top of this glauconite. The upper glauconite is now placed in base of Wills Point fm. because: (1) Glauconitic sands containing phosphatic nodules and pebbles mark commonly basal layers of divisions; (2) the uncon. appears to be at *base* of the glauconite; (3) although the glauconite layer has large fossils which occur both in fms. above and below, it has certain significant ones, like *Venericardia bulla* Dall, that appear for first time; (4) a large percentage of the foraminifera in the glauconite are similar to species in upper or Wills Point clay.

Kinchloe limestone.

Pennsylvanian: Western Kentucky.

F. M. Hutchinson, 1912 (Ky. Geol. Surv. Bull. 19, fig. 28, loose sheet in back of book). *Kinchloe ls.*, 4 ft. thick, shown in section of rocks at Madisonville, Hopkins Co. [May be=Upper Madisonville ls. of pp. 13 and 94 (a ls. 4½ ft. thick lying 38 ft. above Madisonville ls.), but fig. 28 does not show Madisonville ls. nor Upper Madisonville ls., and does not give numbers of coals. Fig. 13 shows Kinchloe coal (seems to be No. 14 or 14A) underlain by 1½ ft. of ls. which may be the Kinchloe ls. of fig. 28.]

Derivation of name not stated, but there is a Kinchloes Bluff in adjoining Muhlenberg Co.

Kinderhook group.

Mississippian: Illinois, Iowa, Missouri, and western Kentucky.

F. B. Meek and A. H. Worthen, 1861 (Am. Jour. Sci., 2d, vol. 32, p. 288). *"Kinderhook group"* is now proposed to include the beds lying btw. Black sl., below, and Burlington ls. above, which have heretofore been considered equivalents of Chemung group of N. Y. This designation will be used in Ill. repts.

A. H. Worthen, 1866 (Ill. Geol. Surv., vol. 1). *Kinderhook group.*—Consists of 100 to 150 ft. of gritstones, sandy and argill. shales, and thin beds of fine-grained and oolitic lss., overlying Dev. Black sl. and underlying Burlington ls. Includes Chouteau ls., Lithographic [Louisiana] ls., Vermicular ss. and shales [Hannibal sh.] of Mo. Rept., the so-called Chemung of Iowa Rept., the Goniatite ls. of Rockford, Ind., and that part of Waverly ss. of Ohio that overlies the Black sl.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., p. 282), divided *Kinderhookian* group of Jersey and Calhoun Counties, Ill., into (descending) Chouteau ls., Hannibal fm., Glen Park ls., Louisiana ls., and Saverton and Grassy Creek shales; and showed the type Kinderhook (of Pike Co., Ill.) as consisting of (descending): (1) McKerney ls., ss., and sh. memb. of Hannibal fm. resting uncon. on (2) Louisiana ls., uncon. on (3) Saverton and Grassy Creek shales, with Chouteau ls. (top fm.) and Glen Park fm. (btw. Hannibal and Louisiana ls.) absent.

A. H. Bell, 1932 (Ill. Geol. Surv. Press Bull. No. 24), and R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc.) included in Kinderhook group Saverton sh., Grassy Creek sh., and Sweetland Creek sh. of Iowa, Mo., and Ill.

For the fms. now included in this group, see Ill. and Mo. correlation charts. The Fern Glen ls., formerly treated as top fm., was several years ago transferred to overlying Osage group, being now treated as basal fm. of the Osage, the next overlying fm. being Burlington ls.

Named for exposures at Kinderhook, Pike Co., Ill.

Kinderhookian.

A time term employed by some geologists to cover the epoch during which the Kinderhook group was deposited.

Kineo rhyolite.

Devonian: Western Maine (Moosehead Lake quadrangle, Piscataquis County).

E. H. Perkins, 1925 (Am. Jour. Sci., 5th, vol. 10, p. 371). *Kineo rhyolite.*—An intrusion of rhyolite locally known as "*Kineo flint.*" Forms a line of hills from Blue Ridge on SW. through Mount Kineo [Moosehead Lake quad.], Shaw Mtn, and Little Kineo to Table Mtn.

E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 10, pp. 440–444). *Kineo rhyolite,* of post-Oriskany age, cuts Moose River ss., of Oriskany age. Splendid outcrops near Mount Kineo hotel.

F. W. Toppan, 1932 (Geol. of Maine, Contr. Dept. Geol. Union Coll., Schenectady, pp. 70, 71). Beginning some 6 or 7 mi. SW. of Lobster group of mtns is a series of low rhyolite hills which extend in exact alignment a distance of about 15 mi. Running NE. to SW. these hills are Norcross Mtn, Table Mtn, Little Kineo, Shaw Mtn, Mount Kineo, and Blue Ridge. While the lava comprising each of these hills is identical it has been named *Kineo rhyolite* by E. S. C. Smith (Am. Jour. Sci., 5th, vol. 10, Nov. 1925), from Mount Kineo, which, because of its steep glaciated cliffs and commanding position on shore of Moosehead Lake, is most striking eminence of the group of mtns. Intrudes Moose River ss., of Oriskany Dev. age.

On 1933 geol. map of Maine, by A. Keith, this rhyolite is assigned to Dev.

King limestone.

Lower Ordovician (Beekmantown): Southwestern Missouri.

E. M. Shepard, 1898 (Mo. Geol. Surv. vol. 12, pt. 1, pp. 49, 71–74). *King ls.*—Soft fine-grained, compact light ashy-gray ls. ("cotton rock" of miners), 1 to 15 ft. thick. No fossils found. Overlies [?] Black or Eureka sh. and underlies Sac ls. All included in Hamilton stage of Dev.

Later repts by S. Weller (1901) and other geologists assigned this fm. to Kinderhook group.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 113–114). Sac ls. uncon. underlies "Phelps" (Sylamore) ss. and overlies King ls. Both Sac and King are lacking in organic remains, are highly mag., and resemble underlying "Mag. series" of the Ord. so closely that in many cases they may be confused with very similar beds of First and Second Mag. lss.

The King ls. appears to belong to lower part of Powell ls. or to Cotter dol. (which uncon. underlies Powell ls. in SW. Mo., and contains the "cotton rock" of the miners), and the overlying Sac ls. appears to belong to upper part of Powell ls., which uncon. underlies Sylamore ss. in SW. Mo. (See Mo. correlation chart.)

Named for outcrops on King Branch and King Mound, Greene Co.

Kingak shale.

Jurassic (Lower?): Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103, 119, map). *Kingak sh.*—About 4,000 ft. of black sh., overlying Shublik fm. (Upper Triassic), and probably underlying Ignek fm. (Jurassic?). The fm. name is confined to the shales containing the Lower Jurassic fauna here listed. The fm. has been identified at only 1 loc., Kingak Cliff, near camp 263, at SE. end of Sadlerochit Mtns.

King Ferry shale member. (In Ludlowville shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 219, 228, etc.). *King Ferry shale memb. of Ludlowville fm.*—Mostly dark aren. sh. occupying interval btw. Ledyard sh. below and Portland Point ls. memb. of Moscow fm. above. Is = Wanakah and Deep Run members, which could not be differentiated btw. Seneca and Owasco Lakes. Is upper memb. of Ludlowville fm. in Cayuga Lake region. Thickness 120 to 130 ft. Type loc., at Clearview, King Ferry, Cayuga Lake.

†Kingfisher formation. (In Cimarron group.)

Permian: Central Oklahoma and southern Kansas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 352–355). *Kingfisher fm.*—Includes Salt Plain measures and saliferous Harper sss., which are in places difficult to separate. Included in Salt Fork div.

Named for Kingfisher Creek and town in Kingfisher Co., Okla.

King Hill shale. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska, northeastern Kansas, southwestern Iowa, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 45, 47). *King Hill sh.*—Bluish-green and reddish argill. sh., about 7 ft. thick at type loc. (in King Hill, SE. of Rock Bluff, Nebr.). Is 4 ft. thick in Mo. and 6 to 7 ft. in Kans. Underlies Avoca ls. and overlies Cullom ls. [later named *Beil ls.* and still later *Cullom* was abandoned]. All included in Lecompton ls.

Kings limestone.

Devonian: Missouri.

E. M. Shepard, 1904 (Drury Coll., Bradley Geol. Field Sta. Bull., vol. 1, p. 41), listed, in table of geol. fms. of Mo., *Kings ls.* as underlying Sac ls. and overlying Eureka sh., all included in Hamilton epoch of Dev.

Kings Branch limestone.

Age (?): Southwestern Missouri (Greene County).

E. M. Shepard, 1905 (Drury Coll., Bradley Geol. Field Sta. Bull., vol. 1, in description of the mag. lss. of Greene Co., Mo.). *Kings Branch ls.*—Soft, very fine-grained, compact white to ashy-gray "cotton" rock, in thin alternating layers of softer and harder material, weathering in thin ridges and grooves, representing successive bedding planes. [All of definition.]

Only record of name.

Kingsbridge marble.

Pre-Cambrian: Southeastern New York (Manhattan Island).

L. D. Gale, 1839 (N. Y. Geol. Surv. 3d Ann. Rept., p. 183). At N. part of this valley [on New York Island, as he called it] and on E. slope of ridge, the ls. generally called *Kingsbridge marble* commences and continues to Kingsbridge, a distance of nearly 1¼ mi. Is mostly granular ls. Has been chiefly wrought for burning into lime. Belongs to the gneiss fm., as is evident from the commingling of the two in many places throughout the course of the ls.

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116–120). [On his "Section across New York [Manhattan] Island along southern shore of Spuyten-Duyvel Creek and Harlem River" *King's Bridge ls.* is shown upturned btw. High Bridge gneiss on one side and Fort Washington gneiss on the other side.]

J. D. Dana, 1881 (Am. Jour. Sci., 3d, vol. 21, pp. 435, 441). [Referred to ls. S. of King's Bridge as *King's Bridge ls.*]

J. F. Kemp, 1887 (N. Y. Acad. Sci., Trans., vol. 7, pp. 49–64). The ls. called *Kingsbridge marble* composes NE. corner of Manhattan Island. It is interbedded with the gneiss.

In U. S. G. S. New York City folio (No. 83) the ls. at and around Kings Bridge was mapped as Stockbridge dol. (of Camb. and Ord. age), but it is now considered by geologists generally to be pre-Camb., and is universally called *Inwood ls.* The gneiss with which it is associated is Fordham gneiss.

Kingsbury conglomerate member (of Wasatch formation).

Eocene: Northern Wyoming (Bighorn Mountains region).

N. H. Darton, Nov. 17, 1906 (U. S. G. S. P. P. 51, pp. 13, 60, etc.). *Kingsbury cgl.*—Appears on S. side of Beaver Creek, developing either out of lower part of top beds of underlying Piney fm. or lower beds of overlying De Smet fm. Thickness 0 to 2,500 ft. Consists of pebbles and bowlders, mostly of Carbf. lss. and darker colored chert and the very distinctive flat-pebble cgl. of Deadwood fm. of mtns to W. Occurs mostly in layers 6 to 12 ft. thick, interbedded with dark greenish to light-yellow clays. The name *Kingsbury*, here used for first time, is from Kingsbury Ridge, [6 mi.] SW. of Buffalo.

In 1910 the U. S. Geol. Survey decided to replace *De Smet fm.* with *Fort Union fm.*, the older name; and adopted *Kingsbury cgl. memb. of Fort Union fm.* for Darton's Kingsbury cgl. Later work, however, proved that Kingsbury cgl. grades laterally into basal part of Wasatch fm., and the Kingsbury is therefore now treated as basal memb. of Wasatch fm., being thus mapped on 1924 geol. map of Wyo.

†Kings Creek silex.

†Kings Creek phase.

Oligocene and upper Eocene: Western South Carolina (Barnwell County) and southeastern Georgia.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies, published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, name only, not defined); 1908 (S. C. Geol. Surv. ser. 4, Bull. 2, pp. 435, 464–465). *Kings Creek silex or silicified marls;* also *Kings Creek phase.*—Comprises ledges of highly siliceous rock inclosing many spicules of sponges and other forms now silicified. The surface of high ground btw. Johnson's Landing, near mouth of Lower 3 Runs, Barnwell Co., S. C., to point immediately S. of King's Creek and about 1 mi. W. of river road is in places strewn with small masses of chalcedony of many hues of white, red, and blue; at the King's Creek locality a moderately prominent knoll is well shingled with this material, specimens of which exhibit silicified corals and other fossil forms studded with minute crystals of silica. This fm. passes under the Brier Creek marls. Its probable equiv. is exhibited capping the high hill immediately S. of McBean Creek near McBean Station. Assigned to Olig.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Kings Creek phase of Sloan includes Glendon fm. and upper part of Eocene, and is abandoned.

Kingsdown marl.

Pleistocene: Southwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 53, 54). *Kingsdown marls.*—Yellowish brown lacustrine or slack-water marls, with concretions of carbonate and silicate of lime; 100 to 200 ft. thick. Overlies Pearlette ash and uncon. underlies Quat. Supposed to be of late Plio. age and to belong to Tule div. of Cummins (*Equus* beds of Cope). Named for Kingsdown, Ford Co.

Kingsley red shale member (of New Milford formation).

Upper Devonian: Northeastern Pennsylvania (Susquehanna County).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571–589). *Kingsley red shale memb.*—Basal memb. of New Milford fm. Recognized but not named by I. C. White. Well exposed in R. R. cut at Kingsley, Susquehanna Co. Occurs at several places in the region, where it is convenient datum for measuring interval up to Damascus red beds, which overlie the New Milford. This interval is occupied by Lanesboro memb. of New Milford fm.

Kings Mill sandstone.

Upper Devonian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 73–77). *King's Mill ss.*—White ss.; some lenticular layers are merely masses of stone honeycombed by cavities left by solution of shells. Fossils indicate transition from Chemung to Catskill, but some may prefer to include them in Catskill. Exposed near King's Mill, 2 mi. NW. of Duncannon, Perry Co.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 585). As Shohola fm. is largely Chemung in age, it is approx. = the 500 ft. of red beds below Kings Mill ss.

Kings Mill shales.

Upper Devonian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, p. 77). *King's Mill shales.*—A series of red sss. and shales, green shales and thin lss., some of latter crowded with poorly preserved fossils. Near middle lies the upper fish bed. Thickness

500 ft. Underlie Dellville ss. and overlie Kings Mill ss. Belong to transition btw. Chemung and Catskill, but some may prefer to include them in Catskill.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 582, 585). The 500 ft. of red beds beneath Kings Mill ss. are approx.=Shohola fm., and the Dellville ss. of Claypole, which overlies Kings Mill shales of Claypole, is possibly=Honesdale ss. [This would correlate latter shales with Damascus red sh. of Willard.]

†King's Mountain group.

†King's Mountain series.

†King's Mountain slates.

Cambrian and pre-Cambrian: Northwestern South Carolina and western North Carolina.

O. M. Lieber, 1858 (Rept. of survey of S. C. for 1856, pp. 23, 30). [On p. 23 the name *King's Mtn series* is used for the rocks mapped and described as *talcose slate*, and on p. 30 the same rocks are called *King's Mtn group*.]

E. Sloan, 1908 (Repts and resolutions of General Assembly of S. C., regular session commencing Jan. 14, 1908, vol. 1, pp. 648–651; also S. C. Geol. Surv., ser. 4, Bull. 2, pp. 414–417, 1908). *King's Mtn slates* (*Archean*).—Comprise large bodies of quartz schist, quartz-mica schist, qtzite, mica schist, sericites, monzonite schists, gneissoids, and some argillites with highly developed slaty cleavage, and intermediate forms of rocks of sedimentary origin, all of which have been more or less foliated, greatly folded and otherwise disturbed by a vast series of igneous intrusions of enormous volumes. Largely confined to Abbeville-York zone, but outlying patches extend to Anderson-Spartanburg zone. Some igneous phases of this fm. find their apparent equivalence in some rocks of Edgefield-Chesterfield zone. The Vaucluse zone also comprises certain highly altered sed. rocks of probable equivalence of King's Mtn slates.

Divisible into several fms., of which Kings Mtn qtzite is one.

Named for development on Kings Mtn, in Cleveland and Gaston Counties, N. C.

Kings Mountain quartzite.

Cambrian (probably Lower): Southern North Carolina and northwestern South Carolina.

A. Keith and D. B. Sterrett, 1931 (U. S. G. S. Gaffney-Kings Mtn folio, No. 222). *Kings Mtn qtzite*.—Includes 3 distinct kinds of qtzite with gradations btw. them in some places (white nearly pure qtzite, kyanitic qtzite, and chloritic-sericitic qtzite grading into schist; the white qtzite normally at top), with Draytonville cgl. memb. at base; apparent gradations or replacements of the cgl. by the qtzite occur in places. Thickness of fm. 5 to 500 ft. Underlies Blacksburg schist and rests uncon. on Battleground schist (Algonkian) and on Archean rocks.

Named for development on Kings Mtn, in Cleveland and Gaston Counties, N. C.

Kings River sandstone member (of Everton formation).

Lower Ordovician: Northwestern Arkansas (Eureka Springs-Harrison region).

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Kings River ss. memb. of Everton ls.*—Massive saccharoidal ss., with cgl. at base. Thickness 0 to 40 ft. Uncon. overlies Sneeds ls. lentil, the basal bed of Everton ls., and is overlain by the white, light-gray, and dove-colored nonmag. ls. forming major part of the Everton. Named for exposures along Kings River, Eureka Springs quad.

Kingston group.

Pre-Cambrian: New Brunswick.

L. W. Bailey and G. F. Matthew, 1872 (Canada Geol. Surv. Rept. 1870–71, pp. 122–138).

Kingston conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 114 and chart). Is cgl. No. 10 of Keweenaw Co.

According to B. S. Butler (U. S. G. S. P. P. 144, 1929) is probably same as Kearsarge cgl. (No. 11).

Belongs to Central Mine group.

Named for occurrence on Kingston farm, on Keweenaw Point.

†Kingston beds.

Lower Devonian: Eastern New York.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). ***Kingston beds***, the "upper shaly beds" of W. M. Davis, which are typically exposed and attain a thickness of 250 ft. in vicinity of Kingston. Underlie Oriskany beds and overlie Becraft ls. Top fm. of Helderbergian group.

The name "Kingston" being preoccupied, it was in 1903 replaced by *Port Ewen ls.*, which is now included in Oriskany group, having been transferred to that group by Schuchert in 1903 (Am. Geol.).

Kingston formation.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 88).

Kingston limestone.

Carboniferous: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 47, 54).

†Kingstown series.

Carboniferous: Central southern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 331–347, and map, pl. 31). ***Kingstown series.***—Irregularly alternating beds of coarse qtzitic ss. (almost an arkose), cgls., medium-grained and fine-grained sss., and dark blue shales. Basal part consists of 100 to 200 ft. of arkose and cgls. often associated with much coaly sh. Thickness 11,200 ft. Typically developed in South and North Kingstown. Underlies Aquidneck shales.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, p. 134), showed Kingstown series of Foerste as including lower part of Rhode Island Coal Measures and all of Wamsutta fm., and as resting on beds equiv. to Pondville cgl.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped all areas of Kingstown series of Foerste as Wamsutta fm. and Pondville cgl.

Kingwood sand.

A subsurface sand, of early Penn. (Cherokee) or late Miss. age, in central and eastern Okla., reported to lie considerably lower than Deaner sand, higher than Lyons sand, and to correlate with lower part of Dutcher sand series. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 180, the Deaner sand is Miss.

Kinishba beds. (In Supai formation.)

Permian: Southeastern Arizona (Fort Apache Indian Reservation).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 533–536). [See under *Fort Apache ls.*]

Kinkaid limestone. (Of Chester group.)

Mississippian: Southern and western Illinois and adjacent parts of Kentucky.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41). *Kinkaid ls.*—Ls. and sh., with possibly some thin beds of ss. The lss. are of variable character, but chiefly hard, dense, and compact, breaking with splintery or conchoidal fracture; they are of gray, yellowish, and black colors, the yellow layers being a conspicuous feature in many outcrops. Some ls. beds are siliceous; chert beds of greater or less extent are scattered through the fm.; one massive light-colored chert bed in lower part recognized over considerable area. The shales are also of variable character, some being almost pure clay, some calc., some siliceous, and some more or less sandy; and they vary in thickness from thin shaly partings btw. the lss. to beds 15 or more ft. thick. In color the shales are black, gray, olive green, and red. Thickness of fm. 100 to 150 or more ft. Top fm. of Chester group. Heretofore not recognized. Contains a Chester fauna. Rests on Degonia ss. with apparent conformity. Uncon. overlain by Pottsville fm. Included in Clore fm. as mapped in previous repts.

Named for good exposures along Kinkaid Creek and some of its tributaries in Jackson Co., Ill.

Kinney limestone. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 37). *Kinney ls.*—Middle memb. of Matfield fm. Thickness 12 ft. in Nebr. and 15 ft. or more in southern Kans. in vicinity of Burden. In Nebr. it consists of (descending): (1) Two mudstone lss. separated by sh., about 1 ft. 8 in.; (2) gray sh., 5 or 6 ft.; (3) gray ls., 5 ft. or more. In central and southern Kans. the lower ls. becomes prominent and massive and the upper zone becomes about 6 ft. of very thin fossiliferous ls. beds separated by sh. seams, with 2 or 3 ft. of limy sh. remaining as zone 2. Underlies Blue Springs sh. memb. and overlies Wymore sh. memb. Type loc. is Burlington R. R. cut just E. of Kinney, Nebr.

Kinnick formation.

Miocene (lower): Southern California (northeastern part of Kern County).

J. P. Buwalda, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 310). *Kinnick fm.*—Mainly basic volcanics, several hundred ft. thick, containing, in interbedded sediments, the Lower Mio. Phillips ranch mammalian fauna. Strongly deformed. Occurs NE. of Monolith [NE. part of Kern Co.]. Underlies (probably uncon.) Bopesta fm. and rests on Witnet fm. with strong angular uncon. [Derivation of name not stated.]

Kinnikinic quartzite.

Ordovician (Middle?): Southern central Idaho (Custer County).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Kinnikinic qtzite.*—Massive light-colored qtzite with local lenses of dol. and dolomitic sh. and some cgl. Thickness 3,500± ft. Underlies Saturday Mtn fm. and overlies Ramshorn sl. Named for creek which flows into Salmon River at Clayton, Custer Co.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 947, etc.). *Kinnikinic qtzite.*—Name here definitely applied only to the strata exposed at intervals from vicinity of Kinnikinic Creek NE. to Round Valley (near Challis) and the area on both sides of that valley. The Ord. strata along Morgan Creek and at N. end of Lost River Range, S. of Ellis, are closely similar to and doubtless to be correlated with Kinnikinic qtzite. No lithologically similar strata exist in Hailey quad. with possible exception of parts of the qtzite members of the 2 supposed pre-Camb. fms. In Bayhorse quad. most of Kinnikinic qtzite is well-bedded, nearly pure qtzite in which shaly partings and subordinate amounts of shaly beds (partly calc.) are common. Thickness 3,500± ft. Fossils discussed.

Kinross moraine.

Pleistocene (Wisconsin stage): Northern Michigan (Chippewa County). See F. Leverett, U. S. G. S. P. P. 154A, 1929. Named for Kinross Station.

Kinsman granodiorite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region, Franconia and Moosilauke quadrangles).

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78). *Kinsman granodiorite* (*Carbf. ?*), exposed around Kinsman Mtn [Franconia quad.].

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 9, 20, map). *Kinsman quartz monzonite*, named for Kinsman Notch, in Moosilauke quad., occupies much of W. and N. parts of Franconia quad. and extends N. in Rumney and Plymouth quads. Is white to gray, coarse- to medium-grained; in places contains large white crystals of potash feldspar 1 to 2 inches long. Is younger than Littleton fm., and either late Dev. or late Carbf. Assigned to New Hampshire magma series.

See also M. P. Billings, Geology of Littleton and Moosilauke quads., N. H., 1935.

Kinter sand.

Ordovician: Northeastern Oklahoma (Oklahoma City oil field).

D. A. McGee and W. W. Clawson, Jr., 1930 (A. A. P. G. Bull., vol. 16, pp. 966, 974+). *Kinter ss.*—An oil and gas horizon, 20 to 80 ft. thick, in Ord. rocks of Oklahoma oil field, NE. Okla. Base lies about 110 ft. above Arbuckle ls. Variously known as "Olds," "Johnson," "Lowery," and "Hoopes." Overlies "Stamper" zone and lies 150± ft. below "Hammer-Haindl" ss.

This sand has been correlated, in earlier repts, with basal part of Simpson fm. Named for a farm.

Kintla argillite.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 324). *Kintla argillite.*—Argillite and qtzite, thin-bedded, maroon red, ripple-marked, sun-cracked, containing casts of salt crystals, also occasional beds of white qtzite and some calc. beds. Thickness 800+ ft. No upper limit seen. Is top fm. of Algonkian. Younger than Sheppard qtzite. Closely resembles Grinnell argillite. Named for occurrence in mtns on 49th par. NE. of Upper Kintla Lake, Mont.

Kinzers formation.

Lower Cambrian: Southeastern Pennsylvania.

G. W. Stose and A. L Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 359, 362–363). *Kinzers fm.*—Siliceous banded dark-blue dol., resting on 50 ft. (in places) of blue hackly sh. (containing *Olenellus* fauna), and, at base, a few thin beds of impure dol. Thickness 150 ft.; S. of Welsh Mtn. only 25 ft. Underlies Ledger dol. and overlies Vintage dol., the 3 fms. being considered=Tomstown dol. Named for exposures in Pa. R. R. cut at Kinzers, Lancaster Co.

†Kinzua Creek sandstone. (In Pottsville formation.)

Pennsylvanian: Central northern Pennsylvania.

C. A. Ashburner, 1879. [See first entry under †*Johnson Run ss.*]

Correlated with Connoquenessing ss. by J. F. Carll in 1880 (2d Pa. Geol. Survey Rept. I_5, p. 82), also by Ashburner in 1880 (2d Pa. Geol. Survey Rept. R). Thickness 45 to 60 ft.

Named for exposures in Kinzua Creek Valley, McKean Co.

Replaced by Connoquenessing ss. memb. of Pottsville fm.

Kiowa shale.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1894 (Colo. Coll. Studies, 5th Ann. Pub., p. 49). *Kiowa sh.*—Inferiorly dark-colored and superiorly light-colored fossiliferous shales, a locally modified northern extension of part of Hill's Comanche series, cut off from main part by erosion. Eastern exposures rest on Cheyenne ss., middle and western exposures rest on "Red-beds." Overlain by brown sss. of middle Cret. age or by Tert. or Pleist. deposits.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 368), redefined *Kiowa sh.* so as to exclude basal oyster bed, 1½ ft. thick, which he named *Champion shell bed.* In 1896 Cragin restored the oyster bed to Kiowa sh., and that classification has since been followed by all writers, and adopted by U. S. Geol. Survey, also by Kans. Geol. Survey (Bull. 9, 1924, by W. H. Twenhofel).

F. M. Bullard, 1928 (Okla. Geol. Surv. Bull. 47, p. 50). It may seem advisable to separate Champion shell bed from the Kiowa, especially if it represents any part of the Fredericksburg. Considering Kans. area alone, the Champion may well be included with the Kiowa, but for convenience of description it is here separated from Kiowa.

Named for Kiowa Co.

Kipp sandstone. (In Bearpaw shale.)

Upper Cretaceous: Southern Alberta (Lethbridge region).

T. A. Link and A. J. Childerhose, 1931 (A. A. P. G. Bull., vol. 15, No. 10, pp. 1232, 1236). *Kipp ss.*—Top lies 410 ft. above base of Bearpaw sh. and 150± ft. below Rye Grass ss. Base lies 100± ft. above McGrath ss. Thickness 40 ft. Named for outcrop on N. bank of Oldman River 1½ mi. SW. of Kipp Station. Of light greenish-blue color; coarse locally, and readily distinguished in diamond cores. A thin zone of glauconitic sand, 3± ft. thick, lies 30 ft. above its top. Many bentonite beds occur directly above upper ledge of this ss., but very few occur below it.

†Kirby clay.

Lower Cretaceous (Comanche series): Central southern Kansas.

C. N. Gould, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 170–174). *Kirby clays.*—Yellowish clays, aren. below, reddish above, containing several beds of light-yellow ss. Thickness 20 to 130 ft. Underlies Reeder ss. and overlies Greenleaf ss. Included in Medicine beds.

Named for Kirby, or C. W., or Fullington ranch, on upper Medicine River, 10 or 12 mi. W. of Belvidere, Kiowa Co.

The U. S. Geol. Survey discarded this name in 1921, the beds to which it was applied being regarded as Kiowa sh.

Kirby granite.

Age (?): Northeastern Vermont (Kirby Township, Caledonia County). See under *Knox Mtn granite*, 1906.

Kirk gas sand.

Occurs in upper part of section in Graham field, NW. part of Carter Co., Okla., 320 or 400 ft. below Moyer gas sands and 250 to 500 ft. above Johnson oil and gas zone. Thickness 30 to 125 ft. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 179, this sand is Perm.; according to C. W. Tomlinson and W. Storm (A. A. P. G. Bull., vol. 8, pp. 593–620, 1924, and Okla. Geol. Surv. Bull. 40Z, 1928) it is Penn.

Kirker tuff.

Oligocene: Western California (San Francisco Bay region).

B. L. Clark, 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, pp. 54–111). *Kirker tuff.*—In Sobrante anticline, in Concord quad., the fm. consists of about 100 ft. of fairly indurated white tuff beds, which contain a few minor layers of tuffaceous ss., the fm. as a whole being very fine and homogeneous in texture, and discon. overlain by Concord fm. and underlain by San Ramon fm. At type loc. (on Kirker Creek, N. of Mount Diablo) the fm. consists of (descending): Tuffaceous ss., 50 ft.; rhyolitic white tuff beds with lentils of bluish tuffaceous ss., 350 ft.; and ss., tuffaceous toward top, 50 ft., resting discon. on Markley fm. and uncon. overlain by San Pablo fm. In latter region the beds were included in San Pablo by Turner (1898) and Weaver (1909).

Kirker's Pass beds.

Miocene: Western California (Mount Diablo region).

J. P. Smith, 1910 (Jour. Geol., vol. 18, table opp. p. 226). [*Kirker's Pass beds with Santa Margarita fauna* appears in column headed "Mount Diablo region." Assigned to middle Mio. and correlated with upper part of San Pablo.]

Kirkfield limestone group.

Ordovician: Ontario.

R. A. Johnston, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 190).

Kirkland formation.

Name proposed by E. O. Ulrich in 1918 (Geol. Soc. Am. Bull., vol. 29, p. 82), for a part of Clinton fm. of N. Y., Pa., and Md., but practically abandoned by him in 1923. See explanation under *Clinton fm.*, 1918 and 1923 entries.

Kirkland limestone and iron ore.

Name proposed by G. H. Chadwick in 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368), for a bed, 6 ft. thick, in the upper part of the pre-Rochester part of Clinton fm. See explanation under *Clinton fm.*, 1918 entry.

Kirkland Lake series.

Pre-Cambrian: Quebec.

M. E. Wilson, 1918 (Canada Geol. Surv. Mem. 103, p. 52).

Kirkwood formation.

Miocene (middle): New Jersey Coastal Plain.

G. N. Knapp, 1904 (N. J. Geol. Surv. Ann. Rept. State Geol. 1903, pp. 81–82). *Kirkwood fm.* (Mio.), underlies Cohansey fm. It carries water-bearing sands at several different strat. horizons.

H. B. Kümmel, 1909 (Jour. Geol., vol. 17, p. 373). *Kirkwood fm.*—Sand and clay, 100 ft. thick. Consists of fine clayey sand, 10 to 20 ft. thick (the Shiloh marl of many repts) underlain by 80 to 90 ft. of chocolate or drab-colored clay. Uncon. overlies Shark River marl and uncon. underlies Cohansey fm.

Named for exposures at Kirkwood, Camden Co.

Kirkwood sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Mooretown ss. of Cumings. Also a sand in Chester group of Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Kirtland shale.

Upper Cretaceous (of Montana age): Southwestern Colorado and northwestern New Mexico.

C. M. Bauer, 1916 (U. S. G. S. P. P. 98P). *Kirtland sh.*—Predominantly clayey. Mostly gray sh. with some brown, bluish, greenish, and yellowish shales, easily weathering gray-white ss., and, in upper part, the brown resistant Farmington ss. memb. So far as known the fm. is of fresh-water origin, although possibly formed in deltas and lagoons. Thickness 836 to 1,180 ft., including Farmington ss. memb., which is 0 to 455 ft. thick, lies 40 to 110 ft. below top of the Kirtland and 271 to 830 ft. above its base. The Kirtland grades into underlying Fruitland fm. and is overlain, with apparent conformity, by Ojo Alamo ss. Was included in so-called Laramie of Holmes' 1877 rept. Named for exposures at Kirtland P. O., San Juan Co., N. Mex.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, pp. 22–25). *Kirtland sh.* (*restricted*).—Consists of three members (all of fluviatile origin): Upper sh. memb., 12 to 475 ft. thick; middle or Farmington ss. memb., 20–480 ft. thick; lower sh. memb., 271–1,031 ft. thick. Grades into underlying Fruitland fm. Except near Durango, Colo., the overlying McDermott fm. seems to be conformable with Kirtland, and the bdy btw. the two is arbitrary. In Durango region the McDermott appears to be uncon. with Kirtland. The McDermott fm. (150 to 200 ft. thick in San Juan Co., N. Mex.) was included in uppermost part of Kirtland sh. of Bauer (1916) and in part in Kirtland sh. of Bauer and Reeside (U. S. G. S. Bull. 716, 1921). [For his opinion as to age see 1924 entry under *Fruitland fm.*]

Kiser gypsum member (of Blaine gypsum).

Permian: Southwestern Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 55). *Kiser gyp.*—Soft bluish or greenish to drab or gray gyp., 1 to 3 ft. thick, occurring in shales which separate Chaney gyp. below from Haystack gyp. above. Included in Greer div. The Kiser is older than Haystack gyp., Cedartop gyp., Collingsworth gyp., and Mangum dol.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3). [See under *Chaney gyp. memb.*]

Named for Kiser salt plain, on Elm Fork, Greer Co.

Kishenehn formation.

Tertiary (Eocene?): Southern British Columbia.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 86). *Kishenehn fm.*—Fresh-water deposit (lake beds) of Tert. age, not known to have an exact strat. equiv. anywhere else in area covered by Commission. Thickness of 250 ft. is exposed in Flathead trough at Boundary line; total thickness in wells probably 700 ft. Tert. fossils (Eocene or later). Named for Kishenehn Creek. Dawson discovered same fm. near mouth of the Kishenehn in 1885, and Willis encountered it in 1901 on N. Fork of the Flathead. He regarded it probably Mio. or Plio. [According to Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, sheets 1 and 2) this fm. does not extend into Mont. but stops at Int. Bdy. Mackenzie, 1916 (Canada Geol. Surv. Mem. 87, p. 31), spelled this name *Kishinena*, and Rose, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 31), spelled it *Kishenena*.]

Kishwaukee moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. (See M. M. Leighton, 16th Int. Geol. Cong. Guidebook 26, 1933, p. 51.)

Kiskatom formation.

Middle Devonian: Southeastern New York (Greene, Albany, Ulster, and Schoharie Counties).

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7). Under the supposed "Oneonta" reds (lower Ithaca or Otselic and older than true Oneonta), in Albany and Greene Counties, are reds once included in the Catskill that prove to be of upper Hamilton age. We shall call them *Kiskatom red beds*. They occur only in Hudson Valley.

G. H. Chadwick, 1933 (Sci., n. s., vol. 77, pp. 86–87). A. G. Cooper's field work this summer, with which he has kept me informed, has shown that top of Hamilton (middle Dev.) goes even higher in the red beds than I had supposed. Publication of his results will be awaited with greatest interest, but meantime it seems wise to extend term *Kiskatom*, following the original intention, up to top of middle Dev. reds, until such time as these may submit to subdivision. Overlies Ashokan.

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 26, p. 480), showed *Kiskatom red beds* as underlying Onteora red beds and overlying Ashokan flags.

G. H. Chadwick and G. M. Kay, 1933 (16th Int. Geol. Cong. Guidebook 9A, pp. 4–7). *Kiskatom red beds* include the continental red and gray shales and sss. that have been called *Oneonta*, though they are considerably older than typical Oneonta, which occurs farther W. They overlie Ashokan bluestone.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 857). To the Hamilton red beds of Greene, Albany, Ulster, and Schoharie Counties, N. Y., the name *Kiskatom fm.* is now applied, pending time when this mass may be more accurately subdivided. The original Catskill fm. of Mather included all of Kiskatom (2,500± ft. thick, including the Tully) and perhaps a little of overlying beds of Genesee age, but since Catskill has later come to apply to Upper Dev. beds, it may be best to let that name continue to be used for post-Kiskatom strata. Westward the Kiskatom passes into the familiar marine beds, the Skaneateles, Ludlowville, and Moscow of Hamilton group.

Kiski volcanics.

Pre-Cambrian: Manitoba.

F. J. Alcock, 1920 (Canada Geol. Surv. Mem. 119, p. 16).

Kisner sand.

A subsurface sand, 10 ft. thick, in central northern Okla., correlated with part of Garrison sh. (Perm.). In Garber pool (Garfield Co.) it is reported to lie at 700 ft. depth. See under *Hoy sand*.

Kisseynew gneisses.

Pre-Cambrian: Saskatchewan.

E. L. Bruce, 1918 (Canada Geol. Surv. Mem. 105, p. 27).

Kissinger sand.

A subsurface sand, of Penn. age, in Kissinger and Moren fields, Young Co., north-central Tex., lying at 2,400 to 2,500 ft. depth.

Kitchener quartzite.

Pre-Cambrian: Southeastern British Columbia and northwestern Montana (Purcell Range).

R. A. Daly, 1905 (Canada Geol. Surv. Summ. Rept. 1904, pp. 96–100). *Kitchener qtzite.*—Hard sss. and argillites interbedded; contain high proportion of disseminated iron oxides; thin-bedded; ripple marks; sun cracks. Thickness 7,400 ft. in section along Int. Bdy btw. Port Hill, Idaho, and Gateway, Mont. Conformably underlies Moyie argillite and conformably overlies Creston qtzite. The intrusive Moyie sill of gabbro, 2,500 ft. thick, lies in middle of Kitchener qtzite.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 4, 115°30′ to 116°). *Kitchener qtzite.*—Thin- to thick-bedded greenish-gray qtzite and metargillite; somewhat dolomitic in places. Upper part is=Siyeh fm., and lower part is=Wigwam fm.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 128, 257). *Kitchener fm.* was named for station on Canadian Pacific Ry (in Kootenay Province of B. C.).

Kitchi schist.

Pre-Cambrian (Keewatin): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 490, 492, 496+). *Kitchi schists.*—Greenstone schists characterized by pebble and boulder-like bodies scattered through them, which are so well rounded that the rocks look like a sedimentary cgl. Indeed, so conglomeratic are their features that they have frequently been called *Deer Lake cgls.* [p. 496]. But they are plainly basic tuffs, which have preserved their tuffaceous character much more perfectly than the banded varieties of Mona schists. Differ from Mona schists in composition, but are of about same age as the Mona. Exposed on Kitchi Hills, in vicinity of Deer Lake.

Kitsalas formation.

Triassic (?): British Columbia.

R. G. McConnell, 1913 (12th Int. Geol. Cong. Guidebook 10, p. 17).

Kitsilano formation.

Tertiary: British Columbia.

W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 23).

Kittanning coal group. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland.

J. P. Lesley and I. C. White, 1876 (2d Pa. Geol. Surv. map of southern Butler County). [The block beneath Darlington coal reads (descending): "*Kittanning group,* Kittanning coal." This map is in library of U. S. G. S.]

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_5, p. xxiii), divided Lower Productive Coal Measures [Allegheny fm.] into (descending) Freeport coal group, *Kittanning coal group,* and Clarion coal group.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Kittanning group* extends from top of Upper Kittanning coal to top of the Buhrstone iron ore overlying the Ferriferous (Vanport) ls.

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas, No. 65, Punxsutawney quad., pl. 4, p. 28). *Kittanning fm.* includes beds from top of Upper Kittanning coal to top of Vanport ls. memb.

Kittanning coal group is treated by U. S. Geol. Survey as an economic memb. in middle of Allegheny fm. In Md. it includes Upper, Middle, and Lower Kittanning coals and, at base, Split-six coal.

Kittanning sandstone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and eastern Ohio.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Kittanning (Industry) ss. and sh.*—In Beaver Co., Pa., is 42 to 50 ft. thick. At Industry, on Ohio River, it is 50 ft. thick and forms massive vertical cliff. Underlies Kittanning fire clay [Lower Kittanning clay] and lies 30 ft. above Vanport ls.

W. G. Platt, 1880 (2d Pa. Geol. Surv. Rept. H_6 p. 283). *Kittanning ss.*—Coarse-grained to pebbly ss. 25 to 40 ft. thick. Underlies Middle Kittanning coal and lies higher than Lower Kittanning coal. Exposed in small ravine btw. village of Worthington and Buffalo mills, and extends to W. edge of Worthington, which town is built on it. [As defined this is a younger ss. than Kittanning ss. memb. of generally accepted nomenclature, which is older than Lower Kittanning coal. On p. xxi of this rept. J. P. Lesley says this ss. "might receive the name of *Pine Creek ss.* east of the river, or of *Worthington ss.* west of the river, because of the fine exhibitions which it makes in those localities." On p. 319 Lesley says this ss. "may be called *Pine Creek ss.* where it is a cgl. It usually comes under Kittanning Middle coal, but sometimes occupies interval between Kittanning Upper coal and Kittanning Lower coal. *Worthington ss.* would be a good name for it."]

I. C. White, 1891 (U. S. G. S. Bull. 65). *Kittanning ss.* is separated from overlying Lower Kittanning coal by Kittanning fire clay, 0 to 15 ft. thick. [This is definition of Kittanning ss. now in use.]

Kittanning shale. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Kittanning (Ferriferous) sh. and ore.*—Dark sandy shales with nodular iron ore.. Thickness 35 to 40 ft. Overlies Lower Kittanning coal. May represent Johnstown cement bed.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Kittanning sh.*—Sandy shales, 35 to 50 ft. thick. Overlie Middle Kittanning coal and underlie Darlington (Upper Kittanning) coal. Seldom exposed in Lawrence Co.

Kittanning fire clay. (In Allegheny formation.)

Pennsylvanian: Southwestern Pennsylvania.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Kittanning (New Brighton) fire clay.*—Underlies Lower Kittanning coal and overlies Kittanning ss.

Is same as *Lower Kittanning clay* of current nomenclature. Is an economic bed in Allegheny fm. Has been mined at Kittanning, Pa., and at New Brighton, Beaver Co., Pa.

Kittanning limestone. (In Allegheny formation.)

Pennsylvanian: Ohio.

E. Orton, Jr., and S. V. Peppel, 1904 (Ohio Geol. Surv. Bull. 3, p. 92), applied *Middle Kittanning ls.* and *Lower Kittanning ls.* to 2 lss. occurring lower in Ohio section than Freeport ls. and higher than Lower Kittanning (No. 5) coal.

Kittanning formation.

See under *Kittanning coal group*, G. H. Ashley, 1926. The name was first used by Ashley in a table in Eng. and Min. Jour.-Press, vol. 115, No. 25, 1923, pp. 1106–1108, but was not defined.

Kittatinny limestone.

Cambrian (Upper, Middle, and Lower?) and Lower Ordovician: Northern New Jersey.

H. D. Rogers, 1840 (N. J. Geol. Surv. 2d and Final Rept., p. 112), applied *Kittatinny ls.* to the ls. "described in preceding pages" as blue ls. or fm. No. 2 of northern N. J. Overlies white quartzose ss. and underlies 3,000 ft. of dark argill. sl. composing fm. No. 3. Thickness probably 2,000+ ft. [As thus defined included Jacksonburg ls. of present nomenclature.]

H. B. Kümmel and S. Weller, 1901 (Geol. Soc. Am. Bull., vol. 12, p. 151; N. J. Geol. Surv. Ann. Rept. 1900, pp. 4, 30–40). *Kittatinny ls.*—Mostly dolomitic and unfossiliferous, variable in texture, bedding and color; color usually blue or gray, sometimes nearly black; in places a pinkish tinge. Thickness 2,500 to 3,000 ft. Nearly all ls. of Kittatinny Valley and the allied highland valleys is included in this fm. Uncon. underlies Trenton ls. [Jacksonburg ls.] and conformably overlies Hardiston qtzite. Contains Beekmantown and Upper Camb. fossils. In previous repts called Mag. ls. and "blue" ls.

†Kittatinny sandstone.

A name casually applied by H. D. Rogers (N. J. Geol. Surv. 2d and Final Rept., p. 112, 1840) to the cgl. later named *Shawangunk cgl.* Conflicts with Kittatinny ls. of same area.

Kittery quartzite.

Carboniferous (Pennsylvanian?): Southwestern Maine and southeastern New Hampshire.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Kittery qtzite.*—Thin-bedded qtzites and argillites, extending, in a belt about 10 mi. wide, along coast from Saco, Maine, to Portsmouth, N. H., and continuing thence inland in SW. direction to Merrimack River, where it forms [part of] the Merrimack qtzite of Mass. Is of Carbf. (Penn.?) age.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 168). *Kittery qtzite.*—Banded flinty and vitreous qtzites, subordinate argillitic and micaceous qtzites, some argillite, and very thin beds of micaceous sl. and schist; all fine grained and characteristically thin bedded. Most striking feature is a fine interbanding of various tones of dark gray, bluish, chocolate-brown, and black with a little light gray and white. Is only slightly metamorphosed. Estimated minimum thickness 1,500 ft.; maximum unknown. In SW. Maine overlain, conformably, by Casco Bay group and by the in part contemp. Eliot sl. Overlies Berwick gneiss, either uncon. or by fault contact. Assigned to Penn. (?). Named for exposures in Kittery, York Co., Maine.

†Kittitas system.

Eocene: Western central Washington (Puget Sound region).

I. C. Russell, 1893 (U. S. G. S. Bull. 108). *Kittitas system.*—Shales, sss., and valuable coal seams, including the coal at Roslyn. Well exposed in W. part of Kittitas Co. Future study may show it can be subdivided. Uncon. overlies crystalline rocks and underlies Columbia lava.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, p. 118). "Kittitas system," provisional name, is divided into Swauk and Roslyn fms., and "Kittitas" abandoned.

Kitzault River formation.

Jurassic: British Columbia.

G. Hanson, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 11).

†Klamath schists.

†Klamath schist series.

Pre-Cambrian (?): Northern California (Klamath Mountains).

Terms used by O. H. Hershey (Am. Geol., vol. 27, pp. 225–245, 1901) to include Abrams mica schist (sedimentary) and Salmon hornblende schist (intrusive).

Klamath gravels.

Pleistocene: Northern California (Weaverville and Red Bluff quadrangles).

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, pp. 120–121). At many places along various canyons of Weaverville quad. are deposits of boulders, pebbles, gravel, and sand similar in appearance to Red Bluff gravels of Redding quad. but generally coarser in texture. Considerably dissected. Present thickness 50 to 100+ ft. Apparently deposited during the Pleist., when the streams were supplied with an exceptional amount of coarse detritus. Rest uncon. on all other fms. Pleist. bones in Weaverville quad. These gravels are continuous with Red Bluff deposits of Redding and Red Bluff quads. Since they are so widespread through the canyons of Klamath Mtns, and since they are so much coarser-textured than the flood-plain phase at type loc. near Red Bluff, writer proposes for them the name *Klamath gravels.* The *Red Bluff* is an accumulation over a surface of low relief deposited by sluggish streams and should be designated *Red Bluff phase.* Upstream this phase grades into the coarser Klamath type near city of Redding. Part of Red Bluff as mapped by Diller is Tehama fm.

Klein sand.

A subsurface sand in Chester group (Miss.) of Marion Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Klondike series.

Pre-Cambrian (?): Canada (Klondike gold fields).

R. G. McConnell, 1900 (Canada Geol. Surv. Rept. on Klondike gold fields, pp. 8–9).

Klondike drift.

Tertiary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 220).

Klondike member. (In Columbus limestone.)

Middle Devonian: Central Ohio (Delaware County).

L. G. Westgate, 1926 (Ohio Geol. Surv., 4th ser., Bull. 30, pp. 17, 22–25). *Klondike member.*—Blue-gray, massive, thick-bedded, fossiliferous ls., weathering thin bedded. Thickness 38 to 40 ft. Top memb. of Columbus ls. in Delaware Co. Overlies *Sp. macrothyris* zone. Was called Delhi beds by Winchell (Ohio Geol. Surv., vol. 2, p. 296, 1874), from old name of Radnor. Makes most of Venice and Marblehead members of Swartz. Best exposed at quarry of Scioto Lime & Stone Co., popularly known as Klondike quarry.

Klusha intrusives.

Tertiary or Pleistocene: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 51).

Klutina group.

Carboniferous or older: Alaska (Copper River region).

F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 410, 413). The Valdes rocks, roughly speaking, extend N. to region of Lake Klutina. Here they form base of the mtns, are still exposed in lower reaches of gulches, but gradually give way to a different class of rocks, which appear above Lake Klutina in upper slopes of the mtns and extend into foothills at edge of Copper River Plateau. These rocks are provisionally called *Klutina series.* They form most of the mtns about the lake and seem to overlie Valdes rocks. They consist of mica schists, quartz schists, sometimes cherty or jaspery, and crystalline ls. or marble. Judging from lithologic resemblance they may belong to Fortymile series. If so, they are probably pre-Sil.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, p. 256). Valdez rocks rest, probably uncon., on *Klutina series.*

T. Chapin, 1918 (U. S. G. S. Bull. 668, p. 22), assigned *Klutina group* to Carbf. or pre-Carbf.

Knapp formation.

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 967–989). *Knapp beds.*—In Salamanca quad. there are beneath Olean cgl. two thin cgls. interbedded with shales lithologically very similar to Oswayo shales. These are doubtless in part at least equivalents of grits and shales just beneath the Olean at rock city and which are there included in the Oswayo, but which evidently thicken and coarsen westward till they are capable of differentiation as *Knapp fm.* Most eastern exposure is at Knapp's Creek Station (Cattaraugus Co., N. Y.), where there are two coarse beds separated by varying thickness of sh. Consist of (descending): Sh., 25 to 30 ft.; cgl., 10 to 15 ft.; sh., 30 to 40 ft.; and cgl., 10 to 20 ft. Overlie Oswayo beds and underlie Olean cgl., probably uncon. The last Devonic forms disappear at top. Assigned to Carbonic.

C. Butts, 1910 (U. S. G. S. Warren folio, No. 172). *Knapp fm.* was long known in Pa. repts as "*sub-Olean cgl.*" It lies 350 to 400 ft. lower than Shenango ss., with which it has heretofore been correlated.

The Knapp, Oswayo, and Cattaraugus fms. were assigned to Carbf. by J. M. Clarke (1903 Hdb.), by C. A. Hartnagel (1912 Hdb.), and by E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22, 1911). They were classified as "Devono-Carboniferous" by C. Butts in 1910 (U. S. G. S. Warren folio, No. 172), and were assigned to Dev. by W. A. VerWiebe, 1917 (Am. Jour. Sci., 4th ser., vol. 44), by G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, pp. 68–69), 1924 (N. Y. State Mus. Bull. 251, p. 157), and 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 455–464), and by C. Schuchert (1924 Textbook of geology). (See further explanation under †*Bradfordian*, which included all these fms.)

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, pp. 202–203). *Knapp fm.* (*revised Cussewago group*) of NW. Pa. is here divided into (descending): Hayfield sh. memb. (including Littles Corner ls.); *Glade ss. memb.* ("Sub-Olean"–Knapp cgl.); Ridgway sh. memb.; Ludlow cgl. memb. ("Lower Knapp cgl."); and

Smethport sh. memb. or lower upper "Riceville" sh. All are of Miss. age. [He did not explain relations of his Glade ss. to Cussewago ss., nor did he define the various members.]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 61, 103–104), replaced some of names given in his 1933 paper cited above, as follows: Glade ss. replaced by Cobham ss.; Ridgway sh. replaced by East Kane sh.; Ludlow cgl. replaced by Wetmore cgl.; Smethport sh. replaced by Kushequa sh.; and he divided his 1933 Hayfield sh. into (descending) Hayfield sh. [restricted] and Tidioute sh. memb., the latter present but only "meagerly developed" at Hayfield type loc. He assigned all of these beds to Miss., and included them in his Knapp monothem. On p. 41 he stated: "At base of *Knapp sh.* (Kushequa sh. of this rept.) there is a faunal and lithic break," and he drew Miss.-Dev. bdy at this point. (See also under his *Knapp formational suite* and his *Knapp monothem.*)

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 332), assigned his Hayfield sh. and underlying fms. to Upper Dev. (See Chadwick, 1935 entry under *Conewango fm.*)

C. Butts, 1936 (personal communication). Typical Knapp fm. is only Cobham cgl. memb. of Caster, and contains true Kinderhook fossils. Caster's East Kane sh. and underlying beds are part of typical Conewango fm. of Warren folio.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 593). The Knapp persists far enough S. to tie in with lower part of basal memb. of the Pocono, the "Berea," if, indeed, it is not actually the attenuated equiv. of that entire memb. [p. 593.] In north-central Pa. the basal Pocono or Knapp rests directly upon the Elk Mtn, or Oswayo, depending upon whether the latter be continental or marine. [p. 600.]

In view of lack of agreement as to age of Knapp, Oswayo, and Cattaraugus fms. the U. S. Geol. Survey at present classifies them as *Dev. or Carbf.*

Knapp formational suite.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 60, p. 111). [*Knapp formational suite* is shown as occurring in lower part of "Cussewago stage," as underlying Tidioute sh. memb. (new name for a sh. which he placed below Hayfield sh.) and overlying Kushequa sh. memb. (new name), and as divided into 3 newly named members, in descending order, Cobham cgl. memb., East Kane sh. memb., and Wetmore cgl. memb., and is assigned to Miss.]

Knapp monothem.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 103–104). *Knapp monothem* (Miss.) as used in this rept is extended down to include the chocolate-colored aren. (Oswayo-like) sh. beneath lower cgl. memb. of Knapp fm. of Glenn. This sh., which is here named *Kushequa sh. memb.*, contains the very characteristic Knapp fauna. Above the upper Knapp cgl. memb. is also a sh. memb. which is part of the monothem. This upper sh., which is usually eliminated by the Olean nonconformity E. of Warren, Pa., is known as *Hayfield fm.* [As defined above Knapp monothem of Caster includes his Knapp formational suite and younger and older beds than he included under latter designation, and according to his table opp. p. 61 it is = his Cussewago monothem = his Cussewago stage.]

†Knife slates.

See under *Knife Lake sl.*

Knife Lake slate.

Pre-Cambrian (pre-Huronian ? and post-Laurentian): Northeastern Minnesota (Vermilion district).

C. R. Van Hise and J. M. Clements, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Knife slates.*—Named for Knife Lake, where specially developed. Uncon. underlie Gunflint fm. and overlie Lower Huronian iron-bearing fm. [Agawa].

J. M. Clements, 1903 (U. S. G. S. Mon. 45). *Knife Lake slates.*—Slates of varying characters, dark- and light-colored. Thickness 2,500+ ft. Conformably overlie Agawa fm. and underlie Gunflint fm.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), redefined *Knife Lake sl.*, by including in it *Agawa iron-fm. memb.* (as they designated it) and underlying *Ogishke cgl. memb.*; they also removed it tentatively from Huronian series and assigned it to *Knife Lake series*, of pre-Huronian and post-Laurentian age.

Knife Lake series.

Pre-Cambrian (pre-Huronian ? and post-Laurentian): Northeastern Minnesota (Mesabi and Vermilion districts and Rainy Lake region).

F. F. Grout, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 992–995). *Knife Lake series.*—Shows poorly assorted sediments, with no clear qtzites or lss. Uncon. underlies Animikie series and overlies Keewatin greenstone. Includes Knife Lake sl. and, at base, Ogishke cgl., which is erratic in occurrence and thickness but may locally be hundreds of ft. thick. The Knife Lake sl. is interfingered with or overlies Ogishke cgl. Recent (1929) work by J. W. Gruner indicates the series may be a complex with some unconformities and igneous activity, but in the areas mapped slates and graywackes of fairly constant nature largely predominate over cgl. and volcanic rocks. The slates are widely exposed at type loc., Knife Lake, and extend W. far along Vermilion dist. as synclines in the area of Keewatin greenstone. Has been considered Archean or Lower Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), redefined *Knife Lake sl.* (by including in it, as members, the Agawa iron-fm. and Ogishke cgl.), and on the map assigned it and contemp. deposits in Ontario to the newly recognized *Knife Lake series*, herein classified as of pre-Huronian and post-Laurentian age, but which may eventually prove to be Lower Huronian. In U. S. G. S. Mon. 52, 1911, these rocks were called "lower-middle Huronian." They rest with marked uncon. on Laurentian and Keewatin rocks and underlie, with conspicuous angular discordance, the Middle Huronian group. They are closely folded, metamorphosed, and intruded by granites of Algoman age.

Knight formation. (In Wasatch group.)

Eocene: Southwestern Wyoming.

A. C. Veatch, 1907 (Jour. Geol., vol. 15, pp. 547–549). *Knight or Coryphodon beds* is proposed for upper part of Wasatch of SW. Wyo. containing *Coryphodon* remains. Named for Knight Station [Uinta Co.], which is near place where fossils belonging to this genus were first found in No. Am., and where typical upper Wasatch is well developed. Rests uncon. on Fort Union.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Knight fm.*—Variegated yellow and red sandy clays, with irregularly bedded white and yellow sss. Contains *Coryphodon* and other animal remains. Thickness 500 to 1,500± ft. Top fm. of Wasatch group in SW. Wyo. Underlies Green River fm. and uncon. overlies Fowkes fm. (middle fm. of Wasatch group).

†Knob sandstone.

Mississippian: Indiana and western-central Kentucky.

D. D. Owen, 1856 (Ky. Geol. Surv. Rept., vol. 1, pp. 89 and 90). Sub-carbf. ss., called *"Knob fm."* because it weathers into conical hills. Greenish-gray argill. ss. and brown ss., with argill. shales in lower part, and locally earthy ls. beds. Thickness 200 to 400 ft. Overlain by sub-carbf. lss. and underlain by Dev. Black Lingula shales.

Same as †Knobstone fm. or group, but the nongeographic terms "Knob ss." and "Knob sh." have also been applied to separate fms. in this group of beds, which is now called *Osage group* and divided into several fms., named (descending) Holtsclaw ss., Rosewood sh., Kenwood ss., and New Providence sh.

†Knob shale.

A descriptive term applied in some early repts to New Providence sh. of Ind., and also to New Providence and Rosewood shales.

†Knob limestone.

A descriptive term applied in some early repts to the basal Miss. lss. of Ind.

Knob Creek facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 163, etc., 1931) to a lithologic development of his Carwood fm. in a part of southern Ind.

Knob Hill group.

Pre-Carboniferous: British Columbia.

O. E. Le Roy, 1912 (Canada Geol. Surv. Mem. 21, pp. 19, 26, 30).

Knob Lick granite.

Pre-Cambrian: Southeastern Missouri.

C. R. Keyes, 1895 (Mo. Geol. Surv. Sheet Rept. No. 4 (vol. 9), pp. 18, 19, 24). ***Knob Lick granite.***—Rather coarse-grained, very compact granite, of reddish to bluish color, in texture approaching porphyritic. Thickness 400 ft. Underlies Iron Mtn porphyry in Mine La Motte dist. Assigned to Archean.

J. Bridge, 1930 (personal communication). Knob Lick granite is now considered by Mo. geologists to be probably Algonkian.

Named for Knob Lick, St. Francois Co.

†*Knob Noster group.*

Pennsylvanian: Central western Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. Rept. on Iron Ores, pt. 2, pp. 169, 176). *Knob Noster group.*—Shales, clays, and lss., 97 ft. thick, including beds 16 to 33 of detailed section of lower Coal Measures from Sedalia to Kansas City. Underlies Warrensburgh group and overlies bed 15 of detailed section.

Is a part of Cherokee sh.

Named for exposures at Knob Noster, Johnson Co.

Knobs-Cherokee coal group.

Name locally applied to Lance fm. of Rock Springs uplift, Sweetwater Co., SW. Wyo. (See U. S. G. S. Bull. 702, 1920.)

†Knobstone formation.

†Knobstone group.

Names applied in early repts on Ind. and western Ky. to the Miss. rocks of Osage age, the term being derived from tendency of the rocks to weather into conical hills called knobs. Cumings has proposed *Borden group* to replace this descriptive term.

†Knobstone sandstone.

A term applied in early Ind. repts to Holtsclaw ss. of SE. Ind.

Knobsville continental beds.

Middle Devonian: Central Pennsylvania (Fulton County).

B. Willard, 1935 (Geol. Soc. Am. vol. 46, Proc. Pal. Soc. Feb. 28, pp. 202, 214, 215, 221). In northern Fulton Co. are 800 to 1,000 ft. of fresh-water beds of Hamilton (Mahantango) age to which *Knobsville cgl. phase* may be applied. They are well developed btw. Knobsville and Hustontown and northward toward Fort Littleton, where they are exposed in highway cuts. Here Marcellus black sh. passes up into what are probably a few ft. of normal but barren Mahantango shaly beds, which are succeeded by barren red or green beds (the Knobsville continental beds), which continue upward into post-Hamilton members with no trace of Genesee. Grade laterally into marine Mahantango shales and sss. In places usurp most of the Mahantango. Contemp. in part with Montebello ss.

Knobtown sand.

A subsurface sand near top of Pleasanton fm. (Penn.) of west-central Mo. Lies higher than Wayside sand. Named for outcrop N. of Knobtown, Jackson Co., on U. S. Highway 50, sec. 22, T. 48 N., R. 32 W. (See Mo. Bur. Geol. and Mines 57th Bien. Rept., 1933, pp. 13, 19, App. 2, pl. 2.)

Knowlton amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. The fm. belongs in lower part of Central Mine group. The mineralized part is the Knowlton lode. Named for occurrence in Knowlton mine, Ontonagon Co.

Knowlton flow.

Includes Knowlton amygdaloid and the underlying trap.

Knox dolomite.

Upper Cambrian and Lower Ordovician: Tennessee, western North Carolina, and northwestern Georgia.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 158–159, 204–226). *Knox dol.*—Heavy-bedded ridge-making dolomites and lss., chiefly dol., 4,000 ft. thick. Lowest strata blue, oolitic, and often fossiliferous; strata next above dark gray and granular; upper strata, light gray with chert layers. Top fm. of Knox or Knoxville group. Overlies Knox [Conasauga] sh. Underlies Trenton or Lebanon [Stones River] group.

In eastern Tenn. underlies Chickamauga ls., or Mosheim ls., where that ls. is present, and overlies Nolichucky sh. (=upper part of Conasauga sh. to S.). In NW. Ga. it rests on Conasauga sh.

Named for development in Knox Co., Tenn.

†Knox group.

Cambrian (Lower, Middle, and Upper) and Lower Ordovician: Eastern Tennessee, western North Carolina, northwestern Georgia, and northern Alabama.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 158–159, 203–226). *Knox or Knoxville group.*—Sss. and shales, dolomites and lss. forming by its outcrops greater part of surface of East Tenn. Valley. City of Knoxville is on ridge made of its lss. and dolomites, and this circumstance, together with fact that the threefold typical character of the series is well developed in Knox Co., has induced me to name it *Knoxville or Knox group.* Includes (descending) Knox dol. (4,000 ft.), Knox sh. (1,500 to 2,000 ft.), and Knox ss. (800 to 1,000 ft.). Underlies Trenton or Lebanon [Stones River] group and overlies Chilhowee ss.

Includes most of Camb. and part of Ord., and conflicts with Knox dol.

†Knox shale.

Upper and Middle Cambrian: Eastern Tennessee, western North Carolina, northwestern Georgia, and northern Alabama.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 158–159, 204–226). *Knox sh.*—Variegated shales, with occasional layers of blue oolitic dol. and ls.; fossiliferous in places. Thickness 1,500 to 2,000 ft. Middle fm. of Knox or Knoxville group. Underlies Knox dol. and overlies Knox ss. [Rome fm].

Conflicts with Knox dol. In Ala. and Ga. replaced by ***Conasauga sh.*** In eastern Tenn. divided into 4 fms. (descending): Nolichucky sh., Maryville ls., Rogersville sh., and Rutledge ls.

Named for Knox Co., Tenn.

†Knox sandstone.

Lower Cambrian: Eastern Tennessee, western North Carolina, northwestern Georgia, and northern Alabama.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 158–159, 203–226). *Knox ss.*—Hard shales and thin sss., interstratified with heavier sss., and intercalated with layers of dol. Heavier sss. often of coarse grain, sometimes quartzose. Thickness 800 to 1,000 ft. Strata often ripple marked and sometimes covered with fucoidal impressions and ledges. In NE. counties becomes more calc. Basal fm. of Knox or Knoxville group. Underlies Knox sh. and overlies Chilhowee ss.

Conflicts with Knox dol. Replaced by *Rome fm.*

Named for Knox Co., Tenn.

Knox sand.

A subsurface sand in Pottsville group (Penn.) of eastern Ky, also a subsurface sand in SW. Okla., correlated with part of Wellington fm. (Perm.).

Knox gneiss.

Pre-Cambrian: Central southern Maine (Waldo County).

E. H. Perkins and E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 9, pp. 204–228). A series of igneous and sed. gneisses and schists which have been tentatively grouped under name *Knox gneiss*. The intruded material is a dark-bluish quartz gneiss, strongly foliated and even schistose in places. Biotite is common but varies greatly in amount. Bedding almost entirely destroyed; where shown is greatly contorted. Sedimentary origin indicated by garnets. A second type of gneiss is made up of bands of light and dark material a fraction of an inch thick; the dark layers contain garnets and are probably sedimentary; the light layers are feldspathic and represent igneous material. The third phase is a biotite gneiss which intrudes the sed. gneiss in dikes and irregular bodies. All gneisses are associated with basic dikes and injected pegmatites. Knox gneiss adjoins Hogback schist on E., and is bounded on E. by Penobscot fm., of which it may represent a highly intruded phase. Is probably pre-Camb. [Probably named for occurrence in town of Knox, Waldo Co.]

On 1933 geol. map of Maine, by A. Keith, the rocks of this area are mapped as pre-Camb.

Knox Mountain granite.

Age (?): Northeastern Vermont (Orange County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol.), mentioned *Knox Mtn granite* in Orange, NE. Vt. (coarser than Kirby granite); *Kirby granite* on Kirby Mtn [E. part of Kirby Twp, Caledonia Co.]; *Barre granite; Bethel granite;* and *Woodbury granite*. The latter 3 granites are now assigned to Dev.

†Knoxville group.

Cambrian (Lower, Middle, and Upper) and Lower Ordovician: Tennessee, North Carolina, Georgia, and Alabama.

See †*Knox group*, 1869 entry.

Knoxville formation.

Lower Cretaceous (Shasta series): California and Oregon.

C. A. White, 1885 (U. S. G. S. Bull. 15, pp. 19–32). The strata of Shasta group occupy only a few isolated areas in Calif., and are in every case either uncon. with rocks both above and below them, or so disturbed that their strat. relations are obscure. Judged by their fossils, two divisions of the strata are plainly indicated, and I shall designate the divisions as *Horsetown beds* and *Knoxville beds*, respectively. The Horsetown beds have been found mainly in Shasta Co. and the Knoxville beds mainly in Lake, Colusa, Contra Costa, and Santa Clara Counties. The Knoxville beds are characterized by *Aucella*, which is, so far as known, absent from the Horsetown. The Horsetown fossils appear to represent the Gault and the Knoxville fossils to represent the Lower Neocomian. There is probably a considerable hiatus btw. the Knoxville and Horsetown beds.

J. S. Diller and T. W. Stanton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 435–464), reported that the Knoxville, Horsetown, and Chico fms. grade into one another and show that they are one continuous series of deposits. They described the Horsetown as consisting of 6,000± ft. of shales, sss., and cgls., and the Knoxville as consisting of an indivisible mass of beds, 20,000 ft. thick, chiefly sh., but containing many sss. and calc. layers, the sss. being especially prominent in lower part. The fm. was named for exposures at Knoxville, Napa Co., Calif. Upper part of the Knoxville characterized by *Aucella crassicollis* and lower part by *Aucella piochii*. [Detailed sections and faunal lists.]

Recent repts of some authors advocate restriction of *Knoxville fm.* to lower and larger part of the Knoxville of the literature, and application of *Paskenta fm.* to upper 4,000± ft. of the Knoxville of the literature, the Knoxville restricted being assigned by them to Upper Jurassic and the proposed Paskenta to Lower Cret. (See under *Paskenta fm.*) These proposed modifications have not been adopted by U. S. Geol. Survey.

†Knoxville marble.

Lower Ordovician (late Chazy): Eastern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 105, 117, 121). *Knoxville marble.*—Red and gray marble, 380 ft. thick, worked at many points in East Tenn. Is a variegated sparry marble, to great extent made up of fragments of fossil crinoids and corals. The belt of it runs lengthwise through middle of Valley of East Tenn. Is found as high as Hawkins Co. and as far S. as McMinn and Bradley. Overlies Lenoir ls. and underlies Sevier sh.

Replaced by Holston marble lentil (of Chickamauga ls.).

Named for Knoxville, Tenn., near which it is exposed. Is not the dol. on which Knoxville is built.

Knoydart formation.

Devonian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 207).

Knuckle Island granite.

Age (?): Ontario (Rainy Lake district).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 99).

Kodak white sandstone.

Silurian: Western New York (Rochester region).

G. H. Chadwick, 1935 (A. A. P. G. Bull., vol. 19, No. 5, p. 702). *Kodak white ss.* introduced to replace "gray band" in Genesee Gorge at Rochester, which was formerly called, by writer and others, *Thorold ss.*, but which is now known to be younger than true Thorold ss. of Niagara Gorge, and of Clinton age. Type exposure in lower Genesee Gorge from the lower falls to Kodak Park, Rochester.

J. T. Sanford, 1935 (A. A. P. G. Bull., vol. 19, No. 9, p. 1390). Chadwick's proposed new name *Kodak ss.* for "gray band" at Rochester is unnecessary, for the "gray band" there does contain *Arthrophycus*, although index value of this fossil is open to question.

Koipato formation.

Middle (?) Triassic: Northern Nevada.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map V) and 1878 (U. S. Geol. Expl. 40th Par. vol. 2, pp. 267–278). *Koipato group.*—Lower div. of Triassic in West Humboldt Range. Consists of qtzitic and argill. beds at head of Buena Vista Canyon. To N. it consists of argillites and siliceous beds interposed with siliceous argillites; no ls. beds. To this whole group of schists and porphyroids we have given the title Koipato group, from the Indian name of West Humboldt Range. No fossils except a few crushed and distorted *Nautilus* remains. Thickness 4,000 to 6,000 ft. Underlies Star Peak group and uncon. overlies Archean granite and schist.

†Koipatoan series.

Triassic (Middle?): Northern Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 59, 79). *Koipatoan series.*—Title adopted from King's Humboldt Range section of Mid Triassic sss., 2,000 ft. thick, underlying Staran series and younger than Inyoan series. Covers all Mid Triassic of Nev. The early title of *Koipatoan* [Koipato "series"] for entire Mid Triassic section of this region is probably too comprehensive; and if the section in this folded belt is actually so thick as formerly considered several units of serial rank are doubtless represented.

Same as Koipato fm., which was named for development in West Humboldt Range, Humboldt Co., the Indian name for which is *Koipato*.

Koko volcanics.

Latest Pleistocene or Recent: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Koko volcanics.*—Tuff and olivine basalt; the tuff well bedded, lithic, gray to brown. Included in upper part of Honolulu volcanic series [q. v.]. Forms Koko Head.

Kokomo limestone.

Silurian (Cayugan): Central Indiana.

A. F. Foerste, 1904 (Ind. Dept. Geol. and Nat. Hist. 28th Ann. Rept., p. 33). *Kokomo ls.*—Geographic name applied to fm. which in previous Ind. repts has been called "Waterlime." Thickness 65 to 150 ft. Fossils suggest equivalence to Bertie or Lower Waterlime bed in lower part of Cayugan.

A. F. Foerste, 1909 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, p. 6). The brachiopod horizon at Kokomo should probably be distinguished from underlying eurypterid horizon by a distinct name, and *Kokomo ls.* be restricted to eurypterid beds, but at present no suitable name is at hand. [Kokomo ls. continued to be used as originally defined until 1927.]

E. R. Cumings and R. R. Shrock, 1927 (Ind. Acad. Sci. Proc., vol. 36, pp. 71–84). *Kokomo ls. of Foerste* (1904), which is probably of Cayugan age, consists of 60 ft. of finely laminated impure ls., more argill. in lower part and more calc. in upper part; alternating beds of earthy material and purer ls. being characteristic. Rests uncon. on Mississinewa sh., and is overlain, possibly uncon., by Kenneth ls., a very cherty ls. 1 to 20 ft. thick, the base of which is exposed in Defenbaugh and Markland Ave. quarries in Kokomo.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 117–135). *In 1927 writers restricted name Kokomo ls.* to the thinly laminated ls. lying btw. Mississinewa sh. below and a cherty ls. above, containing the brachiopod horizon as exposed in Markland Ave. quarry at Kokomo. *The brachiopod horizon was included in overlying fm. called Kenneth ls.* As now defined Kokomo ls. includes 45 to 50 ft. of finely laminated argill. ls. uncon. overlying Mississinewa sh. and discon. underlying cherty Kenneth ls. in Markland Ave. quarry at Kokomo, and the 45 to 50 ft. of similar stone lying below the cherty Kenneth ls. in Big Blue Hole and Kenneth quarries W. of Logansport. Varies in thickness from few ft. to 60 ft. Fossils [listed] writers consider of Cayugan age and = Bertie of N. Y.

Named for exposures at Kokomo, Howard Co.

†Kolmakof series.

Tertiary (?) to late Paleozoic: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 161–163, 182). *Kolmakof series.*—Volcanic rocks of various types, changing laterally into or interbedded with volcanic tuffs, shales, impure lss., and fine-grained arkoses. Plant remains, ripple marks, etc. Folded and intruded by great masses of igneous rocks. Plants. Outcrops frequently along right bank of Kuskokwim River btw. Kolmakof and beginning of low silt plain just above entrance to Yukon portage route above Kalchagamut. Provisionally correlated with Holiknuk series and referred to Cret.

Now regarded as including 3 or 4 distinct units: (1) Upper Cret. sss. and shales which are W. extension of Spurr's Holiknuk series; (2) associated igneous rocks which are dikes and sills and not lava flows; (3) late Paleozoic or early Mesozoic tuff associated with Carbf. ls.; (4) possibly late Tert. volcanic rocks.

Kome beds.

A name long in use for Lower Cret. rocks in Greenland that underlie Atane beds (Upper Cret.).

Komooks beds.

Cretaceous: Vancouver Island.

F. B. Meek, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, p. 315).

Kona dolomite.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 523+). *Kona dol.*—Chiefly cherty dol. interstratified with layers of sl., graywacke, and qtzite, and gradational sediments. Thickness 700 ft., possibly 1,400 ft. Conformably underlies Wewe sl. Grades into underlying Mesnard qtzite. Composes Kona Hills, on E. shore of Goose Lake.

Konawa formation.

Permian (?): Central Oklahoma.

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 140–141, pls. 3, 27, and map). *Konawa fm.*—Chiefly typical red beds, such as cover a large part of western Okla. Red shales constitute greatest thickness of strata, but coarse red sss. are often prominent and sometimes outcrop over large areas. No lss. observed. Top of fm. is drawn at base of 30± ft. of coarse red and brownish red sss. that cap N. bluff of Canadian River from bridge S. of Asher to N. edge of Stonewall quad. and constitute basal memb. of Asher fm. The upward diminishing arkosic material common to Pontotoc strata entirely disappears near base of these sss. Base of fm. is drawn at base of typical red beds of the area. Thickness 500± ft. Constitutes upper part of Pontotoc terrane [group]. Is believed to overlie Stratford fm., and to overlap on it and older rocks. No fossils, but is thought to be early Perm.

R. H. Dott, 1927 (Okla. Geol. Surv. Bull. 40K, pp. 7–31). Writer is inclined to look upon *Konawa fm.* as merely a lateral phase of Stratford fm., due to depositional factors.

F. A. Melton, 1930 (Okla. Geol. Surv. Bull. 40LL). *Konawa fm.* may be a northern gradational facies of Vanoss and Stratford fms.

Named for development at and around Konawa, Seminole Co.

Koochiching granite.

Pre-Cambrian (Laurentian): Northern Minnesota (2 miles west of Rainy Lake).

A. N. Winchell, 1897 (Am. Geol., vol. 20, pp. 293–299). *Koochiching granite.*—Biotite-hornblende eruptive granite, but very poor in quartz. Occurs on N. bdy of Minn., 2 mi. W. of Rainy Lake. Assigned to Laurentian.

Above is spelling adopted by U. S. Geog. Bd. The name has also been spelled *Coutchiching.*

Koolau volcanic series.

Tertiary (and possibly early Pleistocene): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30), and perhaps earlier publications, by others. On p. 40 Wentworth said *Koolau basalt*, the oldest fm. in Diamond Head region, makes up main mass of NE. Oahu, and that next younger is a complex series of calc. reef fms. which includes reef ls., marine calc. sss. and cgls., and eolian calc. sss. On p. 42 Wentworth maps *Koolau basalt* in Diamond Head dist.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Koolau volcanic series.*—Includes all lava flows, intrusive rocks, pyroclastics, breccias, and intercalated soils making up Koolau Range, except those concurrent with the erosion of the great valleys on its slopes, which make up only a very small percentage of the bulk of the range. Its basalt, tuff, dike complex, and breccia members have each been mapped separately. In part of its area it overlies, without any apparent uncon., Kailua volcanic series (which is correlated with basal basalt memb. of Waianae volcanic series). It differs from Kailua series in that it is not generally amygdaloidal and has a much fresher appearance than the Kailua rocks. The main bulk of Koolau basalts was probably erupted at same time as upper basalt memb. of Waianae volcanic series, but its eruption continued after extinction of Waianae volcanic series, upon which part of Koolau series rests with erosional uncon. It is overlain, with great erosional uncon., by Honolulu volcanic series, of middle (?) and late Pleist. age.

Kootanie formation.
Kootenay formation.

Lower Cretaceous: Alberta and British Columbia.

Same as *Kootenai fm.*, the spelling approved by U. S. Geog. Bd.

Kootenai formation.

Lower Cretaceous: Southern Alberta and British Columbia and Montana (widespread except in southern and southeastern Montana).

Notes and News (J. W. Dawson?), Sci., vol. 5, 1885, pp. 531–532). Dr. G. M. Dawson has recently discovered a remarkable Jurasso-Cret. flora in Rocky Mountains, on branches of Old Man River, Martin Creek, Coal Creek, and one other locality far to NW. on Suskwa River. The containing rocks are sss., shales, and cgls., with seams of coal, in some places anthracite. It was proposed by Sir William Dawson, in his paper before recent meeting of Royal Society of Canada, to call these beds *Kootanie group*, from a tribe of Indians who hunted over that part of Rocky Mountains btw. 49th and 52d parallels. The beds lie in troughs in the paleozoic fms. of the mtns, and may be traced for a distance of 140 mi. N. and S. The plants found are conifers, cycads, and ferns, the cycads being especially abundant. Some are identical with species described by Heer from Jurassic of Siberia, while others occur in lower Cret. of Greenland. No dicotyledonous leaves have been found in these beds, which connect in a remarkable way the extinct floras of Asia and America and those of the Jurassic and Cret. periods.

G. M. Dawson, 1886 (Canada Geol. Surv., n. s., vol. 1, pp. 126B–134B, 162B–167B). *Kootanie series.*—Coal-bearing rocks of Bow Valley region, consisting of 5,000 to 7,000± ft. of shales and sss. of very varied texture and appearance, some cgls., and many coals, containing a flora of Lowest Cret. age, and older than the Dakota of Middle Cret. age. The flora has Jurassic affinities. The series overlies Triassic beds in S. part of dist. The volume of strata btw. the coal-bearing horizon and base of overlying volcanic rocks (2,200 ft. thick) on Crow Nest Pass was estimated at 3,350 ft. and on South Kootanie Pass at 2,400 ft. The summit of Kootanie series is not yet precisely defined, but is situated btw. the apparently constant coal-bearing horizon and base of the volcanic beds, as on North-west Branch of North Fork fossil plants believed to represent the horizon of the Dakota are found a few hundred ft. below these volcanic beds.

C. A. Fisher, 1909 (U. S. G. S. Bull. 356, pp. 28–35), applied *Morrison sh. (?)* to 120 to 130 ft. of apparently non-coal-bearing shales and sss. underlying a coal-bearing series (450 to 475 ft. thick in Great Falls region, Mont.) which he designated *Kootenai fm.*, his Kootenai fm. being overlain by Colorado sh. It is a question whether typical Kootenai of Canada did not include the true Morrison fm.

More recent Canadian repts subdivide the Cret. rocks of southern Alberta into (descending) Allison fm., Colorado sh., Crowsnest volcanics, Blairmore fm., and Kootenay fm. According to E. W. Berry (A. A. P. G. Bull., vol. 11, No. 3, p. 241, 1927) the flora of upper part of the Blairmore is Cenomanian (Upper Cret.), the flora of lower part is Aptian or Albian (both Lower Cret.), and the flora of the Kootenay as thus defined by Canada Geol. Surv. is Barremian (also Lower Cret.). The lower part of Colorado sh. is now believed to be of Cenomanian age and is therefore correlated with upper part of the Blairmore. The Kootenai fm. of Mont. therefore appears to be equiv. to the Kootenay and the lower part of the Blairmore of SW. Alberta.

Kootenay granite.

Jurassic (?): British Columbia.

S. J. Schofield, 1912, 1913, 1914, and 1915 repts on East Kootenay, B. C., listed in U. S. G. S. Bull. 746.

†Kootenayan series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). Sss., 600 ft. thick, composing all of early Cretaceous of Alberta. [Same as Kootenai fm.]

Kosciusko sandstone member (of Lisbon formation).

Eocene (middle): Mississippi.

C. W. Cooke, 1925 (U. S. G. S. P. P. 140, pp. 133–135). *Kosciusko ss. memb.*—Designation proposed for the ledges of saccharoidal to qtzitic ss. exposed in vicinity of Kosciusko, the county seat of Attala Co., Miss., and for unconsolidated sands of same age in Miss. Replaces preoccupied name "Decatur sand." Is middle memb. of Lisbon fm. and younger than Winona sand memb. of the Lisbon.

Koster joint clays.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 79, 81): *Koster joint clays.*—Yellow calc. clays, or "joint clays," as they are locally called, rich in fossils of overlying and underlying fms. as well as the lime which has resulted from their disintegration. Greatly resemble *Exogyra ponderosa* marls, except that they have more clay and less lime. Possibly the northern and thinner edge of the great *Exogyra ponderosa* marls [Brownstown marl restricted] seen farther south. Thickness in one section 50 ft. Younger than Big De Gray horizon.

Named for occurrence at or near Nicholas Koster's house, sec. 13, T. 7 S., R. 21 W., Clark Co.

†Kotlo series.

Pre-Cambrian and lower Paleozoic: Southeastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 357). On map the Birch Creek, Fortymile, and Rampart series of Spurr and the Nasina series and Tanana schist of my previous rept [U. S. G. S. 20th Ann. Rept., pt. 7, 1900] have been grouped together under name "*Kotlo series.*" Age not established, but assigned to Lower Paleozoic or pre-Camb.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, p. 214). In 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 357, 358) writer grouped all the gold-bearing rocks under name *Kotlo series*, which would include Birch Creek, Fortymile, and Rampart series. Now that more detailed studies have been made "Kotlo" can be dropped.

Kotsina conglomerate.

Jurassic or Cretaceous: Central southern Alaska.

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 431, map, pl. 52). *Kotsina cgl.*—Massive cgl. characterized by greenish color, seemingly due to material derived originally from green volcanics. Occurs on Kotsina River. Overlain by rocks that are believed to be same as Kuskulana shales (Triassic).

This fm. is at present classified as Jurassic or Cret., in absence of fossils.

†Kougarok group.

See under †*Kugruk group.*

Kowak clay.

Pleistocene: Northwestern Alaska.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 265, 327, map). *Kowak clays.*—On left bank of Kowak River at about W. long. 158° is a remarkable clay bluff, ¾ mi. long and 150 ft. high, containing quantities of mammoth tusks. They are of Plio. or Pleist. age. [In 1898 (U. S. G. S. 18th Ann. Rept, pt. 2, p. 335) Dall assigned this clay to Pleist.]

A. G. Maddren, 1907 (Smithsonian Misc. Coll., vol. 49, pp. 18–28). The Palisades form typical exposure of lacustrine phase of deposits Spurr and Collier designate "Yukon silts" and which Dall has called "Kowak clays." They are for most part Pleist., as shown by fossils.

Koyukuk group.

Lower Cretaceous: Northern Alaska (Koyukuk River region).

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 246). *Koyukuk series.*—Impure pink and reddish ls. (800 ft. thick), sl., dark sh., some ss. and arkose, all more or less associated with or intruded by igneous rocks. Lower Cret. fossils. Correlated with Anaktoovuk series. Occurs along Koyukuk River and may have very wide extent over Koyukuk Basin.

Krao limestone.

Age (?): British Columbia.

S. J. Schofield, 1920 (Canada Geol. Surv. Mem. 117, p. 16).

Kreyenhagen shale.

Eocene and Oligocene: Southern California (Diablo Range).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 163–168). *Kreyenhagen shales.*—Brown bituminous or carbonaceous sh., more or less sandy in lower part; 600 ft. exposed on hills a few mi. N. of Coalinga, but thickens to S. and SE. and at Kreyenhagen wells, for which it is named, it is about 900 ft. thick. Thins to 250 or 300 ft. at head of the Jacalitos and on Zapata Chino. Underlies Domijean sands and overlies Avenal sss. Of Eocene age.

For many years *Kreyenhagen sh.* has been applied to beds described as uncon. underlying Vaqueros ss. and overlying (probably uncon.) Tejon fm. in Coalinga and neighboring districts.

F. E. von Estorff, 1930 (A. A. P. G. Bull., vol. 14, No. 10, pp. 1321–1336). Type loc. of *Kreyenhagen sh.* is on Canoas Creek, about 20 mi. S. of Coalinga, Fresno Co. Its max. thickness in vicinity of Canoas Creek and Big Tar Canyon is 1,000 ft. It consists of sh. with a very few lenticular beds of ss. and a few lenses or nodules of ls. The ss. is common only at base of fm., where the *Kreyenhagen* seems to grade into a transitional friable white ss. interbedded with sandy clay sh. which is tentatively included in the Kreyenhagen. It here overlies, with seeming conformity, but possibly with uncon., Domengine ss., of upper middle Eo. age, and uncon. underlies Temblor ss., of lower middle Mio. age.

O. P. Jenkins, 1931 (Min. in Calif., Rept. State Min., vol. 27, No. 2, pp. 141–149). A dual type loc. was originally given for *Kreyenhagen sh.* The name was applied to shales on Reef Ridge, S. of Coalinga, lying btw. Avenal and Temblor sss., whereas the originally collected Foraminifera employed to determine the age of the Kreyenhagen came from shales N. of Coalinga, beneath Domengine ss. The Federal Survey, however, in area N. of Coalinga, mapped as *Kreyenhagen* the series of diatomaceous strata lying above the "Tejon" (Domengine) and below the "Vaqueros" (Temblor). In this series are now found 2 unconformities which divide it into 3 distinct units and account for previous conflicts in stratigraphic correlation. The upper uncon. is at base of *Leda* zone (probably Olig), which zone, 0 to 150 ft. thick, lies uncon. beneath Temblor ss. and uncon. on sh. and ss. of Olig. or Eo. age, which is eroded away in places. The name *Kreyenhagen,* as used in present discussion, represents certain organic shales (not yet definitely assigned to any one age, though probably Eo. or possibly Olig.) lying discon. on hilly western side of San Joaquin Valley, above known Eo. sss. and sandy shales (variously called *Domengine, Tejon, Meganos,* or *Martinez?*). They contain white diatomite beds at top. The Kreyenhagen is not known to be Eo., but inference is made by writer that it is probably = type Tejon, which is definitely Eo. Writer places upper bdy of Kreyenhagen sh. at first uncon. encountered, the uncon. overlying beds in Cantua-Panoche region consisting of ss. and sh. of Eo. or Olig. age. This sh. series is considered by writer to include more strata N. of Coalinga than it does farther S. on Reef Ridge, on Kreyenhagen Ranch, where Kreyenhagen wells are located, but it is correlated, without hesitancy, by writer with the siliceous phase of Kreyenhagen sh. of Reef Ridge and Canoas Creek, regarded as first type loc. of fm. On Reef Ridge writer is inclined to place lower bdy of Kreyenhagen at base of the siliceous sh. and above the sandy clay zone in which diagnostic Eo. fossils (Foraminifera and Mollusca) have been found in abundance. The beds above this sandy clay zone are siliceous.

G. D. Hanna, 1933 (A. A. P. G. Bull., vol. 17, No. 1, p. 84). There is considerable objection among Calif. geologists whereby Anderson and Pack's error in interpretation of F. M. Anderson's name "Kreyenhagen" is perpetuated. Some geologists believe "Kreyenhagen" should be allowed to lapse because it was originally applied by F. M. Anderson to 2 distinctive units S. of Coalinga (in Canoas Creek), and N. of Coalinga he expressly excluded the part of section to which Anderson and Pack subsequently transferred the name. The first available name which was actually assigned to the fm. and about which there is no ambiguity is "Lillis fm., Ruckman," Merriam, 1915. There seems to be general agreement that the fm. is a distinctive and mappable unit and deserves a distinctive name. There probably will be less confusion if we continue to use "Kreyenhagen" in its erroneous and restricted sense than if we attempt to establish the unfamiliar but strictly applicable term "Lillis."

W. P. Woodring, 1934 (Map and structure sections of Kettleman Hills). *Kreyenhagen sh.* (*Eo. and Olig.?*) [according to micropaleontologic evidence] underlies Temblor ss. (Mio.) and overlies Avenal ss. (Eo.).

W. P. Woodring, March 1937 (personal communication). Type Kreyenhagen (of Reef Ridge) is Eo.; to N. of Coalinga anticline it is Eo. and Olig.; in Kettleman Hills it is Eo. and Olig. (?).

See also under *Lillis sh.*

Krider limestone. (In Sumner group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 60). *Krider ls.*—Middle memb. of Enterprise fm. Consists of (descending): (1) Light-gray to buff ls., 1 to 1½ ft.; (2) olive-drab to gray calc. massive sh. weathering buff, with usually a thin calc. concretion near middle, 2½ ft.; (3) light-gray to buff massive ls. weathering buff, 1½ ft. Thickness 4½ to 6 ft. from Nebr. to southern Kans. and Okla. Underlies Paddock sh. memb. and overlies Odell sh. memb. Type loc. road cut ¼ mi. S. of Krider, Gage Co., Nebr.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), discarded Enterprise and treated Krider ls. as basal memb. of his Nolans ls. (new).

Kruger schist.

Carboniferous (?): Southern British Columbia and central northern Washington.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). *Kruger schists.*—Apparently Paleozoic (probably late Carbf.) schists, qtzites, greenstones, and other rocks, that occur on the roughly tabular Kruger Mtn.

Kruger alkaline body.

Tertiary: Southern British Columbia and central northern Washington.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, p. 349). Crops out on W. surface of Kruger Mtn plateau.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 12, 119°30' to 120°). *Kruger alkaline body.*—Malignite and eleolite syenite.

†Kugruk group.

Ordovician, Silurian, and Devonian (?): Northwestern Alaska (Seward Peninsula).

A. J. Collier, 1902 (U. S. G. S. P. P. No. 2, p. 21, map). *Kugruk group.*—Lss. and calc. beds, argillites, mica schists, graphitic schists, many intrusive masses of schistose greenstone. Fossils (found at 1 loc. only) indicate Upper Sil. or Dev. age, Schuchert says. May be in part Mesozoic. Rests conformably on Port Clarence ls. Is upper part of Nome group, of which Port Clarence ls. is lower part. [The map shows Kugruk Mtn in midst of these rocks and Kugruk River flowing through them, but it seems that the river is Kougarok River, instead of Kugruk River, and that the rocks should have been called *Kougarok group.*]

Further work proved that the lss. included in Kugruk group as above defined are Port Clarence ls. (Sil. and Ord.), and that the schists are younger and of Dev. or Sil. age. The name *Kugruk group* has therefore been discarded (see A. J. Collier, U. S. G. S. Bull. 328, 1908, pp. 61–62, 65), as has *Kougarok group.*

Kummer series. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

G. W. Evans, 1912 (Wash. Geol. Surv. Bull. 3, pp. 42–49). *Kummer series.*—Top div. of Puget fm. in King Co. Chiefly coarse-grained light-colored sss. with numerous sh. and clay beds and 9 coals that are worked at Kummer mine, ¼ mi. S. of Kummer. Basal 475 ft. of light-colored or white massive ss. with nodules or boulders of harder ss. is called *Kummer ss.*, and is line of div. btw. Kummer and underlying Franklin series. Total thickness of Kummer series 1,751 ft.

Kummer sandstone.

Eocene: Western Washington (Puget Sound region).

See under *Kummer series.*

Kupikipikio basalt.

Kupikipikio black ash.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 40, 41, 42, 44). *Kupikipikio basalt.*—Basalt flow covering higher part of Kupikipikio Point. Is similar to Kaimuki basalt, but evidence is lacking for any surface connection btw. the two flows. Rests on Diamond Head tuff. Believed to be essentially contemp. with *Kupikipikio black ash* and with Kaimuki basalt.

Same as Black Point basalt of H. T. Stearns. The meaning of Kupikipikio is Black Point.

Kushequa shale member.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 47, 103). The Mississippian part of Riceville sh. is here named *Kushequa sh.* and included in base of Oil Lake series. It is basal memb. of Knapp monothem, and overlain by Wetmore cgl. memb. Is normally dark-brown to limonitic brown aren. sh., not materially different from underlying Oswayo sh. Fossils throughout. Includes, near middle, Marvin Creek ls. zone.

In his 1933 rept Caster named this sh. *Smethport sh. memb.*

Caster drew base of Miss. at base of this sh., but Chadwick (Geol. Soc. Am. Bull., vol. 46, No. 2, 1935) tentatively drew top of Dev. at base of Berea (Corry) ss.

Kushtaka formation.

Oligocene or Miocene: Southeastern Alaska (Controller Bay region).

G. C. Martin, 1905 (U. S. G. S. Bull. 250, p. 14). *Kushtaka fm.*—Series of coal-bearing strata exposed in valley of Bering River and its tributaries and on shores of Lake Kushtaka. Consists of at least many hundred and probably several thousand ft. of sh., arkosic ss., and coal seams. Lower bdy may be taken at base of lowest coal in Controller Bay region or at first mappable strat. break below that. Upper limit may be taken at top of highest coal or at next succeeding strat. break. Distinguished from Katalla fm. (which lies in an adjacent belt to S.) by presence of coal seams, predominance of ss. over sh., and coarseness of sediments. Probably *overlies* Katalla fm. Contains Kenai fossils.

G. C. Martin, 1906 (U. S. G. S. Bull. 284, p. 66), gave thickness of Kushtaka fm. as 3,500 to 4,000 ft.

G. C. Martin, 1908 (U. S. G. S. Bull. 335, pp. 24, 30), gave thickness of Kushtaka fm. in Controller Bay region as 2,500± ft., and applied new name *Stillwater fm.* to 1,000+ ft. of sh. and ss. underlying (probably conformably) Kushtaka fm. on W. shore of Kushtaka Lake. Did not mention any coal in Stillwater. This may or may not be a restriction of Kushtaka fm. He also stated that Kushtaka fm. occupies part of crest and much of E. slope of Kushtaka Ridge, and that largest known area extends in broad belt from E. edge of Kushtaka Glacier to NE. edge of area mapped. The fm. overlying the Kushtaka he named *Tokun fm.*

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, p. 771). "Writer suggests that Tokun fm. is = lower part of Katalla fm., or the beds he herein names *Split Creek memb.*, and that this is *underlain* by Kushtaka fm., which probably owes its position to a thrust fault, now buried beneath Bering Lake and the mud flats fronting Bering Glacier, along which it may have overridden the later Katalla fm."

Kuskokwim gravels and silts.

Pleistocene: Central southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 175–176). *Kuskokwim gravels and silts.*—Stratified glacial drift, coarse stratified glacial gravel and sand filling bottom of Ptarmigan Valley on W. side of divide btw. the Skwentna and the Kuskokwim. Of Pleist. age.

Kuskulana formation.

Upper Triassic: Alaska (Kotsina-Kuskulana district).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 423, 424, 433). *Kuskulana shales.*—Hard, ringing, highly siliceous grits, shales, slates, and some schists, all much fractured and seamed. Occur along valley of Kuskulana River and its tributaries. Assigned to Triassic.

F. H. Moffit, 1923 (U. S. G. S. Bull. 745). *Kuskulana fm.*—Definition modified so as to include the lss., which are=Nizina ls., as well as the overlying McCarthy sh.

Kuzitrin formation.

Devonian(?): Northwestern Alaska (Seward Peninsula).

A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901 (Reconn. in Cape Nome and Norton Bay regions, Alaska, in 1900: U. S. G. S. Spec. Pub., p. 28, map). *Kuzitrin series.*—Mass (2,000 to 3,000 ft. thick) of schistose rocks characterized by large percentage of graphite, and as a rule very aren. Type rock is well-jointed graphitic quartz schist. Intercalated graphitic slates not uncommon, and the schists sometimes very calc., especially toward top, approaching impure ls. Underlies Nome series and overlies Kigluaik series. Typically exposed in Kigluaik Mtns. Named for Kuzitrin River along whose lower course it is well exposed.

Kyle sandstone.

Tertiary: Southeastern Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 79). *Kyle sss.*—Clays, sands, and gravels occupying abandoned canyon of Old Virgen [Virgin] River. Compose upper fm. of Virgen [Virgin] series. Thickness 1,000 ft. Named for exposures at Kyle Station, in Meadow Valley, below Caliente [SE. Nev.]. "Pliocene perhaps."

Labadie limestone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686F, p. 45). *Labadie ls.*—Where best developed is a crystalline ls. of steel-gray color on fresh surface; on weathered surface upper part is brownish and lower part gray. Thickness 8 to 10 ft. on the point S. of Mission Creek in NE¼ sec. 36, T. 28 N., R. 10 E., but only 3 to 4 ft. a mi. N. of that place. Thins so rapidly to N. that it cannot be recognized N. of E. quarter corner of sec. 24 but a ls. 2 in. thick at about same horizon was seen at several places farther N. in Twps 28 and 29 N., R. 10 E. Lies 175± ft. below middle bed of Oread ls. and 65 ft. above lower *Fusulina*-bearing ls.

D. E. Winchester, K. C. Heald et al., 1918 (U. S. G. S. Bull. 686G, p. 60). *Labadie ls.* is first ls. of any prominence below Oread ls. (in T. 25 N., R. 10 E.), which is about 180 ft. stratigraphically above it. In N. part of Twp it consists of two benches, each 2± ft. thick, separated by 10± ft. of gray sh.; outcrop not recognized W. of Bird Creek. Is both overlain and underlain by gray sh., in which are thin beds of ss. Lies 40± ft. below Cochahee ss. and 60± ft. above Cheshewalla ss.

Named for Labadie Point, sec. 9, T. 26 N., R. 10 E., Osage Co.

Labahia member (of Goliad formation).

Pliocene: Central Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 752, 754). *Labahia memb. of Goliad fm.*—Top memb. of Goliad fm. in central Tex. Consists of (descending): (1) Upper ss. (grayish white, medium- to fine-grained, cross-bedded in places, massive in other places); (2) middle marl (greenish-gray, pink, or reddish calc. clay containing white calc. nodules); (3) lower ss. (grayish-white, medium to coarse-grained), in places grading into calc., cross-bedded cgl. lentils that change laterally into massive and poorly bedded layers. Overlies Lagarto Creek memb. Is typically exposed along San Antonio River near La Bahia Mission, S. of Goliad.

LaBelle series.

Pre-Cambrian: Quebec.

F. F. Osborne, 1935 (Quebec Bur. Mines Rept. Minister Mines 1934–35, pt. E pp. 15, 23, map).

Laberge series.

Jurassic or Cretaceous: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 50).

Labette shale (distinct formation in Kansas and Oklahoma).
Labette shale member *(of Henrietta formation) in Missouri.*

Pennsylvanian: Eastern Kansas, northwestern Missouri, and northeastern Oklahoma.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 36–37, 92, 94, 100). *Labette shales,* suggested by G. I. Adams, in field notes, for shales, with some ss., coal streaks, and thin lss., 30 to 75 ft. thick, underlying Pawnee ls. and overlying Oswego [Fort Scott] ls.

Has for years been treated as middle memb. of Henrietta fm. in Mo. In Kans. the Henrietta has for years been treated as a group by U. S. Geol. Survey and the Labette as a fm. In Okla. the Labette sh. is also treated as a fm. According to recent repts it includes Lexington coal. (See under *Cherokee sh.*) R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), has discarded Pleasanton and Henrietta fms. and treats Labette sh. as a fm. in his Marmaton group.

Named for exposures at Labette, Labette Co., Kans.

†Labette beds.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Labette beds* include (descending) Pawnee ls., Labette sh., and Fort Scott ls.

Preoccupied. Same as Henrietta fm.

La Biche shales.

Cretaceous (Upper): Alberta.

R. G. McConnell, 1893 (Canada Geol. Surv. Ann. Rept., vol. 5, pt. 1, pp. 27D–28D).

†Labrador system.

See 1877 entry under *Pemigewasset series* (Paleozoic).

See also U. S. G. S. Bull. 360, pp. 555–559, 1909.

The name originated with C. H. Hitchcock.

Labrador formation.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 222).

†Labradorian.

A name applied in some early Canadian repts to all and to part of the Laurentian series (pre-Camb.). Named for development in Labrador and for prevalence of mineral labradorite, which was named for Labrador. (See U. S. G. S. Bull. 360, 1909, index.) The name appears to have originated with W. E. Logan and T. S. Hunt.

La Brisca formation.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], p. 16).

La Carriere shale.

Cretaceous: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 36).

Lackawanna sandstone. (In Pocono formation.)

See under *Roaring Branch ss.*

Lackawaxen conglomerate.

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, p. 73). *Lackawaxen cgl.*—Separated from overlying Montrose red sh. by 30 ft. of greenish gray sss. and from underlying Delaware flags by 350 ft. of sss. and shales. Thickness 50 ft. [On later pages of above rept (pp. 94, 99–101, 156, 157, 163) this cgl. is included in his

Delaware River flags, and is described as a very massive pebbly bed, 30 to 75 ft. thick. Exposed a short distance below Lackawaxen village and at other places in Lackawaxen Twp, Pike Co.]

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7). ***Lackawaxen cgl.*** (also ***Lackawaxen fish cgl.***) underlies Delaware flag series.

The Lackawaxen cgl. of I. C. White's Huntingdon County rept (2d Pa. Geol. Surv. Rept. T_3, 1885) was renamed *Saxton cgl. memb. of Chemung fm.* by C. Butts in 1918. because of doubt that it is same as typical Lackawaxen cgl. of NE. Pa.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, p. 105). ***Lackawaxen cgl.*** of White has turned out to be figmentary.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 591–592). Writer has yet to find type loc. of White's Lackawaxen cgl. White made much of it as a key bed, but he erred in trying to correlate local pebble-beds in fresh-water fms. in the NE. counties with marine cgls. in NW. and south-central areas.

Lac la Belle conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Keweenaw County).

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 67–72, pl. 4). [***Lac la Belle cgl.*** as mapped occurs just N. of Lac la Belle, Keweenaw Co., and its strat. position is some distance below Bohemia cgl.]

A. C. Lane, 1911 (Mich. Geol. Surv. Pub. 6, geol. ser. 4, p. 225), described ***Lac la Belle cgl.*** as first marked cgl. beneath a heavy series of ophites, with a very heavy one (the Mabb ophite?) just above.

Belongs to Bohemian Range group, and according to B. S. Butler it may be=Baltic (No. 3) cgl. or it may be younger.

Lac La Rouge series.

Pre-Cambrian (Laurentian): Saskatchewan and Manitoba.

W. McInnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 153).

Laclede sandstone.

Upper Cambrian: Central Missouri.

G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, pp. 59, 61, 62). Friable ss., weathering dark brown, called *Laclede ss.* by Shepard. Included in Elvins fm. Probably=Fourth ss. of Swallow. Well exposed immediately S. of hotel at Decaturville, Camden Co.

E. M. Shepard, 1916 (letter dated Jan. 29, 1916), stated that this was not published by him, but was provisionally used in carbon prints given his students for field work.

J. Bridge, 1930 (personal communication), stated it is probably part of Elvins fm.

Probably named for Laclede Co.

Lacolle conglomerate.

Ordovician: Southern Quebec.

T. H. Clark and H. W. McGerrigle, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pp. 665–674).

Lacoste series.

Pre-Cambrian: Quebec.

F. F. Osborne, 1935 (Quebec Bur. Mines Rept. Minister Mines 1934–35, pt. E, pp. 18, 22, map).

La Cruz marl.

Miocene: Cuba.

T. W. Vaughan, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 276).

Lac Seul series.

Pre-Cambrian: Ontario.

E. M. J. Burwash, 1922 (Jour. Geol., vol. 30, p. 395).

La Cygne shale member.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2, pp. 18, 21, 28). *La Cygne sh. memb.*—Top memb. of Marmaton fm. Overlies Lenapah ls. memb. and underlies Hertha ls. memb. of Kansas City fm. Consists of 125 to 150 ft. of shales and intercalated sss., with some thin discontinuous beds of ls. Has previously been incorrectly called *Pleasanton sh.* Named for town of La Cygne, Linn Co. [In errata pasted on cover of Bull. 6, *LaCygne sh.* is withdrawn, because same as *Dudley sh.*]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 58, 67, 73), discarded *Dudley sh.*, introduced *Memorial sh.* for the beds overlying Lenapah ls. and extending up to uncon. at top of Des Moines "series" as restricted by Moore, and abandoned La Cygne sh. (=Memorial sh. and Bourbon fm.).

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Ladentown diabase.

Upper Triassic: Southeastern New York (Rockland County).

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 92). *Ladentown diabase (1899 Kümmel).*—This is small area of trap in Rockland Co., N. Y., on W. border of Newark beds near Ladentown, and about 2 mi. from extreme W. end of main Palisade trap, and may or may not be connected with it. The area is chiefly interesting in that to some extent it shows a ropy flow structure indicative of an intrusive sheet. [The compiler does not find that Kümmel 1899 used this name, but he did mention the rocks near Ladentown, N. Y.]

Ladiga sandstone.

Lower Cambrian: Eastern Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). *Ladiga (Potsdam) ss.*—Underlies Coosa Valley (Knox) sh. and ss. and overlies Talladega (Ocoee) group. [Only definition is on map legend.]

Probably same as Weisner qtzite.

Named for Ladiga, Calhoun Co.

Ladner series.

Jurassic: British Columbia.

C. E. Cairnes, 1924 (Canada Geol. Surv. Mem. 139, p. 45).

Ladore shale. (In Kansas City group, Kansas.)

Ladore shale member (of Kansas City formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

G. I. Adams, 1904 (U. S. G. S. Bull. 238, pls. 1, 2). *Ladore sh.*—Sh. [7 ft. thick, judging from description of Bronson fm. on p. 17] shown on maps as overlying Hertha ls. and underlying Mound Valley [Bethany Falls] ls. in Iola quad., Kans. Included in Bronson fm. [This definition conforms to that of Hinds and Greene, 1915.]

From 1912 until 1932 the Ladore sh., 3 to 40± ft. thick, was included in Kansas City fm. (or group), the U. S. Geol. Survey treating the Kansas City as a *fm.* in Mo. and Iowa and as a *group* in Kans., where minor subdivisions of these deposits had been named.

R. C. Moore and G. E. Condra in 1932 (correlation charts) restricted *Ladore sh.* to basal part of the unit to which it had previously been applied, and introduced 8 new names for the rest of the Ladore. They treated Ladore as top fm. of their Bourbon group (new name for lower part of their Bronson group of previous repts), and defined it as underlying Schubert Creek ls. (basal memb. of their Swope ls.) and as overlying Uniontown ls., which appears to correspond to the Hertha, but Moore in his May 1, 1935, table of Penn. fms. of Kans. (Kans. Geol. Surv. Bull. 20, table opp. p. 14) placed his Uniontown ls. a considerable distance below Hertha ls.

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21), placed restricted *Ladore sh.*, 7± ft. thick, above Hertha ls. and below Swope ls. in Johnson and Miami Counties of NE. Kans., but stated (p. 26) that the Ladore of *southern* Kans. may include beds up to base of Bethany Falls ls. This classification therefore recognizes two definitions of Ladore sh., the larger one of which corresponds to Ladore sh. of Hinds and Greene.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 82). *Ladore sh.* includes beds btw. top of Hertha ls. and base of Swope ls. In region N. of Erie, Kans., the top of Ladore sh. is base of Middle Creek memb. of Swope ls., but S. of Erie, where Middle Creek ls. is absent, the top of Ladore is considered to extend up to base of Bethany Falls ls. The latter condition obtains at type loc. of the Ladore, and recognizes the probable inclusion at top of Ladore of southern Kans. of sh.=Hushpuckney and Middle Creek members of Swope fm. The Middle Cr. ls. belongs to the cyclothem that includes Bethany Falls ls., and should not be left as a parting in Ladore sh.

The U. S. Geol. Survey has not yet had occasion to give consideration to these innovations in the Penn. classification of Kans. for use in its publications. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for exposures at Ladore, Neosho Co., SE. Kans.

Ladronesian series.

A term introduced by C. R. Keyes (Sci., n. s., vol. 23, p. 921, and Am. Jour. Sci., 4th, vol. 21, pp. 298–300, 1906) for 0 to 200 ft. of Carbf. [Penn.] shales, said to uncon. underlie his Manzanan series and to overlie his Socorran series (lss.) in SW. part of N. Mex. Appears to be named for Sierra Ladrones, 30 mi. N. of Socorro, N. Mex.

Ladystep intrusives.

Devonian (Middle or Upper): Quebec (Dartmouth River area).

I. W. Jones, 1935 (Quebec Bur. Mines, Rept. Minister of Mines 1934–35, pt. D, pp. 16, 19–21). Serpentine, amphibolite, and diorite.

Ladystep volcanics.

Silurian or Ordovician: Quebec (Dartmouth River area).

I. W. Jones, 1935 (same reference as for Ladystep intrusives). Consist of volcanic flows and tuff.

†Lady Washington sandstone.

Pennsylvanian: Southwestern Indiana (Spencer County).

E. T. Cox, 1871 (Ind. Geol. Surv. 2d Ann. Rept., pp. 145, 146, 160, 298). *"Lady Washington" ss.*—Heavy-bedded coarse-grained brownish-red ss., forming high bluff on Ohio River at Rockpoint, Spencer Co. Referred to millstone grit.

Probably same as Mansfield ss.

See also under †*Martha Washington ss.*

†Lafayette formation.

Cretaceous, Eocene, Neocene, and Pleistocene: Coastal Plain of southeastern United States.•

E. W. Hilgard, 1891 (Am. Geol., vol. 8, p. 130). *Lafayette* (Quaternary) adopted by McGee, LeConte, Loughridge, and Hilgard to replace Orange sand and Appomattox fm. Named for Lafayette Co., Miss., where I first discriminated it from Eocene sands. Overlies Grand Gulf rocks.

W J McGee, 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, pp. 347–521), published a treatise on *Lafayette fm.* in which he defined it (p. 497) as a bed of loam, sand, and gravel, with several minor elements, notably kaolin or kaolinic clay, comminuted silica or siliceous clay, etc., in geographic distribution coinciding approx. with Coastal Plain of SE. United States. Thickness a mere veneer to 200 ft. or more about mouth of the Mississippi. Separated from the newer Columbia fm. by the strongest uncon. of Coastal Plain. In structural composition the fm. is a unit, varying from place to place in local characters yet indivisible throughout its area of 250,000 sq. mi., save on arbitrary grounds. Position in biotic scale unknown, its meager flora combining Laramie (Cret.) and Pleist. or modern features, and its still more meager fauna representing the entire Neocene. It is a littoral deposit of materials carried into Atlantic Ocean and Gulf of Mexico by rivers still in existence when the land stood from 200 to 800 ft. lower than today and when the waters of ocean and gulf extended 50 to 500 mi. inland of present coast. The Lafayette fm. as now defined was first discriminated in north Miss. in 1855 and 1856 by Dr. E. W. Hilgard, and was named by him after Lafayette Co., in which it is typically developed. It was then considered Quat. (or Pleist.). (Am. Geol. 1891, vol. 8, p. 130.) [On p. 502 McGee gave a table showing that Lafayette fm. included deposits of Cret. (Tuscaloosa), Eocene (Orange sand of Safford, 1869, and Lagrange of Loughridge), Neocene (Orange sand of Safford, 1888, and Appomattox of McGee), and Pleist. ages (Lafayette of Hilgard, Orange sand of Hilgard (1860) and other writers, Columbia of McGee), etc.]

E. W. Hilgard, 1892 (Am. Jour. Sci., 3d, vol. 43, pp. 389–402). *Lafayette fm.* may be either Tert. or Quat. It is="Orange sand," which is now dropped by agreement. It underlies, usually uncon., Port Hudson (=Columbia of McGee) and uncon. overlies Grand Gulf beds.

In succeeding years the term *Lafayette fm.* came to be generally applied throughout Atlantic and eastern Gulf Coastal Plains to the thin fm. underlying Columbia group and assigned by most writers to late Plio., but considered by other writers to be early Pleist. The U. S. Geol. Survey early accepted the Tert. age of this deposit, and in 1909 adopted *Plio. (?)* as its specific age designation, based chiefly upon studies of T. W. Vaughan. As work in Southern States progressed the undesirability of retaining *Lafayette fm.* became apparent to most workers, the name having been applied to different deposits in different areas, and E. W. Berry having shown that the typical deposits, in Lafayette Co., Miss., belong to Wilcox group (Eocene). In 1915 the U. S. Geol. Survey abandoned *Lafayette fm.* and adopted *Citronelle fm.* (see G. C. Matson, 1916, U. S. G. S. P. P. 98L and 98M) for the nonmarine Plio. deposits of Gulf Coastal Plain extending from western Fla. into Tex. and northward into Miss. The deposits formerly included in so-called Lafayette fm. of N. J., Del., Pa., and Md. are now divided into Brandywine fm. (Pleist.) and Bryn Mawr gravel (Plio.?); in N. C. and S. C. they are represented by Brandywine fm.; and in Ga. and Fla. they are now divided into Charlton fm. (Plio.?) and Citronelle fm. (Plio.).

Lafayette serpentine.

Pre-Cambrian: Southeastern Pennsylvania.

T. D. Rand, 1900 (Phila. Acad. Nat. Sci. Proc. 1900, pt. I). *Lafayette serpentine* is a part of Chestnut Hill schists [Wissahickon fm.].

Named for occurrence at Lafayette, Montgomery Co.

Lafayette granite porphyry.

Late Carboniferous (?): Northwestern New Hampshire (Ammonoosuc River region, Franconia quadrangle).

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78). *Lafayette granite porphyry.*—Dark-gray or green rock. Extends length of Franconia Ridge trail from Mount Lafayette [in Franconia quad.] to Little Haystack [etc.]. Late Carbf.(?).

M. P. Billings and C. R. Williams in 1935 changed this name to ***Mount Lafayette granite porphyry,*** and assigned the fm. to White Mtn magma series of Billings.

Lafferty limestone.

Silurian: Central northern Arkansas (Batesville district).

H. D. Miser, 1920 (U. S. G. S. Bull. 715G). *Lafferty ls.*—Thin-bedded, compact, earthy ls.; upper part gray; lower part mostly red but partly gray. Thickness 0 to 85 ft. Uncon. underlies Penters chert and overlies St. Clair ls. Only known exposure is at the Tate Spring, 1¼ mi. N. of Penters Bluff Station. Named for West Lafferty Creek, which is ½ mi. E. of the exposure.

Lafonde gravel and marl.

Age (?): West Indies.

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 511).

Lagarto clay.

Miocene (?): Southern and eastern Texas.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, p. 560). *Lagarto div.*—Light-colored clays (lilac, lavender, sea green, greenish brown, and mottling of these colors) and sands of different character from those of Lapara div. The clays contain quantities of semicrystalline ls. pebbles with manganese dendritions. Upper part usually a ss. Underlies Reynosa div. and overlies Lapara div. Assigned to Plio.

A. Deussen, 1924 (U. S. G. S. P. P. 126, pp. 21, 100, etc.). *Lagarto clay.*—Light-colored or mottled pink and green clays, with numerous lime nodules; stained heavily with manganese in places. Strings of ls. extend downward into the clay where it is capped by ls. Includes also sands and sss. Thickness 346 to 647 ft. Uncon. underlies Reynosa fm. and overlies (conformably?) Lapara sand in Nueces Valley, but N. of San Antonio River it rests uncon. on Oakville ss. Named by Dumble from Lagarto Creek, in Live Oak Co., where it is typically exposed.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 753, 754, errata dated Dec. 11, 1933). Dumble's Lagarto included beds both younger and older than Lapara sand, as it included all beds btw. Oakville and Lissie fms. The beds on Lagarto Creek uncon. overlie Lapara sand, and are here treated as middle memb. of Goliad fm. (new), under the name *Lagarto Creek beds.* The beds below Lapara sand and above the Oakville are here called *Lagarto fm.*, although the beds on Lagarto Creek are now included in overlying Goliad fm. The Lagarto fm. as here restricted is 500 to 1,000 ft. thick (2,500 in wells), and rests on Oakville ss. Type section of Lagarto as here restricted is the exposures along Brenham-Houston highway just W. of Brazos River bridge, Washington Co.

For further details see Plummer's 1933 rept.

The U. S. Geol. Survey now uses the restricted definition of Lagarto clay described above, i. e., for the beds uncon. underlying Goliad sand (of which Lapara sand is basal memb.) and overlying Oakville ss.

Lagarto Creek beds. (In Goliad sand.)

Tertiary (Pliocene): Southern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 753, 754). *Lagarto Creek beds.—Middle memb. of Goliad fm. (new).* Underlie Labahia memb. of Goliad and overlie [uncon. according to errata sheet dated Dec. 11, 1933] Lapara sand memb. of Goliad. They outcrop on Lagarto Creek, where, according to H. T. Richardson, they consist of pinkish brown and reddish mottled limy clay resembling the clays uncon. underlying the Lapara, but in most places having more pastel shades and a higher calcium carbonate content. Thickness of this unit is about 50 ft. The name *Lagarto fm.* is here restricted to the beds underlying Lapara sand and overlying Oakville ss., which are 500 to 1,000 ft. thick, and 2,500 ft. in wells.

Lagonda sandstone member (of Cherokee shale).

Pennsylvanian: Northern Missouri.

C. H. Gordon, 1893 (Mo. Geol. Surv. Sheet Rept. No. 2 (vol. 9), p. 19). *Lagonda sss. and shales.*—Sandy shales and sss., 18 to 50 ft. thick, overlying Bevier coal and forming top div. of Lower Coal Measures in Bevier quad. (covering parts of Macon, Randolph, and Chariton Counties).

Is now treated as a memb. of Cherokee sh.

Named for exposures at Lagonda, Chariton Co.

Lagonda shale.

A name applied by some geologists to *Lagonda ss. memb. of Cherokee sh.*

†Lagrange formation.

Eocene: Western Tennessee, southern Illinois, southeastern Missouri, Mississippi, and southern Alabama.

J. M. Safford, 1864 (Am. Jour. Sci., 2d, vol. 37, pp. 361, 369–370). *Orange sand or La Grange group.*—Generally great stratified mass of yellow, orange, red, or brown and white sands, usually more or less argill., with occasionally an interstratified bed of white, gray, or variegated clay, and patches, plates, and thin layers of ferruginous, sometimes argill., ss. and locally massive blocks of ss. on high points. Thickness 600 ft.; more than 100 ft. exposed at Lagrange. Forms more than third of entire surface of W. Tenn., in belt 40 mi. wide. Underlies Bluff lignite and overlies Porter's Creek group.

These deposits in Tenn. are now divided into Jackson fm. and Wilcox group, the latter being subdivided into Grenada fm., Holly Springs sand, and, in wells in SW. corner of State, Ackerman fm. It is now believed that there is no representative of Claiborne group in Tenn.

In early Miss. and Ala. repts "Lagrange fm." was applied to the beds underlying †Buhrstone (Tallahatta fm., basal fm. of Claiborne group) and overlying †Flatwoods (Porters Creek or Sucarnoochee) clay, or to Wilcox group and Naheola fm. (upper fm. of Midway group).

Named for exposures at Lagrange, Fayette Co., Tenn.

†La Grange sandstone. (In Chester group.)

Mississippian: Northwestern Alabama.

E. A. Smith, 1879 (Ala. Geol. Surv. Rept. Prog. 1877 and 1878, pp. 17, 34, 36). *La Grange ss.*—Fine to coarse-grained, sometimes heavy-bedded, sometimes flaggy ss. Only ss. in midst of Mountain ls. or Chester group. If a local name be desired, might be called *La Grange ss.* Thickness 20 to 75 ft. in Lawrence, Colbert, and Franklin Counties. In a few localities in Colbert Co. the ss. bed is duplicated, with ls. between.

Preoccupied. Replaced by Hartselle ss., Golconda fm., and Cypress ss.

Named for La Grange, Colbert Co.

Lagrange moraine.

Pleistocene (Wisconsin stage): Northeastern Indiana. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Lagrange, Lagrange Co.

Laguna basalt flow.

R. L. Nichols, June 1931 (Geol. Soc. Am. Proc., 1933, p. 453), named 3 Quat. basalt flows in San José Valley, Valencia Co., NW. N. Mex., and stated: The *Laguna* and *Suwanee flows* are of Pleist. age; the *McCartys flow*, by reason of lack of weathering and presumed superposition on Laguna flow, is believed to be of recent and possibly historic age. The Laguna and Suwanee flows, at their lateral margins, usually rest on old valley slopes (Cret. and Jurassic rocks).

In a later paper (Jour. Geol., vol. 44, No. 5, 1936, p. 628) Nichols stated McCartys flow rests on Laguna flow, and he named a 4th flow (occurring in San José Valley btw. Blue Water and the Rio Puerco in Valencia Co.) the *Blue Water basalt*. The age relations of his Blue Water basalt to the other basalt flows are not explained.

Laguna formation.

Pliocene (?): Northern California (Mokelumne River Basin).

A. M. Piper, H. S. Gale, and H. E. Thomas (U. S. G. S. W. S. P. 780, in press). *Laguna fm.*—Stream-borne silt and sand, with some gravel and presumably some clay; nonandesitic; poorly bedded and poorly exposed. Thickness 0 to 400 ft. Uncon. underlies Arroyo Seco gravel (Pleist.) and overlies Mehrten fm. (Mio. and Plio?). Probably laid down in Plio. time but perhaps in early Pleist. time. Type loc. is in N. bank of Hadselville Creek, a short distance from its junction with Laguna Creek.

La Habra conglomerate.

Pleistocene (lower) and lower Pliocene (?): Southern California (South Coastal Basin).

R. Eckis, 1934 (Calif. Dept. Pub. Works, Div. Water Res. Bull. 45, pp. 38, 49). In W. part of South Coastal Basin the Saugus fm. (lower Pleist.) is locally called *La Habra cgl.* [p. 38]. The cgl. series in the upper Fernando that outcrops along S. margin of hills E. of Whittier is locally known as *La Habra cgl.* (H. M. Bergen, unpublished rept on geol. of Bastanchury ranch). It is 400± ft. thick in vicinity of La Habra, but thickens to W. to possibly 1,000 ft., and is principally lower Pleist. but may be in part upper Plio. Rests, with apparent conformity, on silts and sandy shales with occasional cgl. members. Overlain by upper Pleist. alluvium. Is composed in large part of granitic and Tert. volcanic materials, with some ss. and siliceous sh. pebbles [p. 49].

†Lahontan beds.

See *Lake Lahontan beds.*

Lahontan series.

A term applied by C. [R.] Keyes to Lake Lahontan beds of NW. Nev.

La Jara shale.

Name applied by C. [R.] Keyes (Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 8) to "uppermost black shales section of the Coloradan series around the southern end of the Rocky Mtns." Thickness 1,000 ft. Derivation of name not given.

La Jolla formation.

Eocene: Southern California (San Diego County).

B. L. Clark, November 4, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 5. pp. 103, 111, 117). At present there is in press a monograph on strat. and fauna of the Eo. beds of San Diego Co. by M. A. Hanna. In that monograph he refers major part of this section to a new fm. which he calls *La Jolla* and which he correlates tentatively with Domengine fm. described in this paper. Many species are common to La Jolla and Domengine fms. Overlying the La Jolla fm. are the Poway cgls., which previous workers have referred to Plio., but which Hanna has shown conclusively are Eo., and has tentatively correlated them with Tejon.

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). In previous publications the Delmar sand, Torrey sand, and Rose Cañon sh. have been mapped together and referred to Tejon Eocene. In present paper they are recognized as a distinct fm. and so designated, under name *La Jolla fm.* The whole of La Jolla fm. probably represents deposition along an oscillating coast. For most part the species found in La Jolla fm. are not present in either the Tejon or Meganos. The La Jolla fm. is therefore considered as stratigraphically btw. Meganos [as restricted by B. L. Clark] and Tejon fms., or approx.=Domengine fm.

Lake amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is older than Forest amygdaloid and younger than cgl. No. 8 (Bohemia cgl.). The mineralized part is the Lake lode. Named for occurrence in Lake mine, Ontonagon Co. Belongs to Central Mine group.

Lake flow.

Includes Lake amygdaloid and the underlying trap.

†Lake gneiss.

Carboniferous to pre-Cambrian (?): Eastern New Hampshire (Lake Winnipesaukee region).

C. H. Hitchcock, 1874. [See 1874 entry under †*Lake Winnipesaukee gneiss*, of which it is an abbreviated form.]

Lake sandstone.

A subsurface unit of sss., 5 to 40 ft. thick, in Grove gas field, secs. 483, 484, 487, and 488, Southern Pacific R. R. survey, 5 mi. N. and W. of Cisco, Eastland Co., Tex. Lies in base of Smithwick sh., 45 to 80 ft. below Caddo ls.

†Lake quartzite schist.

Early Paleozoic or older: Northern Alaska (Chandalar Lake region).

F. C. Schrader, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 474). *Lake qtzite schist.*—Chiefly micaceous qtzite schist, 6,000± ft. thick. Overlies Rapids schist and underlies Bettles series. Named for great prominence at Chandalar Lake. Provisionally referred to Birch Creek series.

Lake quartz syenite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series*.

Lake Agassiz clays.

Pleistocene: Mississippi Valley.

W J McGee, 1888 (Am. Jour. Sci., 3d, vol. 35, p. 462). *Lake Agassiz clays*.—Younger than the terminal moraine and 3d till of second glacial stage. Correlated with Champlain clays of Middle Atlantic slope.

Lake Agassiz silt.

Name applied to the silt deposited in Pleist. glacial Lake Agassiz in Minn. and N. Dak.

†Lake Albany clays.

A term applied (G. H. Chadwick, N. Y. State Mus. Bull. 140, pp. 157–160, 1910) to the Albany clay of early repts.

Lake Ardmore sandstone member (of Springer formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

R. Roth, 1928 (Econ. Geol., vol. 23, p. 45). [See under *Overbrook ss. memb.*]

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 13). *Lake Ardmore memb. of Springer fm.*—A persistent ss., 15 to 20 ft. thick and very similar to Overbrook ss., which lies from 300 to 500 ft. lower in Springer fm. The Primrose memb. of Springer lies from 100 to 300 ft. above Lake Ardmore ss.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 17–19). *Lake Ardmore ss.* lies 250 to 500 ft. below Primrose memb. and 500± ft. above Overbrook ss. memb. It is named for a sportsman's lake in sec. 2, T. 4 S., R. 1 E., where it forms narrow peninsulas and islets.

Lake Aylmer series.

Devonian: Quebec.

F. R. Burton, 1931 (Quebec Bur. Mines Ann. Rept. 1930, pt. D, p. 118).

Lake Bonneville beds.

Pleistocene: Northern Utah and southeastern Idaho.

G. K. Gilbert, 1875 (U. S. Geol. and Geog. Surv. Terr. W. 100th M. vol. 3, pp. 89+). In fine, the *Bonneville beds* are the sediments of the lake whose successive margins are recorded by the series of beaches we have described, and their deposition has been continuous over a gradually restricted area from the date of Bonneville beach to present time. The lacustrine deposits which form part of the record of this lake I shall designate *Bonneville group*. These Quaternary deposits of northern Utah consist of fine, friable, white, calc. marl, passing into a cream-colored, partly oolitic sand of calc. and siliceous grains, feebly cemented by calcite into an impalpable clay.

Lake Border morainic system.

Pleistocene (Wisconsin stage): Western Michigan, northwestern Indiana, northeastern Illinois, and eastern Wisconsin. Shown in part on moraine map (pl. 32) of U. S. G. S. Mon. 53, and in part on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for development on E. and W. shores of Lake Michigan.

Lake Bridgeport shale.

Pennsylvanian: North-central Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 29). *Lake Bridgeport shales* is name here given to the shales and sss. in Graford fm. that occupy interval btw. Willow Point ls. below and Rock Hill ls. above. They increase in thickness from less than 100 ft. 2 mi. NE. of Willow Point to 300± ft. btw. Bridgeport and Chico, to 550 ft. in Wise-Comanche No. 1 Spann well 2 mi. E. and 3/4 mi. N. of Chico. To W. and N. of Bridgeport they consist of (descending): (1) Sh. and flaggy sands, 45 ft.; (2) prominent scarp-forming ss., brown, massive, and fine-grained; (3) very dark shales that weather yellow and brown and leave many claystone concretions.

†Lake Champlain clays.

Same as †*Champlain clays.*

Lake Church formation.

Devonian: Southeastern Wisconsin.

E. R. Pohl, 1929. From Raasch ms. See under ***Thiensville fm.***

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 260, 262–263). *Lake Church fm. novum.*—Divided into Ozaukee memb. above (0 to 27 ft. thick) and Belgium memb. below (0 to 8 ft. thick). Underlies Thiensville fm. and overlies Racine fm. (Sil.). Max. thickness at least 45 ft. Thins to S. by overlap, and disappears in vicinity of Ozaukee-Milwaukee Co. line, where Thiensville fm. rests on Sil. Fossiliferous throughout. Best known, most complete, and most accessible exposure of fm. is in and about old Lake Shore stone quarry near Lake Church, Ozaukee Co. Beds referred to by Cleland as ***Waubakee*** in the proposed type section are to be included with the Dev.

Lake Creek shale member (of Pierre shale).

Upper Cretaceous: Northwestern Kansas (Wallace County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7). ***Lake Creek sh. memb. of Pierre sh.***—Mostly dark-gray and black flaky sh.; bentonite rare or absent; many limonite concretionary streaks and small soft ls. concretions; large tough ls. concretions very rare; poor cone-in-cone structure rarely developed; gyp. in places very abundant. Thickness 200± ft. in outcrops in secs. 5 and 7, T. 13 S., R. 41 W. Underlies Salt Grass sh. memb. of Pierre and overlies Weskan sh. memb. of Pierre. Differs from both Salt Grass and Weskan members by total absence or by great scarcity of the large ls. concretions that are so common in those members. Named for Lake Creek, in NW. part of Wallace Co., along which the most extensive outcrops occur.

Lake Escarpment morainic system.

Pleistocene (Wisconsin stage): Northern Ohio, northwestern Pennsylvania, and western New York.

F. Leverett, 1902 (U. S. G. S. Mon. 41). ***Lake Escarpment morainic system*** includes Girard moraine (youngest), Ashtabula moraine, Painesville moraine, and Euclid moraine (oldest). Covers part of brow and much of face of Lake Erie escarpment from Cleveland eastward into N. Y. The combined belt in western N. Y. has been referred to by writer as ***Dayton moraine*** (Am. Jour. Sci., 3d, vol. 50, p. 8, 1895), but it seems preferable to substitute the name ***Lake Escarpment system*** and to give names to each morainic ridge.

On moraine map of Ohio published as fig. 8 of U. S. G. S. Columbus folio (No. 197), 1915, the Lake Escarpment morainic system was erroneously called *Lake Shore morainic system.*

Lake Evans series.

Pre-Cambrian: Quebec.

H. C. Cooke, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 389).

†Lake Flirt marl.

Recent (?): Southern Florida (De Soto County).

E. H. Sellards, 1919 (Fla. Geol. Surv. 12th Ann. Rept., pp. 73–74). ***Lake Flirt marl.***—Overlies Coffee Mill Hammock shell marl. Is strikingly different, both in lithologic appearance and fossils, from Coffee Mill Hammock marl. Consists of a calc. mud in which fresh-water shells, chiefly gastropods, are embedded. Has a thickness of 3 or 4 ft., and is best seen underlying the basin of Lake Flirt [De Soto Co.] from Old Fort Thompson to Coffee Mill Hammock, a distance of about 8 mi. This marl is of fresh-water origin and may be quite recent in age.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.), redefined Fort Thompson fm. so as to include in it the Coffee Mill Hammock marl of Sellards, and stated that Lake Flirt marl of Sellards is probably Recent, also that at some places it overlies Fort Thompson fm.

Lake Fork andesite.

Miocene (?): Southwestern Colorado (San Juan Mountains region).

W. Cross and E. S. Larsen, 1923 (U. S. G. S. P. P. 131, table opp. p. 184, and Bull. 718, table opp. p. 12). *Lake Fork breccia.*—Chiefly chaotic andesitic flows and breccias locally developed in Uncompahgre and adjoining quads. Thickness 0 to 1,000± ft. Named for exposures in Lake Fork of Gunnison River in Uncompahgre quad. Uncon. underlies San Juan tuff and uncon. overlies Telluride cgl. Is probably Eocene.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Lake Fork andesite.*

Lake Hanbury slate group.

Huronian: Northern Peninsula of Michigan (Menominee iron region).

C. Rominger, 1881 (Geol. Surv. Mich., vol. 4, pt. 2, p. 182). The most southern, *seemingly uppermost,* group of rocks in Menominee iron region, is a series of dark gray slaty or schistose beds, with interlaminated quartzose belts, perhaps over 2,000 ft. thick, which I will call *Lake Hanbury sl. group.* A second group, next succeeding [downward], which I will name *Quinnesec ore-fm,* is not less than 1,000 ft. thick, and locally perhaps much thicker. It consists of, in upper part, light-red or whitish, or gray hydromicaceous and argillitic strata, and in lower part of siliceous beds richly impregnated with iron oxide and constituting the valuable ore deposits. A third group is a series of light-colored qtzite and ls. beds of siliceous character, usually in part of brecciated structure, and also at least 1,000 ft. thick, which I will call *Norway ls. belt.*

J. Fulton, 1888 (Am. Inst. Min. Engrs. Trans., vol. 16, pp. 525–536). Huronian rocks of eastern Menominee region consist of 3 fms. (descending): (1) *Lake Hanbury sl group,* 2,000 ft.; (2) *Quinnesec ore-fm.,* 1,000 ft.; and (3) a basal fm. of crystalline siliceous ls., at least 1,200 ft. thick, which outcrops at many localities along the range, especially N. of the Norway, Quinnesec, and Chapin mines.

The pre-Camb. sl. (upper Huronian) of Menominee region was for many years called "Hanbury sl.," but that name was long ago discarded for *Michigamme sl.* The underlying iron-fm. is *Vulcan iron-fm.* (middle Huronian); and the older lss. are the Randville dol. (lower Huronian).

Lake Huron shale.

Upper Ordovician: Northern Indiana (Kokomo).

M. Thompson, 1886 (Ind. Dept. Geol. and Nat. Hist. 15th Ann. Rept., p. 325), listed following fms. in Kokomo gas well No. 2, in descending order: (1) Upper Sil. and Dev. ls., 434 ft.; (2) *Lake Huron sh.* (*Hudson River and Utica sh.*), 470 ft.; and (3) Trenton, 4 ft.

Lake Kemp limestone. (In Lueders formation.)

Permian: Central northern Texas (Baylor County).

M. M. Garrett, A. M. Lloyd, and G. E. Laskey, 1930 (Tex. Bur. Econ. Geol., geol. map of Baylor Co.). *Lake Kemp ls.* lies at top of Lueders fm. and 45± ft. higher than Maybelle ls. [The top ls. of Lueders fm. in Jones and Taylor Counties was called *Lueders ls.* by P. A. Meyers and H. T. Morley (Tex. Bur. Econ. Geol., geol. maps of Jones and Taylor Counties, 1929), but this name is preoccupied by *Lueders fm.*]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 174). *Lake Kemp ls.* is top memb. of Lueders fm. Occurs at E. end of Lake Kemp, Baylor Co.

Lake Lahontan beds.

Pleistocene: Northwestern Nevada.

I. C. Russell, 1885 (U. S. G. S. Mon. 11, p. 143). *Lahontan sediments.*—Sediments deposited in Lake Lahontan. Consist of upper lacustral clays, 50 to 75 ft. thick; resting uncon. on medial gravels, 50 to 200 ft. thick, which rest uncon. on lower lacustral clays, 100+ ft. thick.

Lake Louise shale.

Lower Cambrian: Alberta and British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 5). *Lake Louise fm.*—Siliceous shales, 105 ft. thick at upper end of Lake Louise. Type loc.

on both sides of Lake Louise at its upper end. Well shown on NW. and N. sides of Fairview Mtn. Lower Camb. fossils. Underlies St. Piran fm. and overlies Fairview fm. [Latter name preoccupied and later replaced by *Fort Mtn ss.*]

Lake Lytle limestone.

J. Hornberger, Jr., 1932 (Tex. Bur. Econ. Geol., geol. map of Throckmorton Co.), applied *Lake Lytle ls.* to top bed of Arroyo fm., and showed it as 40± ft. above Rainy ls. It therefore appears to be a synonym of Lytle ls.

Lake Mills morainic system.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Lake Mills, Jefferson Co.

Lake Missoula beds.

Pleistocene: Southwestern Montana (Missoula, Ravalli, and Granite Counties).

C. M. Langton, 1935 (Jour. Geol., vol. 43, pp. 34–35). [*Lake Missoula beds* used in table on p. 35 as underlying terrace gravels and overlying glacial drift, and on p. 34 he refers to Pardee's "Glacial Lake Missoula," Jour. Geol., vol. 18, 1910, pp. 376–386.]

Lake Monongahela deposits.

Pleistocene: Southwestern Pennsylvania.

R. R. Hice, 1905 (Am. Ceramic Soc. Trans., vol. 7, pt. 1). Lacustrine deposits laid down in glacial lake called *Lake Monongahela* by Dr. [I. C.] White, which existed near mouth of Beaver River [in SW. Pa.] during Kansan stage of ice sheet.

Lakemont formation.

Name proposed by E. O. Ulrich in 1923 for upper part of Clinton fm. in central Pa. and western Md., as explained under *Clinton fm.*, 1923 entry.

F. M. Swartz, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 101). Neither lithologic nor faunal evidence favors uniting the upper Rose Hill, Keefer, and Rochester in the *Lakemont fm.*, as has been proposed by some authors.

F. M. Swartz, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, p. 1169). The name "Lakemont fm." was proposed by Ulrich and Bassler for Upper Clinton of central Pa. from a section near Lakemont Park, btw. Hollidaysburg and Altoona. [Swartz's correlation table on p. 1167 shows this unit=his Rochester sh. and upper part of Rose Hill sh.]

Lake Pinto sandstone member (of Mineral Wells formation).

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, p. 77, and charts). *Lake Pinto ss. memb. of Mineral Wells fm.*—Massive ss. which caps the escarpments about Mineral Wells. Named for Lake Pinto, ½ mi. W. of Mineral Wells, which lies in a valley almost surrounded by an outcrop of the bed. The exposures in hills E. and W. of Mineral Wells locally contain lenses of fine to moderately coarse cgl. Thickness 22 ft. Underlies Salesville sh. memb. and overlies East Mtn sh. memb. of Mineral Wells fm.

Above is definition still in use. (See F. B. Plummer and J. Hornberger, Jr., Univ. Tex. Bull. 3534.)

Lakeport limestone.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Lakeport ls.*—Immediately below the typical fossiliferous Rochester sh. and above the Donnelly ore in the Lakeport hole [Madison Co.] there are 16 ft. of ls. with considerable sh. that have been interpreted by Hartnagel as summit Clinton [exclusive of Rochester sh.]. Corresponding to these in position in South Granby well, the next hole W. to penetrate this horizon, are but 18 inches of impure ls. with fossils, grading apparently into the Rochester. Without knowledge of their fauna the importance of these beds cannot well be evaluated, so it will be safe to employ temporarily a local designation for them. Overlie Donnelly ore. Uncertain whether Lakeport is (1) uppermost Irondequoit coordinate with the "reef" zone at Rochester, or (2) a new intercalated memb., or (3) a calc. eastern facies of lower true Rochester (above the "reef" horizon).

According to E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 347), this ls. is of Rochester age. See under *Phoenix or Schroeppel sh.*

Lake Shore trap.

Pre-Cambrian (Keweenawan): Northern Michigan and Wisconsin.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 186. etc., pls. 17 and 18). *Lake Shore trap.*—Diabase and diabase amygdaloid, including one or more thin porphyry cgls. Underlies Outer cgl. and overlies Great cgl. Thickness about 1,500 ft.

According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, 1911) the *Lake Shore trap* ranges in thickness from 0 to 1,800 ft., and is composed of an upper trap sheet, a middle cgl., and a lower trap sheet. In some repts the lower trap and the middle cgl. have been included in Great cgl.

Is middle fm. of Copper Harbor group.

Named for exposures on shore of Lake Superior at Keweenaw Point, Mich.

†Lake Shore morainic system.

Same as *Lake Escarpment morainic system.*

Lake Superior sandstone.

Upper Cambrian: Michigan (Northern Peninsula).

D. Houghton, 1840 (Mich. Geol. Surv. 3d Rept., for 1839. H. Doc. No. 8, p. 13). *Lake Superior ss.*—Red ss. Rests on Primary rocks. Its easterly prolongation is not very thick, but westerly it attains a thickness of several hundred ft. on S. shore of Lake Superior. No fossils found.

Later repts (by C. R. Van Hise and others) call it "Potsdam ss.," record Upper Camb. fossils from it, and include in it Munising and Jacobsville sss.

†Lake Superior group.

A. Winchell, 1871 (Mich. Geol. Surv. Rept. Prog., pp. 26–27), applied this name to a group of sss. lying stratigrapically btw. "Cincinnati group" above and Huronian "system" below in Upper Peninsula of Mich. Includes Upper Gray ss. of Houghton, the sss. E. and W. of Keweenaw Point, and a cgl. at base.

Laketown dolomite.

Silurian (Niagaran): Northeastern and western Utah and southern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36. pp. 407, 410). *Laketown dol.*—Massive light-gray dol., 1,000 ft. thick in northern Utah. Underlies Jefferson dol. and overlies Fish Haven dol.

Named for exposures in Laketown Canyon, Rich Co., NE. Utah.

Lake Trammel sandstone.

Permian: Central northern Texas (Taylor and Nolan Counties region).

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pl., pp. 95–96). *Lake Trammel ss.*—Massive, soft, red ss. 100 ft. thick. Disintegrates readily. Lies 130 ft. above base of Quartermaster fm. in section from Abilene to Sweetwater. Overlain by 2 ft. of white crystalline gyp. [Derivation of name not stated.]

C. N. Gould, 1926 (Jour. Geol., vol. 34, p. 419). *Lake Trammel ss.* of Tex. is strat. equiv. of Whitehorse ss. of Okla. and Kans., and the horizon can be traced continuously in the 3 States.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pp. 945–946). Typical Whitehorse ss. can be seen W. of Aspermont, Stonewall Co., and W. of Sweetwater [Nolan Co.], where occur the outcrops of Wrather's Lake Trammel ss., now correlated with Whitehorse ss.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 167). *Lake Trammel* ss. of Wrather is part or all of Whitehorse ss. and is discarded.

Lake Valley limestone.

Mississippian (early): New Mexico.

E. D. Cope, 1882 (Eng. and Min. Jour., vol. 34, p. 214). I was first to determine Carbf. age of *Lake Valley ls.*

C. R. Keyes, 19(… (Ores and Met., vol. 12, p. 48). The Lower Carbf. is clearly differentiated in N. Mex. at several localities. Principal of these places is Lake Valley, Sierra Co. Here have been found extensive lss. carrying fauna of Lower Burlington ls. of Mo., Iowa, and Ill. To this remarkable ls. the local geographic name *Lake Valley* appears appropriate.

C. R. Keyes, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 360–362). *Lake Valley fm.* consists of 200 ft. of lss., underlying Sandia fm. and overlying Dev.

C. R. Keyes, 1905 (Iowa Acad. Sci. Proc., vol. 12, pp. 169–171). *Lake Valley ls.* is a remarkable blue crinoidal ls. carrying typical Lower Burlington fauna.

C. H. Gordon, 1907 (Am. Jour. Sci., 4th, vol. 24, pp. 58–64). *Lake Valley ls.* at Lake Valley is divisible into (descending): (1) Coarse subcrystalline yellowish-white ls. in moderately thick beds, more shaly below, with some cherty beds, and abundant crinoids and other fossils, 60+ ft.; (2) blue sh. with thin beds of bluish ls., same fossils as No. 3 but not so many crinoids, 75 ft.; (3) grayish blue, hard, compact ls., more or less siliceous at top, 25 ft. (locally called "Foot-wall lime"); (4) compact grayish ls., filled with nodular chert, and sh. partings, usually rather thick, 50 ft. Rests on Percha sh. (Dev.) and is overlain by andesite.

Lakeview limestone.

Middle Cambrian: Northern Idaho (Pend Oreille district).

E. Sampson, 1928 (Idaho Bur. Mines and Geol. Pam. 31, p. 9). *Lakeview ls.*—Varies from a pure little-altered ls. to a coarse marble. Where unaltered two main varieties occur: Heavy-bedded extremely massive ls. and thin-bedded shaly ls., which has yielded large collection of fossils identified by Resser as Middle Camb. and contains a variable amount of argill. material. The heavy-bedded ls. varies btw. nearly pure calcite and nearly pure dol. Named for exposures at town of Lakeview, near SE. end of Pend Oreille Lake. Thickness not stated.

Lakeview quartz-hornblende diorite.

Late Jurassic (?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 502). Late Jurassic (?) rock found throughout greater part of Lakeview Mtns, Riverside Co.

†Lake Winnipesaukee gneiss.

Carboniferous to pre-Cambrian (?): Eastern New Hampshire (Lake Winnipesaukee region).

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, pp. 508–545), used *Winnepiseogee gneiss (or, for short, Lake gneiss)*. In previous repts he had used *gneiss about Lake Winnepisseogee*. (*Winnipesaukee* is spelling adopted by U. S. Geog. Bd.) In this 1874 rept he stated: "I think this includes the Berlin and Manchester ranges." On pp. 55–58 he stated *Winnipiseogee Lake gneiss fm.* consists of granitic gneiss filled with segregated veins, and has not yet been observed away from vicinity of the lake. Where he placed it below his White Mtn series and above the porphyritic gneiss or granite ("the oldest fm. in the State"). In 1874, in his general descriptions of the rocks of the State, he placed his Bethlehem group btw. the porphyritic gneiss and the Lake gneiss.

In Geol. N. H., pt. 2, 1877, Hitchcock in parts of the rept used *Lake gneiss;* in other parts, *Winnipiseogee gneiss;* and in other parts *Lake or Winnipiseogee gneiss;* while in his description of White Mtns dist. in that rept he designated (p. 111) the fm. *Berlin or Lake gneiss*, apparently from either the town or Twp of Berlin, both of which are in White Mtns. In that area he placed the fm. uncon. above his Bethlehem gneiss and below his Montalban group. In the Atlas of N. H. (1878) and in Mcfarlane's Geol. Ry Guide (1879), Hitchcock designated the rocks *Lake Winnipiseogee gneiss.* He has given 18,600 ft. as thickness of the fm. In

1884 and subsequent repts Hitchcock sometimes used *Lake gneiss* and sometimes *Lake Winnipiseogee gneiss*, while some other writers designated the rocks as *Winnipesaukee gneiss*. The shorter form *Lake gneiss* has also been used by other geologists. The names seem to have fallen into disuse. On 1932 geol. map of U. S. the rocks around Lake Winnipesaukee are mapped as pre-Camb., but Billings later (1934) questioned presence of any pre-Camb. rocks in N. H.

M. Billings, 1935 (letter dated Aug. 27). We have abandoned *Lake Winnipesaukee gneiss*, as it included most every conceivable kind of rock.

Lakota sandstone. (In Inyan Kara group.)

Lower Cretaceous: Western South Dakota, eastern Wyoming, southeastern Montana (in wells), and northwestern Nebraska.

N. H. Darton, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 387). *Lakota ss.*—Coarse buff sss. with fire clays and local coal beds. Overlie Beulah shales [Morrison fm.] in Black Hills, S. Dak. Is Lower Cret. or Jurassic.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 526). *Lakota fm.*—Massive buff coarse cross-bedded ss. with some intercalated sh. and locally coal beds. Top memb. is dull-yellow ss. Thickness 200 to 300 ft. If not Jurassic it represents earliest deposit of Lower Cret. Contains local unconformities. Underlies Minnewaste ls. and uncon. overlies Jurassic Beulah shales [Morrison fm.]. Included in Dakota ss. of early repts. Name derived from one of tribal divisions of Sioux Indians.

N. H. Darton and C. C. O'Harra, 1909 (U. S. G. S. Belle Fourche folio, No. 164, p. 4). Type loc. of Lakota ss. is Lakota Peak, a summit on hog-back range 4 mi. NW. of Hermosa, S. Dak.

W. W. Rubey, 1930. See under *Inyan Kara group.*

Lalor sands.

Quaternary (probably Recent): Southern New Jersey (Trenton region).

J. B. Woodworth, 1911 (Harvard Univ. Peabody Mus. Am. Arch. and Eth. Papers, App., pp. 238–241). *Lalor sands.*—Eolian sand and rain wash. No stratification, but a well marked secondary structure consisting of irregular bands of inosculating ferruginous clayey material usually horizontal but locally vertical and clearly due to segregation of iron oxides through action of percolating waters. Belong to postglacial period, but appear to be in part contemp. with Trenton gravels to S. and E., at least that part of Trenton gravels that shows signs of wind action. Named for Lalor farm, near Riverview Cemetery, Trenton.

La Luz schists.

Age (?): Mexico.

C. W. Botsford, 1909 (Eng. and Min. Jour., vol. 87, p. 691).

La Luz basalts.

Triassic: Mexico.

A. Wandke and J. Martinez, 1928 (Econ. Geol., vol. 23, p. 8).

Lamar limestone member (of Delaware Mountain formation).

Permian: Western Texas (Delaware Basin).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Lamar ls. memb. of Delaware Mtn fm.*—Black calc. bed, 25 to 30 ft. thick, forming top memb. of Delaware Mtn fm. in Delaware Basin. Within the basin it is a carbonaceous and highly calc. ss. As basin rim is approached the rock grades into ls., and finally becomes pale-gray ls. at base of the escarpment. In places it is overlain by additional Delaware Mtn beds, of ls. and ss., of variable thickness up to probably 100 ft. Underlies Castile anhydrite. Type loc. is escarpment N. of Lamar Canyon, where the canyon is crossed by the Western Gas pipe line, about 15 mi. due E. of Guadalupe Point. This ls. was previously called *Frijole ls.* by Blanchard and Davis, from Frijole P. O., but the similar dark ls. that occurs at Frijole P. O. is an older ls., and the name *Frijole ls.* is therefore abandoned, to avoid confusion.

Lamb dolomite.

Upper Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Lamb dol.*—Lower third largely thick-bedded oolitic and pisolitic dolomites, some of them cross-bedded. Above this lies thick-bedded medium-gray dol. mottled by patches of dol. containing white rods which closely resemble parts of the older Young Peak dol. In upper 150 ft. thinner-bedded dolomites with sandy partings become increasingly abundant, and these grade upward into a ss. that weathers reddish brown, which was chosen to make top limit of fm. This ss. lenses out to N. but a similar lens starts at about same locality a short distance higher stratigraphically. Thickness 1,050 ft. No fossils, but believed to be Upper Camb. because lithologically similar to overlying Hicks dol., which contains Upper Camb. fossils. Overlies Trippe ls. Named for exposures in Lamb Gulch, on N. side of Dry Canyon, Gold Hill dist.

See also U. S. G. S. P. P. 177, 1934, by T. B. Nolan.

Lambton formation.

Devonian: Canada.

E. J. Chapman, 1864 (A popular and practical exposition of the minerals and geology of Canada, p. 195).

Lamoille glacial stage.

A name applied by E. Blackwelder (Geol. Soc. Am. Bull., vol. 42, pp. 911, 918, 1931) to time covered by a Pleist. glacial deposit in Ruby Mtns, NE. Nev., which he correlates with Iowan stage. The largest glacier of this stage, 15± mi. long, issued from Lamoille Canyon, and built a low bulbous moraine upon the plain.

Lamont stone.

Trade name for a stone used in Chicago, Ill., for basements and facings of buildings. Analysis given on p. 92 of Ind. Geol. Surv. 8th, 9th, and 10th Ann. Repts (for 1876, 1877, and 1878), 1879. [Derivation of name not stated.]

Lamotte sandstone.

Upper Cambrian: Eastern and central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 347–358). *Lamotte ss.*—Great body of ss. in SE. Mo., more than 250 ft. thick, immediately overlying Archean crystallines about Mine La Motte Station, but overlying Cambrian Iron Mtn cgl. in Iron Mtn dist., St. Francois Co. Underlies St. Francois or St. Joseph ls.

C. R. Keyes, 1896 (Mo. Geol. Surv. vol. 11, pp. 35–47). *La Motte ss.*—Consists of ss., some sh. and clay, with cgl. at base. Underlies Fredericktown dol. and uncon. overlies Algonkian crystallines.

A. Winslow, 1896 (U. S. G. S. Bull. 132). *La Motte ss.*—Thick massive ss., thinly bedded or flaggy near top; generally yellow or reddish, sometimes white. Thickness 400 ft. Underlies St. Joseph ls. and overlies Iron Mtn cgl.

C. R. Keyes, 1901 (Am. Geol., vol. 28, pp. 51–53). The cgl. called *Iron Mtn cgl.* by Winslow (1896) should properly be part of La Motte ss. It cannot be considered a distinct geol. terrane unless the original signification of title be wholly changed and restricted to the cgls. encircling the peak of Iron Mtn alone. On same horizon of uncon. and over a large area similar cgls. occur. They are usually of local extent, and may properly be regarded as local basal facies of La Motte ss.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 267, p. 21). *La Motte ss.*, 0 to 300 ft. thick, includes, in St. Francois Mtns, a cgl. which has been called Pilot Knob cgl. and Iron Mtn cgl. Some regard it as Algonkian, others as a part of La Motte ss. It is not older than La Motte ss.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines, 2d ser., vol. 16). *Lamotte ss.* probably underlies most of State. Outcrops chiefly in NE. St. Francois and western Ste. Genevieve and Madison Counties. Well records show thicknesses of 50 to 400 ft. Overlies pre-Camb. granites, porphyries, and qtzites.

Named for Mine La Motte Station, Madison Co.

Lamoureux shale (also spelled Lamoureaux).

Devonian: Eureka district, Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 79). *Lamoureux shales*, 300 ft. thick, underlie Atrypa lss. and compose basal fm. of Nevadan series [Nevada ls.] and of Devonic section in Eureka dist. Highly fossiliferous. Named for exposures in Lamoureux Canyon, Eureka dist.

Lampkins sandstone member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 118, 178, 183, 291, etc.). *Lampkins ss. memb. of Carwood fm.*—A stout, angular fine-grained gray to buff ss. bed, 1 to 4 ft. thick, lying 55 to 65 ft. below top of Carwood fm. and 45 to 50 ft. above base of Carwood fm. The overlying beds are alternating ss. ledges and sh. partings. The underlying beds are sh. Thickness ½ mi. E. of Lampkins Bridge (3 mi. SW. of Belmont) and ¾ mi. N. of Lampkins Bridge and 2½ mi. SW. of Belmont is 4 ft. Is absent at Gent. Named for Lampkins Bridge, being shown prominently in nearby ravines and hillsides.

La Muda limestone.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 22). [No age assigned; but H. A. Meyerhoff, 1931 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 276) and 1933 (Geol. of Puerto Rico, p. 44), assigned this ls. to Cret.]

Lana conglomerate.

Pre-Cambrian: Northwestern Vermont (Addison County).

W. G. Foye, 1919 (11th Rept. Vt. State Geol., p. 85). *Lana cgl. (Camb.)*.—Arkose cgl., a few ft. thick, conformably underlying Lower Camb. qtzite and uncon. overlying Proterozoic Mendon dol. just above the Falls of the Lana, N. of Silver Lake [S. part of Addison Co., in Brandon quad.]. This cgl. is never so coarse-grained or thick as Ripton cgl., which writer believes underlies Mendon dol.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 284). *Lana cgl.* consists of quartz cgl. with fragments of older rock in it. Metamorphism has reunited many of the pebbles. [Foyles seems to treat Lana cgl. as distinct fm. underlying Cheshire qtzite, and separated from Mendon dol. by Lana sh.]

Lana shale.

Pre-Cambrian: Northwestern Vermont (Addison County).

E. J. Foyles, 1929 (16th Rept. Vt. State Geol. p. 284). *Lana sh.*—A phyllite with foliation doubtfully cutting across the bedding planes. The mica in it is badly altered and it contains plagioclase feldspars. The rock alternates with slaty-banded ss. [Foyles seems to place his Lana sh. below Lana cgl. and above Mendon dol. Probably named for Falls of the Lana.]

Lanai basalt.

Age (?): Lanai, Hawaiian Islands.

C. K. Wentworth, 1925 (Bernice P. Bishop Mus. Bull. 24, p. 34).

†Lancaster limestone.

Ordovician and Cambrian: Eastern Pennsylvania.

J. P. Lesley and P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_3, map of Lancaster Co.). *Lancaster ls., including argillites.*—Overlies Lower calc. slates and underlies Mesozoic ss. and shales.

Same as Shenandoah ls., which has been mapped over large areas and is now usually divided into several named fms.

Lancaster formation.

Devonian or Carboniferous: New Brunswick.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, pp. 207, 212).

Lance formation.

Upper Cretaceous (except as stated in last entry): Wyoming (widespread), Montana (widespread), western North Dakota and South Dakota, and northwestern Colorado.

J. B. Hatcher, 1903 (Am. Geol., vol. 31, pp. 369–375). *Lance Creek (Ceratops) beds.*—The name *Ceratops beds* cannot be used for these Wyo. deposits, and I give to them the above name, from the principal stream in the region where they are best represented, in Converse Co., Wyo. That these beds conformably overlie the Fox Hills in this region has been published by present writer, who spent nearly 4 full years collecting from them, and been abundantly corroborated by investigations of T. W. Stanton and F. H. Knowlton. [On p. 374 he calls these beds the *Laramie (Lance Creek) beds of Converse Co., Wyo.*] The beds are overlain by the Fort Union.

See definition of †*Ceratops beds.*

T. W. Stanton, 1910 (Am. Jour. Sci., 4th, vol. 30, pp. 172–188). *Lance fm. ("Ceratops beds").*—The name *Lance fm.* has recently been adopted by U. S. Geol. Survey for the "Ceratops beds" of eastern Wyo. and adjacent areas. It is an abbreviated form of *"Lance Creek beds"* which J. B. Hatcher applied to these deposits in 1903 (Am. Geol., vol. 31, p. 369), with the statement that the name is taken "from the principal stream in the region where they are best represented, in Converse Co., Wyo." At present one of most important points at issue is relationship of Lance fm. to Laramie fm. and to the conformable Cret. sequence beneath the Laramie. Some geologists hold that the Lance fm. wherever it has been studied rests uncon. on the Laramie or some older fm., and that the uncon. beneath it represents a long complex epoch of elevation and erosion. In this paper evidence will be presented to show that in the rather widely distributed areas discussed there is a real transition from the marine Cret. Fox Hills ss. into Lance fm. and that sedimentation was practically continuous from the one into the other and probably on through the [overlying] Fort Union. If it is true that there is a transition with practically continuous sedimentation from Fox Hills ss. into Lance fm. in region discussed, then Lance fm. includes or forms part of the Laramie.

See also under *Cannonball marine memb. of Lance fm.*

The age of the Lance fm. and its relation to true Laramie fm. of Denver Basin (of unquestioned Upper Cret. age) are still disputed questions among American geologists, in view of which the U. S. Geol. Survey for many years tentatively classified Lance fm. as *Tertiary? (Eocene?)*. In consideration, however, of the accumulated evidence of a large amount of additional field work, extending over a period of many years, this age designation was modified as follows, in Dec. 1935: (1) The Hell Creek and Tullock deposits (previously classified as members of Lance fm.) were raised to fm. rank; (2) the age of Hell Creek fm. was changed to *Upper Cret.*; (3) the age of Tullock fm. was changed from *Tert. (?)* to *Upper Cret. or Eo.*; (4) in areas in Mont. and NE. Wyo. where the Hell Creek and Tullock are not recognizable, the age of the Lance was changed to *Upper Cret.*, except where Eo. fossils are found above Cret. fossils, in which case the age of the Lance is to be *Cret. and Eo.*; (5) the age of the Lance in other parts of Wyo. (outside NE. part of State) is to be *Upper Cret.*, no Eo. flora having been reported from these areas; (6) the age of Arapahoe fm. was changed to *Upper Cret.*; and (7) the age of the Dawson arkose and Denver fm. was changed to *Upper Cret. and Eo. (?)*.

Named for exposures on Lance Creek, Niobrara Co., Wyo. (formerly a part of Converse Co.).

Lance Cove formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Lance Cove fm.*—Sss. and shales, underlying McGraw bed and uncon. overlying Little Bell Island fm. Included in Bell Island series.

†Lance Creek beds.

See *Lance fm.*

Landaff granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map, p. 28). *Landaff granite.*—Fine-grained massive pink to gray hastingsite granite. Late Dev. or late Carbf. Is related to White Mtn magma series. [Mapped over NE. part of Landaff Twp.]

Lander sandstone member (of Bighorn dolomite).

Upper Ordovician (Richmond): Western Wyoming (Wind River Mountains).

A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 196–213). *Bighorn fm.* of NE. slope of Wind River Mtns, Wyo., consists of: (1) A very fossiliferous, thin, basal ss. memb., 1 to 4 ft. thick (here named *Lander ss.*, from exposures about 10 mi. SW. of Lander, Wyo.); (2) a massive dol. memb. about 300 ft. thick in NW. part of range and less than 150 ft. in SE. part of range; and (3) an upper dol. memb., about 25 ft. thick (the *Leigh dol.* of Blackwelder). [Lists and discusses fauna of Lander ss. (135 sp.) and concludes that it is of Richmond age and a southern extension of a widespread Arctic fauna of that age.] "Available evidence indicates Lander ss. is to be correlated with basal ss. memb. of [typical] Bighorn fm. of Bighorn Mts." [He therefore concludes all of Bighorn dol. is of Richmond age.]

Landes limestone.

Middle Devonian: Northeastern West Virginia.

D. B. Reger, 1924 (W. Va. Geol. Surv. Rept. on Mineral and Grant Counties, pp. 313, 745). *Landes ls.*—Dark, highly fossiliferous ls., present in form of good-sized nodules scattered through 1 to 5 ft. of brown sh. at extreme top of Hamilton series [fm.] in Mineral and Grant Counties. Contains Hamilton fossils.

Named for occurrence in public road along North Mill Creek 0.2 mi. N. of Landes, S. part of Grant Co.

Landgraff sandstone. (In Pocahontas formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 235). *Landgraff ss.*—Massive, medium grained, micaceous, buff, 0 to 25 ft. thick. Underlies Pocahontas No. 1 coal and overlies Landgraff coal. Once quarried at Landgraff, McDowell Co. Belongs in Pocahontas group.

Landisburg sandstone.

Silurian: Central Pennsylvania (Perry County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 761–777). In Rept. F_2 this is called *Bloomfield ss.*, but I have changed the name to ***Landisburg***, where it is equally remarkable, so as to avoid confusion btw. the names Bloomfield and Bloomsburg. The Landisburg ss. lies in Middle Salina shales. At Landisburg, Perry Co., it is 42 ft. thick, and consists of (descending): Hard olive sh. and ss. with *Leperditia alta*, 3 ft.; red sh. and ss., 15 ft.; gray ss. with *L. alta*, 4 ft.; and red sh. and ss., 20 ft. It is underlain by gray and yellow sh. and overlain by 6 ft. of ls. and sh. with wrinkled surfaces. [After giving above section of Landisburg ss. he says: The *Landisburg ss. proper* is a thin bed of soft friable sandrock, breaking up into brick-shaped fragments, varying in color from dull reddish to olive greenish. Its outcrop, sometimes 10 ft. thick, makes low ridge traceable across Centre Twp, passing under New Bloomfield. He also calls this soft friable sandrock the *Landisburg fish-bed ss.*, and says that *L. alta* occurs in great abundance in "this little group of beds."]

Landston formation.

Middle Cambrian: Utah.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38), in table giving "General geol. section of Utah," listed (descending): Spence sh., 100 ft.; *Landston* (lss.), 500 ft.; uncon.; Pioche (early Camb.). Derivation of *Landston* not stated.

Lane shale. (Of Lansing group, in Kansas.)

Lane shale member (of Lansing formation, in Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1895 (Kans. Univ. Quart., vol. 3, p. 277, and pl. opp. p. 290; Am. Jour. Sci., 3d, vol. 50, p. 460 and pl. opp. p. 466). *Lane shales*.—Shales, with heavy ss. at top and many ss. beds scattered throughout, varying in thickness from thin to 150 ft. Underlain by Carlyle ls. and overlain by Garnett ls.

E. Haworth and J. Bennett, 1908 (Univ. Geol. Surv. Kans., vol. 9), defined *Lane sh.* as overlying Iola ls. and as separated from the higher Vilas sh. by a ls. which they called *Allen ls.* (=*Carlyle ls.*), and stated that Garnett ls. of Haworth and Kirk included (ascending) Allen [Plattsburg] ls., Vilas sh., and Stanton ls.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). *Lane sh.* (basal memb. of Lansing fm.) overlies Iola ls. and underlies Plattsburg ls., which is lower bed of "Garnett" ls. and is the ls. exposed at Carlyle, Kans., according to Kans. Geol. Survey. [This definition of Lane sh. was followed by Kans. Geol. Survey until 1931, when R. C. Moore (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart) restricted *Lane sh.* to lower part of Lane sh. of previous repts, and defined it as separated from overlying Plattsburg ls. by (ascending) Argentine ls., Island Creek sh., Farley ls., and Bonner Springs sh.]

Early in 1932 (Jan. or Feb.) G. E. Condra, R. C. Moore, and C. O. Dunbar transferred Lane sh. and their overlying Argentine ls. to Kansas City group. (See Nebr. Geol. Surv. Bull. 5, 2d ser., p. 17, table opp. p. 18.) Later in 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3) Moore still further restricted *Lane sh.* by introducing two more named units (Frisbie ls. and Quindaro sh.) btw. Argentine ls. and Lane sh., and stated that this restricted Lane sh. was typical Lane sh. R. C. Moore and G. E. Condra adhered to this latter definition in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 55–58). Haworth applied *Lane* to 100 ft. of sandy sh. btw. 2 prominent lss. near town of Lane. The lower ls. was correctly identified by Haworth as Iola. The upper ls., capping the scarp at Lane, is not Allen (Plattsburg ls.), as Haworth thought, but is a third ls. lying btw. the Iola and the Plattsburg. This ls. (Wyandotte of this rept.), although very prominent around Lane and northward to Kansas City and beyond, pinches out near Greeley in NE. Anderson Co. It is clear the early workers recognized only 2 lss. immediately succeeding Lane sh., whereas there are 3 in NE. Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 117). *Lane sh.* overlies true Iola ls. at Lane type loc. Field studies have shown that ls. next above Lane sh. at Lane is not †Allen (Plattsburg) ls., but a lower fm. that is absent in Allen Co. The base of Plattsburg ls. does not mark upper bdy of Lane sh., as inferred by several geologists. The ls. next above Lane sh. is traced into ls. now called *Argentine ls.* The Lane as thus defined is variable in lithology and thickness. In places, mostly where it is thin, i. e., 15 to 35 ft. thick, it is wholly dark bluish-gray clayey sh. Where thick (50 to 110 ft.) most of the sh. is sandy and micaceous, light gray to yellowish brown or buff, with carbonaceous streaks but no coal beds. It is persistent from E. part of Miami Co., Kans., to NE. and N. Has been recognized in northern Mo., Iowa, and in Platte Valley, Nebr. Disappearance of Wyandotte ls. a short distance S. of Lane makes it impossible to recognize upper bdy of Lane sh., and in that region Lane is combined with overlying sh. under designation *Lane-Bonner Springs sh.* This combined unit (75 ft. thick near Iola and 60± ft. in southern Kans.) is dark bluish or bluish-gray clayey to fine silty sh. [On p. 45 Moore showed *Lane sh.* of his "revised classification" as underlying Frisbie ls., as overlying Raytown memb. of Iola ls., and as included in Kansas City group.]

The U. S. Geol. Survey has not yet had occasion to consider, for its publications, the modified definitions of Lane sh. and its transfer to Kansas City group.

Named for exposures at Lane, Franklin Co., Kans.

Lanesboro member (of New Milford formation).

Upper Devonian: Northeastern Pennsylvania (Susquehanna County).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571–589). Where basal Kingsley red sh. is present the remainder of New Milford fm. may for convenience be referred to as *Lanesboro memb.*, from exposures near Lanesboro, Susquehanna Co. In general the Lanesboro memb., or *New Milford fm.* as a whole, where the Kingsley is absent, consists of greenish to grayish flags; some massive; many cross-bedded. Upper part often forms cliffs. Max. thickness in Susquehanna Co. 400–500 ft.

†Laneville shale.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 108). *Laneville shales.*—Shales, 75 to 100 ft. thick, with several beds of valuable ss. Overlies Oswego ls. [Fort Scott ls.] and underlies Erie ls. Includes Fort Scott flagstones.

As thus defined apparently extended from top of Fort Scott ls. up to base of Hertha ls., which is basal bed of †Erie ls., according to R. C. Moore, 1936.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 60, 62–67, 72). †Laneville sh. of Haworth and Kirk included Labette sh., Pawnee ls., Bandera sh., Altamont ls., Nowata sh., Lenapah ls., Memorial sh., Bourbon fm.

Named for exposures at Laneville, Labette Co., Kans.

Laney shale member (of Green River formation).

Eocene: Southwestern Wyoming (Sweetwater County) and northwestern Colorado (Moffat County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Laney sh. memb. of Green River fm.*—Thin-bedded sh., ss., and lss., some of which are oolitic; also some dark-colored bituminous sh. Thickness 0 to 950 ft. Uncon. underlies Plant beds and Tower ss. of Powell, which compose upper part of Green River fm., and uncon. overlies Cathedral Bluffs red beds memb. of Green River fm. [now called Cathedral Bluffs tongue of Wasatch fm.]. Named for Laney Rim, Sweetwater Co., Wyo.

†Lang division.

Tertiary: Southern California (Los Angeles County).

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349–372). *Lang div.*—A great bed of gravel and sand of buff color; red and brown lava cobbles plentiful. Thickness 3,000 ft. Has appearance of delta of a large river flowing westward on approx. site of Soledad Canyon. May be marine in W. part of basin. Conformably underlies Soledad div. and uncon. overlies Mellenia series. Named for exposures at Lang, Los Angeles Co.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753, p. 81). The "Lang div." of Hershey is thought by writer to be equiv., in greater part at least, to upper part of Mint Canyon fm. (upper Mio.) of this rept.

Langara quartz diorite.

Jurassic: British Columbia.

J. D. MacKenzie, 1916 (Canada Geol. Surv. Mem. 88, p. 52).

Langston limestone.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 6, 7). *Langston fm.*—Massive-bedded bluish-gray ls. with many round concretions. Thickness 107 ft. in Blacksmith Fork Canyon, Cache Co., Utah, and 30 ft. W. of Liberty, Bear Lake Co., Idaho. Middle Camb. fauna. Most readily accessible locality is in Blacksmith Fork, Cache Co., Utah, but strike of beds carries fm.

into valley of Langston Creek, Bear Lake Co., Idaho. Underlies Ute fm. and overlies Brigham. fm. [qtzite].

†Lang Syne beds.

Eocene (lower): Central South Carolina (eastern part of Calhoun County).

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 449, 451–452). At Lang Syne and Warley Hill the Congaree shales rest on fine-grained, black, slightly glauconitic sands, and partly indurated gray sands, both of which contain tender casts of small shells. We shall refer to them as the *Lang Syne beds.* Stratigraphically they belong below the Congaree shales, and are tentatively treated as part of the Black Mingo, pending further investigations. [In table on p. 449 Sloan tentatively placed his Lang Syne beds above his Williamsburg pseudobuhr.]

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Lang Syne beds of Sloan are here tentatively referred to lower part of Black Mingo fm. (of Wilcox age), and name is abandoned. They rest uncon. on Tuscaloosa fm. near Fort Motte, Calhoun Co.

Named for exposures at Lang Syne plantation, Calhoun Co.

Lanoria quartzite.

Pre-Cambrian: Western Texas.

G. B. Richardson, 1909 (U. S. G. S. El Paso folio, No. 166). *Lanoria qtzite.*—Mass of pre-Camb. qtzite that outcrops along E. flank of Franklin Range. Consists of alternating layers of thick- and thin-bedded qtzite; some beds almost white, others dark-colored, prevailing tint being gray. The qtzite is fine-textured and thoroughly indurated. Thickness 1,800± ft. No fossils. Is cut by thin sills and dikes. Uncon. overlain by rhyolite porphyry. Base not exposed. Named for exposures just W. of an old settlement near base of Franklin Mtns, 8 mi. NE. of El Paso.

†Lanphier beds. (In Cheyenne sandstone.)

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 367). *Lanphier beds.*—Incoherent, more or less shaly sands, sometimes passing into shales, often heavily charged with carbonaceous matter, pyrites of iron and selenite crystals, and including numerous fragments of lignite. Thickness 10 or 15 ft. Basal part of Elk Creek beds. Overlain by Stokes ss. and underlain by Corral ss.

This name was discarded by U. S. Geol. Survey in 1921, the beds being a local facies of Cheyenne ss. and without strat. value. (See also last entry under *Cheyenne ss.*)

Named for draw running through Lanphier claim ("which may be called Lanphier Draw"), in SE. corner of Kiowa Co.

Lansdale shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1893 (Pa. Geol. Surv. geol. and topog. map of Bucks and Montgomery Counties) and 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, pp. 2589–2638). *Lansdale shales.*—Red shales with a few scattered green layers, 4,700+ ft. thick. Underlie Perkasie shales and overlie Gwynedd shales. Underlie Lansdale, Montgomery Co., and a broad area.

Corresponds to basal part of Brunswick sh. of Newark group.

L'Anse series.

Age (?): Northeastern Michigan.

T. B. Brooks, 1873 (Mich. Geol. Surv. vol. 1, pt. 1, pp. 151–155), described, but did not name, the rocks of L'Anse iron dist. On p. 155, under heading *Huron Bay slates,* he stated that those slates, with associated rocks, "may be regarded as belonging to L'Anse series, although more than 10 mi. away in a NE. direction."

Lanse à Loup series.

Pre-Cambrian: Newfoundland.

N. C. Dale, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 421).

L'Anse au Loup limestones.

Cambrian: Canada (St. Lawrence Valley).

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 197).

Lansing group, in Kansas.

Lansing formation, in Missouri.

Pennsylvanian: Missouri, Kansas, southeastern Nebraska, Iowa.

H. Hinds, 1912 (Mo. Bur. Geol. and Mines, vol. 11, 2d ser., p. 7). *Lansing fm.*—Lower half or two thirds consists of sh. and ss. with ls. only locally important. Top of fm., however, is Stanton ls. memb., 14 to 25 ft. thick. Thickness of fm. 140 ft. in Platte Co. and 100 ft. farther NE., near Iowa line. Overlies Kansas City ls. and underlies Douglas sh.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13, pp. 28, 156). *Lansing fm.*—Is distinct fm. from overlying Douglas fm., containing more ls. than Douglas. Includes (descending) following members: Stanton ls., Vilas sh., Plattsburg ls., and Lane sh. Overlies Kansas City fm., the top memb. of which is Iola ls.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3, p. 99). A very important faunal break, clearly defined by Beede and Rogers and Girty, occurs at top of Kansas City fm. (the top memb. of which is Iola ls.). Accordingly the beds above Iola ls. which were formerly included in Pottawatomie fm. have been separated from underlying beds and named, from typical outcrops in vicinity of Lansing, near Leavenworth, Kans., the *Lansing fm.* Faunally the Lansing appears to be continuous with overlying Douglas fm., but as latter differs lithologically from the Lansing, and has been well defined in literature for some time, it seems desirable to recognize both fms. Includes (descending) following members: Stanton ls., Vilas sh., Plattsburg ls., and Lane sh. [This was generally accepted definition of Lansing group until 1931.]

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), redefined *Lansing group* by including in its top Weston sh., Iatan ls., and lower part of Lawrence sh. of established usage, and by excluding from its base the upper part of Lane sh. memb.

R. C. Moore, Aug. 28 to Sept. 3, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook), again redefined his *Lansing group* by excluding at top the Weston sh., Iatan ls., and lower part of Lawrence sh., to which latter bed he applied new name *Hardesty sh.* The 3 latter units he assembled under new name *Pedee group.*

R. C. Moore and G. E. Condra, Oct. 1932 (revised classification chart of Penn. rocks of Kans. and Nebr.), again redefined *Lansing group* by drawing its base at base of Plattsburg ls., and including in it the overlying Vilas sh. and Stanton ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 70). Bdy btw. Kansas City and Lansing divisions as originally defined can not be recognized, either lithologically or faunally, in Kans. S. of Johnson Co., because Farley ls. coalesces with Argentine ls. Moore therefore proposes to redefine Lansing to include only Plattsburg ls., Vilas sh., and Stanton ls. This usage corresponds to *Garnett ls.* of early Kans. Surv. [which has long priority]. [See under *Garnett ls.*]

These modified definitions have not been considered by U. S. Geol. Survey for its publications. The 1933 (57th) Bien. Rept. of Mo. Geol. Surv. continues to draw top of the Lansing at top of Stanton ls. and base at top of Iola ls.

Lansing moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Lansing.

Lantern Hill quartz rock.

Age (?): Connecticut.

H. E. Gregory, 1906 (Conn. State Geol. and Nat. Hist. Surv. Bull. 6, p. 136).

Laona sandstone.

Upper Devonian: Western New York (Chautauqua County).

J. Hall, 1841 (N. Y. Geol. Surv. 5th Ann. Rept., p. 177). Quarries have been opened at Shumla on Canadawa Creek, and at Laona on same stream. The mass at

Laona was noticed by Dr. Beck, and in his rept was called *Laona ss.* Is somewhat peculiar in character, being much thicker here than in other parts of county. Is about 5 ft. thick. Upper 3 ft. often forms a single course. Is highly bituminous. Thins to S. and at Westfield it is about 1 ft. thick and considerably changed in character. The *Laona ss.* appears to have been deposited in a depression of the strata below, which causes it to grow thinner on either side.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 25 and chart). *Laona ss.* of Chautauqua Co. is a basal memb. of Chemung series.

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1026–1029). *Laona ss.* was named for exposures [in Canadaway Creek] at Laona. [Appears to be included in Portage group.] No other representatives of Portage fauna were found above Laona ss. On lower surface of thin ss. 10 ft. higher and in subjacent shales, Chemung brachiopods are common. Lies 260 to 280 ft. below Shumla ss. Rests on Portland gray sh.

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, p. 214). In Lake Erie section (Erie and Chautauqua Counties) there comes in above the Portland light-colored shales and thin flags a ss., 22 ft. thick, carrying Chemung brachiopod fauna, termed by James Hall the *Laona ss.*, exposed at Laona [Chautauqua Co.], Forestville, Brocton, etc.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 79 and chart). *Laona ss.* (1903 Clarke) is=lower part of Nunda ss. The fauna, while mainly Chemung, contains a few cephalopods suggestive of the Portage. [Chart states that Nunda ss. of Portage beds includes at base the Laona ss.]

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157), and 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), included Laona ss. and underlying Gowanda beds (also the still older Dunkirk sh.) in Chemung, and applied *Westfield sh.* to beds above the Laona.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), divided Chemung of western N. Y. into (descending) Chadakoin beds, Cuba ss., Northeast sh., Shumla ss., Westfield sh., Laona ss., Gowanda sh., and Dunkirk sh. But G. H. Chadwick (1933, 1935, etc.) transferred to his Canadaway group (q. v.) all beds from top of Northeast sh. to base of Dunkirk sh.

Lapara sand member (of Goliad sand).

Tertiary (Pliocene): Southern Texas.

E. T. Dumble, 1893 (Brown coal and lignite of Texas, p. 154). [No definition except that *Lapara beds* rest uncon. on Fayette div.]

E. T. Dumble, 1894 (Jour. Geol., vol. 2, pp. 559–560). *Lapara beds or div.*—Coarse, sharp sands and light-red, green, and other colored clays interbedded and somewhat cross-bedded. Underlies Lagarto div. and overlies Miocene Oakville. Assigned to Plio.

A. Deussen, 1924 (U. S. G. S. P. P. 126, p. 100). *Lapara sand* consists of sand and interbedded and cross-bedded limy clay. The sand is sharp, coarse, and friable and contains clay pebbles and lime concretions. The clay is of several colors—pink, light red, green, etc. At some places it contains lime nodules and at others clay pebbles. Thickness 75 to 455 ft. in well records. Is exposed on Nueces River, where it lies uncon. (?) on Oakville ss. and conformably (?) below Lagarto clay. Named by Dumble after Lapara Creek, Live Oak Co., Tex., where it is typically displayed.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 751, 753, 754). San Antonio committee on geologic mapping decided to include Lapara sand in the new Goliad fm., and to draw base of Goliad at base of Lapara gravel beds [shown as basal bed of Lapara sand memb. of Goliad fm.], which rest on underlying Lagarto fm. [restricted]. The memb. is typically exposed on Nueces River SE. of Mikeska on Manahuilla Creek, 4 to 5 mi. NE. of Goliad, and on Guadalupe River SE. of Cuero. The type loc. comprises the exposures along Lapara Creek, in Live Oak Co. According to H. T. Richardson it is a more or less continuous layer of sand and gravel, 15 to 20 ft. thick, that can be traced across central Tex. and mapped from Nueces River to Guadalupe River. Consists of cgl., cross-bedded sand, and limy clay. The cgl. is composed of cobbles that range up to 6 inches diam., clay balls, sand, and much reworked material, such as bone fragments and bits of fossilized wood. The sand is coarse, friable, and contains clay pebbles, calc. concretions, and lentils of red and green clay. The clay is irregularly bedded and contains pebbles and nodules similar to those in the cgl. The Lapara sand memb. is uncon. [errata sheet dated Dec. 11, 1933] overlain by Lagarto Creek beds.

The U. S. Geol. Survey follows Plummer's definition of Goliad sand, and treats Lapara sand as basal memb. of the Goliad.

†La Plata sandstone.

Upper Jurassic: Southwestern Colorado and southeastern Utah.

C. W. Purington, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, p. 759; named by W. Cross). Lying directly on the Trias (mostly red sss.) in Telluride quad., Colo., is lower memb. of Jura. It consists of friable medium-grained white ss., of massive appearance, which has a thickness of 50 to 100 ft. It has been called La Plata ss. by W. Cross, owing to its extensive development in La Plata Mtns, to S. It includes a layer of black impure ls. 8± ft. thick. The upper memb. of Jura is Gunnison sh., about 700 ft. thick.

W. Cross, 1898 (geol. map accompanying rept cited above, the areal geology of which is by Cross). *La Plata ss.*—Two white ss. layers with dark ls. btw. them. Underlies Gunnison fm. and overlies Dolores fm.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). It is proposed to name lower memb. of Gunnison fm. after La Plata Mtns, on account of its prominent and characteristic exposures in peaks and on slopes of that mtn group. From dominant development of white ss. in Telluride and other quads, it is there quite appropriate to call this fm. *La Plata ss.*, but it is known that the thin ls. of Telluride area represents a much more extensive series of shales, etc., in some other regions. In this quad. *La Plata fm.* consists of 2 massive ss. members separated by a thin dense bluish or almost black ls. 6 to 16 ft. thick. Total thickness here is seldom more than 100 ft. The sss. here are very light gray or white, but in many places, especially to S. and W., a distinct or even brilliant coloring in varying shades of red or orange has been observed in the lower ss. But the contrast with the bright-red strata of underlying Dolores fm. is very striking. The 2 ss. members are usually of similar character, but in this quad. the upper one is sometimes thin bedded and shaly and much less prominent than the lower. The upper ss. layer is succeeded by a highly colored sh., taken as lowest stratum of McElmo fm. The McElmo is Gunnison fm. restricted of Purington. Type Gunnison includes McElmo and La Plata.

See explanation under †*McElmo fm.*, for reasons for abandonment. Also see U. S. G. S. P. P. 183, 1936, by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., for details regarding the units into which the La Plata ss. of different authors, in different areas, is now divided.

†La Plata limestone.

Name locally applied by miners to ½ ft. to 8 ft. of ls. forming basal bed of Morrison fm. (Upper Jurassic) in La Plata dist., SW. Colo.

Lapoint horizon. (In Duchesne River formation.)

Oligocene: Eastern Utah (Uinta Basin).

See under *Randlett horizon.*

La Posta quartz diorite.

Late Jurassic or early Cretaceous: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 115–141, map). *La Posta quartz diorite.*—Large typical exposures occur in general vicinity of La Posta Valley, southern Peninsular Range. Probably youngest of late Jurassic or early Cret. intrusive series.

Laramian series.

A term used by C. R. Keyes to cover Laramie fm. and supposedly contemp. deposits. He calls the underlying deposits "Masukian series."

Laramide revolution.

A period of mountain building and erosion in Rocky Mountain region that began in late Cret. time and ended in early Tert. time. "The Laramide system of mtn ranges, including Wasatch Range, extends along summit of Rocky Mtns far northward into B. C. and southward into Mexico. In B. C. just N. of Mont. the upturned belt lies E. of the Archean protaxis. In U. S. it occupies the summit region of the mtns, btw. the line of the Wasatch Archean and the Front Range or protaxis." (J. D. Dana, 1895, Textbook geol. 4th ed., p. 359.)

Laramie formation.

Upper Cretaceous: Denver Basin region of eastern Colorado.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, maps 1 and 2). [The maps are dated 1875, and copies were distributed before issuance of the Atlas, which is dated 1876. *Laramie* (latest Cret.) is shown as overlying Fox Hill and underlying Vermilion Creek (Eo.) in NW. Colo. and southern Wyo. On map 1 the Laramie is mapped as far S. as S. part of Weld. Co. in NE. Colo., where it is shown as overlain by Quat. Beds around Carbon, Wyo., and far to W. are mapped as *Laramie*.]

F. V. Hayden, 1876 (U. S. Geol. Surv. Terr. 8th Ann. Rept., pp. 20–27, 40–46). *Lignitic or Laramie group.*—Occupies very large area along Upper Missouri and Yellowstone Rivers and extends far N. into British Possessions. Has been traced S. in broad continuous belt across Yellowstone River, btw. Black Hills and Big Horn Mtns, until overlapped by White River group about 60 mi. N. of Fort Laramie. Southward along E. base of Laramie Range it reappears about 10 mi. S. of Union Pacific R. R. The Laramie Range formed a barrier that prevented White River group from extending into Laramie Plains, but evidence is clear that at time of existence of the great Lignitic lake or sea this barrier did not prevent water communication with Laramie Plains. With exception of Bear River and Coalville group we may connect the coal-bearing beds of Laramie Plains and Colo. with the vast group in the Northwest. Everywhere it rests on Fox Hills group. [Hayden's 1874 rept. stated that he had traced "Lignitic group" without interruption along E. base of Rocky Mtns S. to near Laramie Peak, "where it is overlapped by White River deposits." As defined above Laramie "group" included Lance, Fort Union, and Wasatch fms. of present terminology.]

On pp. 40 to 46 of above (1876) rept Hayden described *Lignitic or Laramie group* of Colorado Springs and vicinity as older than his Monument Creek group, and as overlying Fox Hills "group", as he called it. According to G. B. Richardson (U. S. G. S. Castle Rock folio, No. 198, 1915) Hayden's Monument Creek group included (descending) Castle Rock cgl. (Olig.) and Dawson arkose (=Denver and Arapahoe fms.), of Eo. age. The beds btw. Monument Creek group of Hayden and Fox Hills ss. in Denver Basin region, or Laramie fm. as originally defined in this area, consist of 600 to 1,200 ft. of brackish and fresh-water sandy and clay sh. with some thin sss. and in places 200 ft. of white ss. at base.

A. Hague, 1877 (U. S. Expl. 40th Par. Rept., vol. 2, pp. 28, 58–65), described *Laramie div.* of the Cret. plains of Colo. E. of the Colorado or Front Range. (Vol. 1, in which King defined the Laramie, was not published until 1878.) Hague gave thickness in eastern foothills of Colo. as 1,500 ft., and defined Laramie as uncon. overlain by Plio. or Quat. and as grading into underlying Fox Hills ss. His measured section was on Denver Pacific R. R. 5 or 6 mi. W. of Carr Station and about 18 mi. SE. of Cheyenne, Wyo.

C. King, 1878 (U. S. Expl. 40th Par. Rept., vol. 1, pp. 298, 331, 350, etc.). *Laramie group.*—Marine sss. of variable character; beds of lignite and seams of carbonaceous clay characterized throughout by molluscan forms of both salt- and brackish-water types and by several important zones of plant-bearing beds. Thickness 1,500 to 5,000 ft. The last of the conformable marine Cret. It is Lignitic series of Meek and Hayden in Upper Missouri section. Dr. Hayden has successively considered these rocks as Tert. and as transitional btw. Cret. and Tert. They conformably overlie Fox Hill of Meek and Hayden, and are developed throughout large part of Wyo. as well as upon the great plains E. of Rocky Mtns S. of 41st par. That there might be no misunderstanding as to strat. position and nature of the rocks themselves, Dr. Hayden and I mutually agreed to know them hereafter as *Laramie group*, and to leave their age for present as debatable ground, each referring them to the horizon which the evidence seemed to him to warrant. The result of our investigations leads me to distinct belief of their Cret. age. Le Conte, Newberry, Stevenson, and Powell have all committed themselves to view advanced by me in 1870, that the whole of the conformable series is Cret. Dinosaurs are found at very summit of *Laramie group*. The fauna up to base of Laramie is strictly marine. The Laramie itself carries the remains of an estuarial or brackish-water life associated with strictly Mesozoic saurians. The most important uncon. in whole Cordilleran region is at top of Laramie group, which is overlain by Vermilion Creek group (=Wasatch group of Hayden).

F. V. Hayden, 1878 (U. S. Geol. Surv. Terr. Rept., Mon. 7, pt. 2, p. iv). If objection is made to use of *Lignitic group* I would say that in this work it is restricted to a series of coal-bearing strata lying above Fox Hills group, or Upper Cret., and these are embraced in the Laramie and Fort Union groups. It is well known that there are in various parts of the West, especially along fortieth parallel and southwestward, very thick beds of coal in the divisions of the Cret., extending down even into upper Jurassic. Had this not been the case, the more general term *Lignitic* would not have been retained by the Survey in preference to any other. The facts as we understand them at the present time would seem to warrant this general division, viz, a marine series, Cret.; gradually passing up into a brackish water series, Laramie; gradually passing up into a purely fresh-water series, Wasatch. It is also probable that the brackish-water beds on the Upper Missouri must be correlated with the Laramie, and that Wasatch group as now defined and Fort Union group are identical as a whole, or in part at least. [Although deposits now recognized as belonging to true Fort Union fm. have in the past been included in both Wasatch fm. and so-called Laramie fm. of southern Wyo. and NW. Colo., the Wasatch fm. as now recognized overlies Fort Union fm. as now interpreted. See under *Fort Union fm.*]

See further explanation under †*Lignite fm.* The Laramie as mapped by King, Hayden, and other early workers covered large areas in Rocky Mtn region, and as more detailed geologic work in that region progressed it was found that the name *Laramie fm.* had been applied to rocks of different origin and of definitely both Upper Cret. and Eo. age, and also to rocks whose age is still questioned. Thus "What is the Laramie fm.?" became a burning question among American geologists. In order to retain the name in the literature the U. S. Geol. Survey in 1910 decided to, for the present, restrict *Laramie* to Denver Basin region, and, after 20 years of disconnected study, it is still thus restricted, while the age of the probably equiv. Lance fm. of Wyo. and other areas to N. and E. long remained undecided, being classified as *Tert.* (?). (See *Lance fm.*) The rocks in Carbon Co., Wyo., that were called *Laramie* by the early workers are now divided into (descending) Ferris fm. (Eo. and Upper Cret.) and Medicine Bow fm. (Upper Cret.). The so-called Laramie of other parts of Wyo., of Mont., of the Dakotas, and of NW. Colo. is now divided into Fort Union fm. (Eo.) and Lance fm. (Upper Cret.). The so-called Laramie of SW. Colo. is now divided into (descending) McDermott fm., Kirtland sh., Fruitland fm., and Pictured Cliffs ss., all Upper Cret.

Lardeau diabase schists.

Post-Carboniferous (?): British Columbia.

M. F. Bancroft, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. B, p. 36).

Lardeau series.

Pre-Cambrian: British Columbia.

J. F. Walker and M. F. Bancroft, 1929 (Canada Geol. Surv. Mem. 161, p. 11).

Larder Lake series.

Pre-Cambrian: Ontario and Quebec.

M. E. Wilson, 1912 (Canada Geol. Surv. Mem. 17, p. 20) and 1918 (Canada Geol. Surv. Mem. 103, p. 52).

Lares shales.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

Lares formation of Puerto Rico assigned to Olig. by H. A. Meyerhoff, 1933 (Geol. of Puerto Rico, p. 67).

Lares limestone of Puerto Rico assigned to upper Olig. by C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 466).

†Largo beds.

Eocene (lower): Northwestern New Mexico.

W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, pp. 205–207). Wasatch group of NW. N. Mex. consists of red, gray, and ocherous bands of sh. and ss., with no evident uncon. throughout the series. It is here separated into two faunal divisions, the upper, here named *Largo beds*, 333± ft. thick, characterized by genus *Meniscotherium*, and similar in appearance to the lower (Almagre) beds, except that red strata are more dominant. The lower, or *Almagre beds* are 666± ft. thick, characterized by absence of all perissodactyls except *Eohippus*. The Largo beds are named for Largo Arroyo and Almagre beds for Almagre watershed. The Wasatch uncon. overlies Torrejon fm.

The U. S. Geol. Survey does not apply geographic names to faunal zones, and has therefore discarded the use of "Largo beds" and "Almagre beds."

Larimer sandstone member (of Pierre shale).

Upper Cretaceous: Central northern Colorado (Larimer County).

M. W. Ball, 1924 (A. A. P. G. Bull., vol. 8, pp. 81–87). *Larimer ss.*, 141 ft. thick, was first discriminated by A. T. Schwenneson, E. W. Krampert, and C. H. Henley as distinct from Hygiene ss., and was mapped and named by them [unpublished repts] "Waverly ss.," but that name being preoccupied, writer substitutes for it the name *Larimer ss.* It lies 171 ft. below Richard ss. and 163 ft. above Rocky Ridge ss. Is exposed in Larimer Co. canal in sec. 24, T. 8 N., R. 69 E., on W. flank of Fort Collins structure. Can also be studied about 1 mi. E. of village of Waverly, Larimer Co. [See also 1924 entry under *Hygiene ss. memb.*]

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B). *Larimer ss. memb. of Pierre sh.* is 0 to 150 ft. thick, lies 100 to 200 ft. below Richard ss. memb. and 0 to 170 ft. above Rocky Ridge ss. memb.

Larke dolomite.

Lower Ordovician (Beekmantown): Central Pennsylvania (Blair and Huntingdon Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 527, 534, 537). *Larke dol.*—Thick-bedded, coarse, steely blue ls., 250 ft. thick. Uncon. underlies Beekmantown group and overlies Mines dol. Named for Larke P. O., S. of Williamsburg, Blair Co.

This fm. is now classified by U. S. Geol. Survey as of Lower Ord. (Beekmantown) age.

Larsen limestone.

Miners' local name for an ore-bearing ls., 15 ft. thick, in middle part of Oquirrh fm. (Penn.) of Stockton dist., NW. Utah. Lies 500± ft. below their Ben Harrison ls., and 2,000± ft. above their Paisley ls. Outcrops in Muerbrook mine, which is owned by Mrs. Larsen. (See U. S. G. S. P. P. 173, 1932.)

Larsh shale. (In Deer Creek limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northwestern Missouri, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 49, 50). *Larsh sh.*, near base of Deer Creek ls., is 1⅔ to 2 ft. thick in SE. Nebr. and SW. Iowa, 6 to 8 ft. thick in NW. Mo., and 8+ ft. thick in NE. Kans. Underlies Haynies ls. and overlies Rock Bluff ls. Named for Larsh farm, on Ervine Creek, NE. of Union, Nebr.

See under *Mission Creek sh.*, also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936, and 1937 entry under *Topeka ls.*

La Salle limestone member (of McLeansboro formation).

Pennsylvanian: Northeastern Illinois (La Salle County).

G. H. Cady, 1908 (Ill. Geol. Surv. Bull. 8, pp. 128–134). *LaSalle ls.*—Blue-gray to light cream-colored ls., 20 to 30 ft. thick, forming topmost part of Coal Measures where it outcrops. Upper ls. bed is 5 to 15 ft. thick, lower ls. bed is 6 to 16 ft. thick, the two lss. being separated by 8 in. to 3½ ft. of calc. sh. At La Salle is about 400 ft. above base of Coal Measures,

G. H. Cady, 1919 (Ill. Geol. Surv. Bull. 37, pp. 64–69), described typical LaSalle ls. of LaSalle, NE. Ill. He stated: Base of LaSalle ls. is arbitrarily taken as top of a black fissile sh. about 1 ft. thick, commonly associated with a coal seam 1 in. thick. This black sh. forms floor of quarry of LaSalle Cement Co., E. of LaSalle. The ls. terminates below 20 ft. of red concretionary sh. Typical LaSalle ls. is found only on W. flank of anticline in strip not much over 1 mi. wide. At cement quarries it is a succession of 30± ft. of ls. varying from white crinoidal and oolitic strata to brecciated nodular dense thin-bedded layers associated with argill. material. Is highly calc. but contains variable amounts of argill. material. West of Vermilion Rivers the LaSalle becomes more argill., even essentially sh.

G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 26, pp. 36, 38), applied this name in N. part of dist. 4, central western Ill. (including Peoria, Fulton, Tazewell, Logan, Menard, Sangamon, Macon, De Witt, McLean, Mason, Cass, and Schuyler Counties), where he stated it is 180± ft. above coal No. 7 and 25± ft. above Spring Valley ls., which he placed 10 to 15 ft. above coal No. 8.

G. E. Ekblaw, 1933 (Ill. Acad. Sci. Trans., vol. 25, pp. 143–145). *LaSalle ls.* (called *Shoal Creek ls.* by Wallace Lee in U. S. G. S. Mount Olive-Gillespie folio, No. 220, 1926) lies 52± ft. above Shoal Creek ls. (called *Carlinville ls.* by Lee).

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129–138). In Clark Co., SE. Ill., the LaSalle ls. has been called *Livingston, Marshall, Casey* and *Quarry Creek ls.* It also embraces the 16 to 20-foot ls. in Vermilion Co. that has been called Fairmount ls., also the *Baldwinsville ls.* of Edgar Co., and the *Ryans Ford ls.* of Coles and Cumberland Counties.

†La Salle formation.

Pennsylvanian: Northeastern Illinois.

F. W. De Wolf, 1910 (Ill. Geol. Surv. Bull. 16, p. 180). *LaSalle fm.*—Shales, sss. and thin coals lying btw. base of coal No. 2 (below) and base of coal No. 5 (above). Thickness 160 to 190 ft. in northern Ill. and 250 to 320 ft. in southern Ill. Overlies Pottsville fm. and underlies Petersburg fm.

Preoccupied by *La Salle ls. memb.* Strata constitute lower part of Carbondale fm.

Named for La Salle Co.

Las Cahobas formation.

Miocene: Haiti.

W. F. Jones, 1918 (Jour. Geol., vol. 26, p. 737). [Assigned to Tert.]

W. P. Woodring (1922 and 1924) and others assign it to Mio.

Las Cascades agglomerate.

Eocene (?): Panama Canal zone.

D. F. MacDonald, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 708). [See also MacDonald, 1919 (U. S. Nat. Mus. Bull. 103, p. 526).]

Las Esperanzas formation.

Cretaceous: Mexico.

E. Ordóñez, 1908 (Min. and Sci. Press, vol. 96, p. 363).

Las Matas gravels.

Pliocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Lasoya Creek conglomerate.

See *Losoya Creek cgl.*

Las Posas formation.

Pleistocene: Southern California (Ventura County).

E. D. Pressler, 1929 (Univ. Calif. Pub., Dept. Geol. Sci. Bull. vol. 18, No. 13, pp. 325–345). *Las Posas fm.*—In South Mtn area consists of 1,500± ft. of loose sands and cgl. alternating with beds of silty sand and gravel. In Las Posas Hills it consists of 75 ft. of light-colored cgls. and yellow to tan fine to medium-grained sands. Overlaps Pico in some places and in other places appears to rest conformably on Santa Barbara beds (Upper Pico, Plio.). Divided into *Long Canyon memb.* (above) and *Kalorama memb.* (below). Is marine Pleist.; equiv.

to Upper San Pedro, Lower San Pedro, and "San Pedro Pliocene" of Deadman's Island. Is=Saugus, which typically is terrestrial. It seems very unsatisfactory to use same name for both marine and terrestrial strata, which are so situated that their integrating phases cannot be traced, and for this reason the term *Las Posas fm.* has been applied to the beds containing the Kalorama and Long Canyon faunas that come above the coolwater Santa Barbara in W. part of the basin.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 766). *Las Posas fm.* is marine Saugus of Kew.

U. S. Grant, IV, and H. R. Gale, 1931 (Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 42–43, 61). *Las Posas zone* in Los Angeles Basin is most characteristically exposed at Lomitas Quarry and in Hilltop Quarry. It uncon. underlies Timms Point zone (=Deadman Island "Plio." of repts) and overlies Santa Barbara zone. Correlation with Las Posas of Ventura Basin practically certain. [See *Lomita fm.*]

D. Cassell and A. J. Tieje, 1933 (Pan-Am. Geol., vol. 59, p. 376), stated Las Posas fm. overlies Timms Point. (See under *Timms Point fm.*)

T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 3, pp. 492–494). Kalorama memb. of Las Posas fm. contains a typical Santa Barbara fauna and is here included in Santa Barbara fm. The upper half of the Santa Barbara is here tentatively placed in Lower Pleist., instead of Upper Plio.

Las Puercas marl.

Pleistocene (?): Cuba.

S. Taber, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 589).

Las Salinas formation.

Miocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Lassen dacites.

See under *Divide Peak andesite.*

Last Chance andesite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). Andesite, breccia, and aggl. The flows thin (rarely exceeding 50 ft. to a flow) and alternating with pyroclastic rocks. In places the breccias and aggls. exceed the lavas in volume, and in places they have been more or less reworked by water. Thin beds of fine-grained ss. also occur. Thickness 300 to 600 ft. Younger than Fanney rhyolite and older than Deadwood Gulch rhyolite tuff.

Named for exposures at Last Chance Mine, S. of Silver Creek, Mogollon dist.

Las Vigas formation.

Lower Cretaceous (Comanche series): Southwestern Texas (Presidio region) and northern Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 293) and 1910 (Soc. Geol. Mexicana, Bol., t. 7, p. 93).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 271, 293). *Las Vigas fm.*, of basal Trinity age, was named by Burrows, from exposures in Conchos River Valley, northern Chihuahua, W. of Presidio, Tex. According to interpretation of C. Burckhardt it overlies upper Jurassic Plumosas fm. of Burrows. It consists of gray, black, and red qtzitic ss., gray limy ss., black shales, and sandy lss. Some of sss. and shales contain veins of copper. The upper part, transitional to overlying Cuchillo fm., contains gyp. and fossiliferous lss. (*Exogyra*). Thickness in Conchos Valley reaches 1,968 ft. Outcrops in southern Quitman Mtns with est. thickness of 500+ ft.

Las Virgenes sandstone.

Eocene (lower): Southern California (Ventura County).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 11, pp. 400–401 and map). *Las Virgenes ss.*—Beds of coarse-grained ss. conformably overlying and in part grading laterally into Simi cgl., and conformably underlying and in part grading laterally into the marine memb. of Martinez group on W.

side of the faults south of Simi Valley. Thickness 311 ft. 1 mi. W. of head of Las Virgenes Canyon. Is middle div. of Martinez group (lower Eo.). Named for typical development at head of Las Virgenes Canyon, on S. side of Simi Hills, Ventura Co.

Latah formation.

Miocene (upper or middle): Eastern Washington and western Idaho.

J. T. Pardee and K. Bryan, 1926 (U. S. G. S. P. P. 140, pp. 4–12). *Latah fm.*—Chiefly clay and sh., with some beds of sand and gravel and one or more beds that contain sufficient quantities of diatom skeletons to be classed as impure diatomaceous earth. Many sh. beds appear to be composed largely of very fine volcanic ash. The sh. generally contains plant remains classified by F. H. Knowlton as middle or lower Mio. [Berry assigned the flora to middle or upper Mio.; R. W. Brown considers it middle Mio. The fm. is mapped in this rept as far N. as 25± mi. from Spokane and 10± mi. S. of Spokane.] Evidence indicates it extends E. into the open valleys near Coeur d'Alene, Idaho. Thickness at least 250 ft. in area of typical exposure on slope W. of Latah Creek (a short distance S. of Spokane), and 0 to 1,500 ft. in Spokane-Coeur d'Alene [Idaho] area. In Spokane area, so far as known, it everywhere rests on the granite-schist group, and apparently it is or was at one time everywhere covered by the lava flows comprising the "rim rock," which are somewhat later than Yakima basalt. It formerly extended continuously over the area from Silver Hill-Cheney Ridge N. and E. to the mtns, except for the "islands" or "steptoes" of crystalline rock, many of which were not covered even by the highest lava flow. To S. and W. of the ridge the extent of the fm. is not definitely known and the upper beds are surely missing.

V. R. D. Kirkham and M. M. Johnson, 1929 (Jour. Geol., vol. 37, No. 5, pp. 483+). The Latah fm. at Spokane, Wash., by definition occupies position underlying Columbia River basalt instead of being interstratified with the lava. But plants collected from 7 localities described by Russell are all typical of Latah flora. The fm. has been identified in Benewah, Latah, and Nez Perce Counties, Idaho. [Describes exposures at 40 places in these counties.] The material in Idaho differs little from that at Spokane. Although defined in type loc. as being essentially a pre-basalt fm., the Latah, as shown by a large number of localities over a much greater area, appears to be more commonly a series interbedded with lava flows of Columbia River basalt. In nearly all Idaho localities the greater part of the series has basalt underlying as well as overlying it. In some places, however, the Latah beds lie directly on the pre-basalt terrain. At all places where this was observed, except at Moscow, higher and thicker members interstratified with the overlying basalt were also present. The beds consist chiefly of fine sediments which contain plant fossils that indicate their Latah age. Where two members of the series are thought to be separated by as much as 400 ft. of lava the fossil assemblage shows neither notable break nor evolution, so far as observed. The various members of Latah series as found in Idaho appear to occur within a range of 800 ft. The geographic extent of the series is many times greater than was at first surmised. The lake beds are interstratified with the basalt without angular uncon., but both basalt and sediments abut uncon. against pre-basalt fms. The greatest measured thickness of any one memb. in Idaho is 350± ft. At no Idaho locality is the combined thickness of the various sed. layers believed to be more than 400 ft. The usual thickness of upper layer is 100± ft., and that of lower layer 150 to 200 ft.

Latonia shale. (In Eden group.)

Upper Ordovician: Southwestern Ohio and northern Kentucky.

N. M. Fenneman, 1916 (Ohio Geol. Surv., 4th ser., Bull. 19, p. 63). *Latonia sh.*—More distinctly blue than underlying Utica [Fulton] sh. Is soft and calc.; contains some thin beds of ls.; weathers greenish yellow or drab. Thickness 180 to 230 ft. Latonia sh. and Utica [Fulton] sh. comprise Eden group. Is overlain by Mount Hope sh. memb. of Fairview fm. Named for Latonia, Kenton Co., Ky.

Latour formation.

Tertiary (middle or upper Miocene): Northern Idaho (Coeur d'Alene region).

O. H. Hershey, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 529–536). *Latour fm.*—White and variegated silts, 500 ft. thick, in region btw. Medimont and Kellogg. Deposited in [ancient] Lake Latour, which was of an extent and depth comparable with present Coeur d'Alene Lake. There is evidence of their extent to a point several mi. above Kellogg.

†Latrania sands.

Miocene (lower): Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, p. 435). [See quotation under *Imperial fm.*] Contains large assemblage of marine Mollusca. [Letter from G. D. Hanna, dated August 19, 1926, states that the name "is derived from latrans, the Latin name for a barker, such as a dog or a wolf," the rocks being exposed in Coyote Mtn, and the name *Coyote* having been previously used.]

An undiff. part of Imperial fm. (See W. P. Woodring, 1930, under *Imperial fm.*)

†Lauderdale chert.

Mississippian: Northern Alabama.

E. A. Smith, 1892 (Sketch of geol. of Ala., Birmingham, Ala., Roberts & Son, pam. of 36 pp.). *Lauderdale* (*Keokuk*).—Basal div. of Sub-Carbf., and the lower Siliceous of Safford. More cherty than beds above. Underlies St. Louis or Huntsville (=upper Siliceous of Safford) and overlies Dev. Black sh.

E. A. Smith, 1894 (Ala. Geol. Surv. map of Ala., with explanatory chart). *Lauderdale* (*Keokuk, etc.*).—The Lauderdale cherty ls. is generally a highly siliceous ls., with beds of rather pure crinoidal ls. at base. Occurs chiefly N. of Tennessee River in Lauderdale, Limestone, and Madison, in the "Barrens." Overlies Dev. black sh. and underlies Tuscumbia ls. Is=lower part of Fort Payne chert.

Replaced by Fort Payne chert as restricted by C. Butts in 1910, the name *Fort Payne* having been applied to these cherty rocks in several States. Named for great development in Lauderdale Co.

Laughery formation. (In Richmond group.)

Upper Ordovician: Southeastern Indiana.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull., vol. 17, p. 22). The Waynesville and Liberty, taken together, contain that part of the Richmond fauna along Cincinnati geanticline which most nearly is related to Mississippi Valley Richmond. The two fms. appear more closely linked together in their fossil content than the other Richmond fms. For that reason the term *Laughery fm.* is proposed for the Waynesville and Liberty as exposed along Laughery Creek in Ripley Co.

Laurel limestone.

Laurel dolomite.

Laurel limestone member (of Wayne formation).

Silurian (Niagaran): Southern Indiana and west-central Kentucky and Tennessee.

A. F. Foerste, 1896 (Cincinnati Soc. Nat. Hist. Jour., vol. 18, pp. 190–192). *Laurel bed.*—White or bluish white pure lss., with intercalations of chert in upper half. [Thickness not given.] Richly fossiliferous basal part might be appropriately called *Osgood phase of Laurel fm.* Overlain by Waldron sh. and underlain by Clinton rock or Montgomery bed.

A. F. Foerste, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., pp. 217, 230), restricted *Laurel ls.* to 35 to 45 ft. of hard white ls. overlying *Osgood beds* and underlying *Waldron sh.*

Adopted by U. S. Geol. Survey to exclude the Osgood. In southern Ind. and north-central Ky. the rocks are treated as a distinct fm., underlain by Osgood sh. and overlain by Waldron sh. In west-central Tenn. the rocks become *Laurel ls. memb.* of Wayne fm., being overlain by Waldron clay memb. of Wayne fm. and underlain by Osgood earthy ls. memb. of the Wayne. In Jefferson Co., Ky., the Laurel deposits consist of dol., and are called *Laurel dol.* The Laurel fossils are of Rochester age, according to E. O. Ulrich.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, pp. 152–153). In vicinity of Laurel, Ind., only lower part of *Laurel ls.* is exposed, and this part nowhere exceeds 12 ft. in thickness. To W., in Decatur Co., several sections are known, which are at least 30 ft. thick, and at St. Paul, in SE. part of Shelby Co., it is 37 ft. thick. This suggests Laurel ls. thins out E. of St. Paul at least as far as Yellow Springs, Ohio, where it is overlain by Massie clay sh., 5½ ft. thick. It may be present at Cedarville, Ohio, but is not exposed. The identification of Laurel ls. in Preble and Miami Counties, Ohio, is based solely on strat., the fossiliferous part of the Laurel being limited chiefly to upper part of the fm.

Named for Laurel Franklin Co., Ind.

Laurencic period.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). *Laurencic period.*—Older than Huronic period and younger than Varennesic period.

Includes part of Keewatin series and later lavas and granites.

Laurens member.

Upper Devonian: Eastern New York (Susquehanna, Otego, and Butternut Valleys).

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, p. 544) and 1934 (Am. Jour. Sci., 5th, vol. 27, p. 10). *Laurens memb.* (of Tully ls.) is suggested for rocks btw. New London and Schenevus that carry *Hypothyridina* and a modified Ithaca fauna. Name is needed because *Hypothyridina* zone in eastern N. Y. is a different facies from that of the Tully and actually represents only basal part of Tully. It appears that the 88 ft. of Laurens memb. in Otego Valley is = the 4-inch thick oolite with *Hypothyridina* in Chenango Valley. Underlies Sherburne and overlies Moscow (Hamilton).

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 803, 809–815, 827). *Laurens memb.* was proposed in 1933 for the thicker *Hypothyridina* beds of Otego Valley. These beds in Butternut Valley, to which *Laurens* is applicable, are thinned equiv. of Otego Valley exposures. In Butternut Valley it is overlain by 89 ft. of West Brook memb. of the Tully and underlain by New Lisbon memb. of Tully. In Otego and Susquehanna Valleys and at Schenevus it rests on Hamilton. The Laurens is chiefly ss. but contains some sandy sh., and includes 3 *Hypothyridina* zones. Thickness 21 to 88 ft. Exposed in Houghtaling's Glen, 1½ mi. NE. of Laurens [Otsego Co.], also in ravine 1 mi. NE. of Laurens. Fossils listed.

Laurentian epoch (or **series**).

A period of pre-Camb. granitic intrusion following the Keewatin epoch. (For definition see U. S. G. S. Bull. 769, pp. 127–128.) Formerly included in Archean period (and system), but U. S. Geol. Survey no longer uses "Archean" except as a rock type term. As now defined the Laurentian series precedes the Knife Lake series (lower Huronian?) and follows the Keewatin series. (See U. S. G. S. P. P. 184, 1935, by C. K. Leith, R. J. Lund, and A. Leith.)

†Laurentian clay.

Term that has been applied to the marine Pleist. clay of Northeastern States and Canada that has also been called "Lawrencian clay" and "Champlain clay."

ùrie formation.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 134).

Lauzon formation.

Ordovician or Cambrian: Quebec.

J. Richardson, 1866 (Canada Geol. Surv. Rept. 1863–66, pp. 32–36). *Lauzon div.*—Lower Sil.; eastern Canada; included in Quebec group.

Some later Canadian repts include this fm. in Ord. and others include it in Camb.

La Ventana sandstone member (of Mesaverde formation).

Upper Cretaceous: Northwestern New Mexico (La Ventana region).

C. H. Dane, 1937 (U. S. G. S. Bull. 860C). *La Ventana ss. memb.*—Buff marine fossiliferous ss. and gray sh., including, in upper part W. of Rio Puerco, some white ss., carbonaceous sh., and coal beds. Thickness 0 to 1,256 ft. Is top ss. of Mesaverde fm., along Puerco River, where it replaces Cliff House ss. of Renick. Named for town of La Ventana, on Rio Puerco, near which it outcrops, and, perhaps more appropriately, from the exposure of its basal part on top of La Ventana Mesa E. of Rio Puerco, on S. edge of T. 19 N., R. 1 W. The La Ventana memb. grades laterally into upper part of Allison memb. (continental).

Laventille limestone.

Pre-Cretaceous (?): Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol. No. 7, p. 33). [Assigned to pre-Cret.; but Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 704), assigns *Laventille fm.* of Trinidad to Lower Cret.]

Laverne formation.

Tertiary: Northwestern Oklahoma.

C. N. Gould, 1927 (Obsolete Okla. geol. names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, pp. 235–238). *Laverne fm.*, Tert., used by Waite [where?] to include some leaf-bearing beds of Tert. age in Harper and Beaver Counties. The name has never come into popular use.

La Vieille formation. (In Chaleur series.)

Silurian (Niagaran): Quebec (Gaspe Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 45).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43. No. 1, p. 271). Faunas of Clemville and La Vieille fms. of middle Sil. Chaleur series are of Clinton age.

Lawrence shale. (In Douglas group, Kansas.)

Lawrence shale member (of Douglas formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1894 (Kans. Univ. Quart., vol. 2, p. 122). *Lawrence shales.*—Shales, interbedded with sss., 210 ft. thick, including a thin ls. exposed at Haskell Institute, Lawrence, Kans., and called *Institute ls.* Underlies Oread ls. and overlies Ottawa ls.

In 1899 C. R. Keyes used *Lawrence sh.* in a broader sense, and some early writers applied the name to all beds down to top of Plattsburg ls. H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13), defined Lawrence sh. as underlying Oread ls. and overlying Iatan ls., and for many succeeding years that was the generally accepted definition, the (descending) Oread ls., Lawrence sh., Iatan ls., and Weston sh. all being included in Douglas group (or fm.). For the innovations in this terminology introduced by R. C. Moore in 1931 and 1932 see under *Weston sh.* Also see Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21) followed Moore's restricted definition of Lawrence sh. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 154, etc.), still further restricted Lawrence sh. by transferring (under new name *Robbins sh.*) to his Stranger fm. the basal part of his previously restricted Lawrence sh. of southern Kans. (See 1936 entry under *Stranger fm.*)

The U. S. Geol. Survey has not yet had occasion to consider, for its publications, these redefinitions of Lawrence sh.

Named for exposures at Lawrence, Douglas Co., Kans.

Lawrence clay. (In Allegheny formation.)

A bed of clay, 0 to 8 ft. thick, underlying Lawrence coal in SE. Ohio, and lying 0 to 3 ft. below Lower Kittanning clay. (W. Stout, personal communication, Feb. 1930.) Probably named for persistency in Lawrence Co.

†Lawrencian clay.

Term applied by E. Desor to the marine Pleist. clay of Northeastern States and Canada that has also been called "Laurentian clay" and "Champlain clay." (See under *†St. Lawrencian terrane.* Also see H. D. Rogers, Geol. of Pa., vol. 2, 1858, p. 775.)

Lawrencic period.

Term used by C. [R.] Keyes. Same as his Laurencic period.

Layton sand.

A subsurface sand, of Penn. age and 0 to 500± ft. thick, in Okla., which is correlated with upper part of Coffeyville fm. Named for Layton farm, in Cleveland field, in NW¼ sec. 2, T. 20 N., R. 8 E., Pawnee Co.

Layton lime.

A subsurface ls., of Penn. age and 0 to 20± ft. thick, in central northern Okla., said to correlate with Hogshooter ls. It lies higher than Layton sand. D. A. McGee and W. W. Clawson, Jr. (A. A. P. G. Bull., vol. 16, No. 10, 1930) give thickness in Oklahoma City field, NE. Okla., as few ft. to 100 ft.

Lazeart sandstone member (of Adaville formation).

Upper Cretaceous: Southwestern Wyoming.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). [See under *Adaville fm.*, of which it is basal memb.]

Lazy Bend member (of Millsap Lake formation).

Pennsylvanian: North-central Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept. by G. Scott and J. M. Armstrong, on geol. of Parker Co. Named for Lazy Bend on Brazos River. See 1933 entry under *Millsap Lake fm.*

As defined in above-cited publication, *Lazy Bend beds* was applied to strata underlying Kickapoo Falls ls. and overlying Dickerson beds.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 16). *Lazy Bend memb.*—Middle memb. of Millsap Lake fm. as defined by G. Scott and J. M. Armstrong, in unpublished rept. on Parker Co. Includes the series of shales, sss., and lss. btw. base of Kickapoo Falls ls. up to top of Brannon Bridge ls., which are identified by Scott and Armstrong, who have the sequence exposed along Brazos River and its tributaries in vicinity of Lazy Bend of Brazos River, but only uppermost strata occur in Palo Pinto Co. The Lazy Bend memb. as defined by Scott and Armstrong underlies Grindstone Creek memb., overlies Dickerson memb., and includes, in interval btw. Brannon Bridge ls. and Kickapoo Falls ls., 2 other lss.—Meek Bend ls. and Dennis Bridge ls. [This is a modification of definition given by Sellards in 1933 rept. cited above.]

Lead system.

Pre-Cambrian: Western South Dakota (Black Hills).

J. J. Runner, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 354–372). The pre-Camb. rocks of Black Hills, S. Dak., are divided into (descending) Lead system, Estes system, and Nemo system. The *Lead system*, which is believed to correlate with the fms. of Lead dist., is divided into (descending) Garfield fm., Northwestern fm., Ellison fm., Homestake fm., and Poorman fm. It overlies, with possible uncon., Estes system.

Lead Creek limestone.

Pennsylvanian: Western Kentucky (Hancock County).

A. F. Crider, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 279). *Lead Creek ls.*—Three or four ledges of ls. ranging in thickness from 8 to 10 ft., extending through an interval of 30 to 40 ft. in Coal Measures of Tell City and Owensboro quads. Base is 255 ft. above top of cgl. forming basal part of Penn. The bdy btw. Allegheny and Pottsville fms. of Appalachian field is placed by D. White at about top of this ls.

D. B. Chisholm, 1931 (Ky. Geol. Surv., ser. 6, vol. 41, pp. 224–225). *Lead Creek ls.* is in upper part of Tradewater fm., lying 190 ft. below top of the Tradewater in Hancock Co. and 85 ft. below Lewisport ls. Thickness 5 to 11 ft. Fossiliferous. Upper part blue and shaly and weathers to a buff fissile "ss." or "sh."; lower 3 to 5 ft. thick-bedded hard ls., blue when fresh, but weathers to buff porous "ss." Usually rests on Lead Creek coal, but in places is separated from that coal by 15 ft. of sh.

Named for Lead Creek, Hancock Co.

Lead King lime.

Name locally applied to the ls. memb. (of Niobrara age) of Mancos sh. in the Snowmass Mtn area of Gunnison Co., Colo., and also applied by prospectors to the indurated lower part of underlying sh. memb. of the Mancos of that area. The name was probably derived from fact the lime is the ore horizon in Lead King mine, in Lead King Basin.

Lead Point argillite.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 79, map). *Lead Point argillite.*—Chiefly well-bedded argill. sl. with minor bands of quartz-mica schist and ls.; medium to dark gray; usually fine-grained and distinctly argill. Thickness 2,200 ft. Lies parallel to and just N. of Republican Creek ls. [Derivation of name not stated, and there is no geographic feature called Lead Point on map.]

Leadville limestone.

Mississippian (lower): Colorado.

G. H. Eldridge, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *Leadville ls.*—Upper third, massive blue and cavernous ls.; lower two-thirds bedded gray to brown lss., somewhat dolomitic and carrying a few beds of dark-gray or black chert, and sometimes separated by bands of calc. sh. Thickness 400 to 525 ft. Carries Sub-Carbf. [Miss.] fossils. Uncon. underlies Weber ls. [Penn.] and overlies Yule ls. [Ord.]. Known to miners as the "Blue" ls.

S. F. Emmons, 1898 (U. S. G. S. Tenmile folio, No. 48). *Blue or Leadville ls.*, the principal ore-bearing horizon of Leadville, Red Cliff, Aspen, and other mining dists, is not exposed in this dist. Near Leadville it rests uncon. on Parting qtzite.

E. Kirk, 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 222–240). *Leadville ls.* here restricted to the Miss. lss. of Colo., and the new name *Chaffee fm.* is introduced for the Dev. rocks of Colo. in areas to N. and E. of SW. Colo., where the Dev. ls. will continue to be called Ouray ls. and the underlying Dev. fm. will continue to be called Elbert fm. The Miss. part of Ouray ls. of SW. Colo. to hereafter be called Leadville ls. The typical Leadville ls. rests uncon. on Dev. lss., which overlie the Dev. Parting qtzite.

Named for occurrence in Leadville dist.

†Leadville porphyry.

See under *White porphyry.*

†Leaf Hills moraine.

Pleistocene (Wisconsin stage): Western Minnesota (Douglas, Todd, and Ottertail Counties).

W. Upham, 1888 (Minn. Geol. and Nat. Hist. Surv. vol. 2, pp. 549–571; also see Minn. Geol. Surv. 22d Ann. Rept., map (pl. 1) and p. 47, 1894). Ninth or *Leaf Hills moraine.* Named for fact it forms Leaf Hills, Ottertail Co.

F. Leverett, 1932 (U. S. G. S. P. P. 161). The Leaf Hills moraine of Upham is not ninth moraine, but is at latest an early part of second or Altamont morainic system, and may prove to be earlier than Altamont system.

†Leander beds.

Local name, incidentally applied (but not defined) to upper part of *Caprina* (*Edwards*) *ls.*, by R. T. Hill in 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 105, 126). Exposed in country btw. Florence and Leander, Williamson Co., Tex.

Leaning Tower quartz monzonite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 123, map). On fresh fracture, dull-gray color and moderately fine texture. Under the microscope appears to be porphyritic. On weathered surfaces deeply decayed and rusty.

Named for fact it forms considerable part of slopes of Leaning Tower, Yosemite Nat. Park.

Lea Park formation.

Cretaceous: Alberta.

S. E. Slipper, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 8) and 1919 (Canada Geol. Surv. Mem. 116, p. 21).

Leatherwood granite.

Pre-Cambrian: Central southern Virginia (Henry and Pittsylvania Counties).

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Leatherwood granite.*—Biotite muscovite granite with porphyritic facies. Intrusive into Glenarm series. Mapped at and around Leatherwood, Henry Co. Is pre-Camb.

A. A. Pegau, 1932 (Va. Geol. Surv. Bull. 33, pp. 15, 29, pls. 2, 3). *Leatherwood granite* is named for Leatherwood, the home of Patrick Henry near Martinsville, Henry Co. It occurs as irregular bodies of variable size intruding Wissahickon schist in Henry and Pittsylvania Counties.

L'Eau Frais shale.

Eocene: Southwestern Arkansas.

See explanation under *Manchester sh.*

Leavenworth limestone. (In Oread limestone.)

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 32, 33, 38). *Leavenworth ls.*—Middle ls. bed of Oread ls. Dark-gray, dense, vertically jointed, fossiliferous, and in 1 or 2 beds. Thickness 1½ ft. in Nebr., 2½ ft. at Atchison, Kans., and at St. Joseph, Mo. Underlies Heebner sh. and overlies Snyderville sh. Named for a roadside exposure high in the upland spur NW. of Federal Penitentiary at Leavenworth, Kans.

Lebanon limestone. (In Stones River group.)

Lower Ordovician: Central and western Tennessee.

J. M. Safford, 1851 (Am. Jour. Sci., 2d, vol. 12, pp. 353, 354–356). *Lower Lebanon ls.* and *Upper Lebanon ls.*—[See descriptions under *Stones River group.*]

In 1869 (Geol. Tenn.) Safford substituted "Trenton or Lebanon group" for the rocks previously named *Stones River group*, replaced "Upper Lebanon ls.," with "Carter's Creek ls.," replaced "Lower Lebanon ls." with "Glade ls.," and divided underlying beds of his Trenton or Lebanon group (=Stones River group) into three named fms. In 1900 Safford and Killebrew substituted *Carter ls.*, for ls. previously called "Upper Lebanon ls." and "Carter's Creek ls.," and substituted *Lebanon ls.* for ls. previously called "Lower Lebanon ls." and "Glade ls."

Included in Stones River group. Underlies Carters ls. and overlies Ridley ls. Named for exposures at Lebanon, Wilson Co.

†Lebanon group.

Lower Ordovician (Chazy): Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 159, 258–268). *Trenton or Lebanon group.*—Divided into (descending): (1) Carter's Creek ls. [=Upper Lebanon ls. of earlier repts and Carters ls. of later repts]; (2) Glade ls. [=Lower Lebanon ls. of earlier repts and Lebanon ls. restricted, of later repts]; (3) Ridley ls.; (4) Pierce ls.; and (5) Central ls. [=Murfreesboro ls. of later repts]. Underlies Nashville group and overlies Knox dol.

Same as Stones River group, older name.

Named for Lebanon, Wilson Co.

†Lebanon beds.

Upper Ordovician: Southwestern Ohio and northern Kentucky.

J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, table opp. p. 89, pp. 103, 119), and E. Orton, 1873 (same vol., pp. 371–399). *Lebanon beds.*—Fossiliferous even-bedded semicrystalline blue lss., alternating with blue shales; 300 ft. thick. Lie stratigraphically higher than highest stratum of Cincinnati hills (Hill Quarry beds) and underlie Upper Sil. Medina ss. Topmost fm. of Cincinnati group. Not present at Cincinnati, Ohio.

A. F. Foerste, 1903 (Am. Geol., vol. 31). *Lebanon beds* of Orton included Saluda at top and Warren [Arnheim] at base.

Preoccupied by J. M. Safford's name for older Ord. rocks in Tenn. Replaced by *Richmond group.*

Named for Lebanon, Warren Co., Ohio.

Lebanon granite.

Late Paleozoic (?): Southwestern New Hampshire (Hanover quadrangle, Grafton County).

C. H. Hitchcock, 1908 (Vt. State Geol. 6th Rept., pp. 155–156, etc.), in description of rocks of Hanover quad., N. H., referred many times to *Lebanon granite.* The village of Lebanon is in Hanover quad., SW. part of Grafton Co., N. H.

J. W. Merritt, 1921 (Vt. Geol. Surv. Rept. State Geol. 1919–20, pp. 1–36, map). *Lebanon granite.*—First described by Hitchcock (Geol. N. H., vol. 2, 1878) as "protogene gneiss," and several areas in N. H. and Vt., the rocks of which resembled each other, were grouped together and given the name *Bethlehem gneiss.* Later he revised his opinion, making this rock the youngest, instead of the oldest, in Hanover region. His latest map, however, shows the area under name "protogene." Hawes calls it "protogene gneiss;" Iddings calls it "epidote-micagneiss." Is of medium to fairly coarse grain; texture tends to gneissic. Is intruded underneath or into a schist, and probably has a laccolitic form. Igneous origin.

M. Billings, 1935 (letter dated Aug. 27). *Lebanon granite* belongs to Oliverian magma series [which Billings classified as late Dev. or late Carbf.].

Lebo andesitic member (of Fort Union formation).

Eocene: Central northern, southern, and eastern Montana.

R. W. Stone and W. R. Calvert, 1910 (Econ. Geol., vol. 5, p. 746). *Lebo andesitic memb.*—Basal memb. of Fort Union fm. NE. of Crazy Mtns. Thickness 450 to 2,200 ft. Overlain by massive sss. and intercalated shales composing upper part of Fort Union fm., and underlain by Lance fm. (1,000 to 2,400 ft. of light-gray ss. and variegated sh.). Named for exposures on Lebo Creek, NE. of Crazy Mtns.

To E. (in Bull Mtn coal field and elsewhere) the Lebo strata become so shaly that they are called *Lebo sh. memb.*

Le Boeuf conglomerate.

Upper Devonian or Mississippian: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 101, 103, 104, 112, 239, etc.). The Venango Lower ss. (Third oil sand), 30 ft. thick, is without doubt=*Le Boeuf* *cgl.* and Panama cgl. which is exposed in Le Boeuf Twp, Erie Co., along French Creek, and has been quarried on left bank of the creek 1 mi. SW. of Le Boeuf Station, where it consists of 7 ft. of pebbly rock underlain by 8 ft. of bluish white ss. East of Le Boeuf Creek it is partly coarse cgl. containing a great many pebbles of metamorphic rock.

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 455–464). *Le Boeuf cgl.* underlies Amity sh. and overlies Chadakoin beds, all of which are considerably below Riceville sh., and correlate with lower part of Chagrin sh. [which U. S. Geol. Survey classifies as Upper Dev.]. It can be traced into Panama cgl.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203), says Panama cgl. memb. of Cattaraugus fm. is same as Le Boeuf cgl. and Wolf Creek cgl. (The U. S. Geol. Survey classifies Cattaraugus fm. as *Dev. or Carbf.*) K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 77–83), repeats the statement that Le Boeuf and Panama are same cgl.

Leclaire dolomite.

Silurian (Niagaran): Central eastern Iowa.

J. Hall, 1858 (Iowa Geol. Surv. vol. 1, pt. 1, pp. 46, 73–75). *Leclaire ls.*—Gray or whitish gray mag. ls., semi-crystalline, very porous and vesicular; some brecciated beds in upper, middle, and lower parts. Thickness 100–540 ft. Fossils distinct from Niagara. Overlies Niagara ls. and underlies Onondaga Salt group.

S. Calvin, 1895 (State Univ. Iowa Lab. Nat. Hist. Bull., vol. 3, No. 3) and 1896 (Iowa Geol. Surv. vol. 5, pp. 50–56). *Leclaire ls.* restricted to 80 ft. of generally heavy-bedded chertless, highly crystalline dol. underlying Anamosa ls. and overlying Delaware ls.; all included in Niagara. [This is definition that has since been followed in Iowa repts.]

See also under *Gower dol.*

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 42). Type loc. of LeClaire dol. (Leclaire, Scott Co., Iowa) is just across Miss. River from type loc. of Port Byron ls. of Ill. Fauna is somewhat different from that of Port Byron, and LeClaire strata have reef structure, but the two fms. are probably of equiv. age, and *Port Byron* might prove more satisfactory than earlier term *Leclaire.*

See also A. H. Sutton, p. 274 of 1935 book cited above: Port Byron of Ill. includes all beds of Sil. age in Ill. above the Racine, and is more nearly= Gower rather than Leclaire of Iowa. [Suggests restricting Leclaire to "reef" phase of Gower, and retaining *Port Byron* for use in Ill. See also 1935 entry under *Anamosa dol.*]

Lecompton limestone. (In Shawnee group, Kansas.)

Lecompton limestone member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, central northern Oklahoma, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1895 (Kans. Univ. Quart., vol. 3, p. 278 and pl. opp. p. 290; Am. Jour. Sci., 3d, vol. 50, pl. opp. p. 466). *Lecompton ls.*—Three fossiliferous lss. separated by thin shales. Thickness 25 ft. Overlain by 75 ft. of sh. [Tecumseh sh. memb.], and separated from underlying Oread ls. by a little more than 60 ft. of sh. [Kanwaka sh. memb.].

Is now treated by U. S. Geol. Survey as a memb. of Shawnee fm. in Mo. and Iowa. In Kans. the Shawnee is treated as a group and Lecompton ls. as a fm. In northern Okla. it is a memb. of Pawhuska fm.

Named for exposures at Lecompton, Douglas Co., Kans.

†Lecompton shale.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 64, 94). *Lecompton shales.*—Name suggested by G. I. Adams. Persistent and heavy shales, 90 ft. thick, in places containing much ss., in other places almost no ss. Basal memb. of Shawnee fm. Underlies Lecompton ls. and overlies Oread ls.

Preoccupied. Replaced by *Kanwaka sh.*, according to H. Hinds and F. C. Greene (1915) and R. C. Moore (1936).

Named for exposures at Lecompton, Douglas Co.

†Lecompton beds.

Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of Kans.). *Lecompton beds.*—Include Calhoun shales, Deer Creek ls., Tecumseh shales, Lecompton ls. and Kanwaka shales.

Preoccupied and conflicts with established classification. Includes lower half of Shawnee group.

†Leda clay.

A paleontologic term applied in early repts on Northeastern States to beds of marine clay, of so-called †Champlain period of Pleist. epoch (late Wisconsin), which are not all of same age but which are characterized by the fossil *Leda truncata.*

Ledger dolomite.

Lower Cambrian: Southeastern Pennsylvania.

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci. Jour., vol. 12, pp. 359, 363). *Ledger dol.*—Granular gray to white dol., mostly thick-bedded, some siliceous beds, which weather to rust-stained granular cherty layers. Thickness 1,000± ft. Uncon. underlies Elbrook dol. and overlies Kinzers fm. No fossils found, but Ledger, Kinzers, and underlying Vintage believed=Tomstown dol. Named for Ledger, Lancaster Co.

Ledyard member. (In Ludlowville shale.)

Middle Devonian: Central and western New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 218, 224, etc.). *Ledyard memb. of Ludlowville fm.*—Black fissile sh., 100 ft. thick, overlying Centerfield ls. (basal memb. of Ludlowville) on Paines Creek, Ledyard Twp, Cayuga Lake. At type section is characterized by *Leiorhynchus laura* and a fauna with a "Marcellus facies." Is Third *Leiorhynchus* zone of Cleland. Overlain by Wanakah memb. of Ludlowville fm. to W. and by contemp. Kings Ferry memb. to E. Can be traced from Cayuga Lake to Lake Erie, and is coextensive with Centerfield ls. From Lake Erie to Genesee Valley it is overlain by *Strophalosia* bed, 6 inches thick; from the Genesee to Cayuga Lake it is overlain by *Pleurodictyum* or *Michelinia* zone. At Lake Erie has been erroneously called Skaneateles and Marcellus, but its true position above the Centerfield can be seen on Buffalo Creek btw. Blossom and Elma.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 45). Writer has examined *Ledyard* type section and agrees with Cooper that the name is inappropriate for Skaneateles Lake region.

See also *Avery sh.*

Lee quartz diorite.

Pre-Cambrian: Western Massachusetts and Connecticut.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902), first used *East Lee gneiss.*

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*East Lee black biotite-hornblende gneiss* shown as older than Tyringham gneiss and younger than Hinsdale ls. On pp. 20 and 29–30 of Mon. 29 the fm. is called *Lee gneiss,* and is described as a heavy black hornblende or hornblende biotite gneiss.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 153 and map). *Lee quartz diorite.*—Black fine-grained heavy hornblende, hornblende-biotite, or biotite-quartz diorite. Is believed to be a contact zone of Becket granite gneiss. Named for exposure in East Lee.

Lee formation. (In Pottsville group.)

Pennsylvanian: Southwestern Virginia and eastern Kentucky and Tennessee.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 36). *Lee cgl.*—Heavy sss. and cgl., shales, and coals, 1,200 to 1,600 ft. thick. At Big Stone Gap contains massive ss. (Bee Rock), 95 ft. thick, at top; heavy cgl., 250 ft. thick, at base; and, in middle, 566 ft. of ss. with a few thin beds of sh. Overlies Pennington sh. and underlies Norton fm. Is basal fm. of Coal Measures in Bigstone Gap coal field of Va. and Ky.

Basal fm. of Pottsville group. In east-central Tenn. the Lee itself becomes a group, composed of (descending) Rockcastle ss., Vandever sh., Bonair ss., Whitwell sh., Sewanee cgl., and Gizzard fm. In some early Ky. repts the name *Lee fm.* was applied to all beds up to top of Corbin cgl. memb., but later repts place top of Lee at top of Rockcastle cgl. memb. This is U. S. Geol. Survey definition.

Named for Lee Co., Va.

Leech River group.

Carboniferous: Northwestern Washington (San Juan Islands) and British Columbia.

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 87). *Leech River fm.*, Upper Paleozoic (?), British Columbia, included in Victoria group.

R. D. McLellan, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 217). The upper part of San Juan series, which will be referred to as *Leech River group* (G. M. Dawson Rept. on Reconn. of Leech River and vicinity: Geol. Surv. Canada, Rept. Prog. 1876–77, pp. 95–102, 1878), since it no doubt includes Clapp's Leech River "fm.," is composed of black argillites, schists, tuffaceous graywackes, slates, and volcanics. Also includes occasional thin ls. beds containing the Penn. foraminifer *Fusulina*, and the argillites have scattered thin seams of semi-anthracite. Most of sediments were derived from underlying Orcas group, the lower part of San Juan series. [In 1927 (Wash. Univ. Pub. Geol., vol. 2, p. 99) McLellan assigned these rocks to Perm., Penn., and upper Miss., and stated that the basal graywackes, several thousand ft. thick, are=Malahat volcanics of B. C.]

Leesport limestone.

Middle Ordovician: Southeastern Pennsylvania (Berks County).

G. W. Stose and A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 505–536). *Leesport ls.*—The uppermost beds of the lss. which underlie Martinsburg sh. from Steelton, Dauphin Co., to Leesport, Berks Co. Consists, generally, of thin-bedded dark slaty impure ls. containing fossils of probable lower Trenton age. Extensively quarried as "cement rock" to E., at Schlemville, N. of Reading. Thickness at Leesport, Berks Co., 130 ft.; from Hummelstown to Womelsdorf 81 ft. Best exposed at Leesport, Berks Co. In general uncon. on Beekmantown dol., but from Hummelstown to Womelsdorf it is underlain by a considerable thickness of very pure, white, sugary marble and fine-grained blue ls. believed to be of Stones River age.

G. W. Stose (personal communication). *Leesport ls.* is of Trenton age and is a calc. phase of Martinsburg sh.

Leesville limestone member (of Harrodsburg limestone).

Mississippian: Southern Indiana.

P. B. Stockdale, 1929 (Ind. Acad. Sci. Proc., vol. 38, pp. 233–242). *Leesville ls. memb. of Lower Harrodsburg ls.*—Heavy coarse-grained blue-gray crystalline and crinoidal ls., 1½ to 8 ft. thick, underlying Guthrie Creek memb. and overlying Ramp Creek memb. of Lower Harrodsburg ls. Named for exposures at Leesville, on E. edge of Lawrence Co.

Legion shale member.

Pennsylvanian: Southeastern Nebraska, Kansas, and northern Oklahoma.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1). *Legion sh. memb. of Grenola fm.*—The newly established Grenola fm. is divided into following members (descending): Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls. The Legion sh. is largely gray argill. sh. with few fossils in north, becoming nearly black at top N. of Manhattan and at Elmdale, Kans. In central and southern Kans. it is indurated and more calc. locally, with numerous pelecypods, some brachiopods, crinoids, Bryozoa, etc. In Okla. it grades into red sandy sh. Thickness 4 to 8 ft. Type loc., cuts on U. S. Highway 40, just SW. of American Legion Golf Club grounds, about 1¾ mi. SW. of Manhattan, Kans.

G. E. Condra, 1935. (See under *Roca sh.*)

Lego limestone member (of Wayne formation).

Silurian (Niagaran): West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 565, 578–582, 694). *Lego or Louisville ls.*—Lss., 30 to 45 ft. thick, overlying Waldron bed and underlying Dixon red clays in Tenn. River Valley. Of Niagaran age. Occupies same strat. position as Louisville bed. Usually no sharp line btw. Lego ls. and overlying Dixon red clay. Lithologically the lss. forming middle and lower parts of Lego bed often resemble Laurel bed so closely that when intervening Waldron horizon can not be identified it is impossible to distinguish the Lego. In that case the name *Glenkirk ls.* may be used to designate the combined Laurel-Lego section.

Named for Lego, Decatur Co.

†Le Gore limestone.

Lower Ordovician (Beekmantown): Western Maryland (Frederick County).

G. W. Stose and A. I. Jonas, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 564–565). *Le Gore ls.*—A ls. of Ozarkian age that underlies Frederick ls. E. of Le Gore quarry, in a small triangular area at N. edge of Frederick ls. valley. Was erroneously called Beekmantown ls. in previous repts.

G. W. Stose and A. I. Jonas abandoned this name in Jan. 1936, further collections of fossils proving that this ls. is same as Grove ls., and that it is of lower Beekmantown age.

Le Grand beds.

Mississippian: Central northern Iowa (Marshall, Tama, and Grundy Counties).

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, p. 57). *Le Grand beds.*—Chiefly rather soft, somewhat irregularly bedded buff ls., probably containing considerable magnesia, with blue calc. ss. at base. Thickness 80 ft. Exposed along Iowa River and some of its tributaries. Probably to be correlated with Burlington and Kinderhook.

S. W. Beyer, 1897 (Iowa Geol. Surv. vol. 7, pp. 221–226). *Le Grand beds* in Marshall Co. consist of (descending): 30 ft. of brown and gray subcrystalline ls.; 35 ft. of buff mag. ls., cherty below; 15 ft. of gray white oolite; and 20 ft. of argill. blue ss. Thickness 135 ft. They underlie Marshalltown sh. and overlie Hannibal (?) sh., all of which are included in Kinderhook group.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 88–90). *Le Grand beds* are probably transitional from Kinderhook to lower Burlington.

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 419–431). *Le Grand beds* belong to Hampton fm. They uncon. overlie English River fm. but it is highly probable that over greater part of their area they lie uncon. on Sheffield fm. Thickness 80 ft. Divided into 6 faunal zones, which correlate the beds with upper part of Chapin memb., the Maynes Creek memb., and lower part of Eagle City memb. of Hampton fm. of other parts of central northern Iowa. The beds consist of (descending): (1) Very thin-bedded brown ls., 10 ft. (*Camarotoechia* zone); (2) thin-bedded hard brown ls. occasionally oolitic, 12 ft. (*Spiriferina* zone); (3) thin-bedded brown banded ls., 8 ft. (*Cactocrinus* zone); (4) hard brown crystalline crinoidal ls., locally carrying chert and oolite, 18 ft. (*Orophocrinus* zone); (5) massive, soft, gray ls., chert and calcite abundant, 16 ft. (*Pachylocrinus* zone); (6) massive white hard oolitic ls., 18 ft. (*Schellwienella* zone). No. 1 correlates with lower part of Eagle City memb.; Nos. 2 to 5 correlate with Maynes Creek memb., and No. 6 correlates with upper part of Chapin memb. Occur along Iowa River in E. part of Marshall Co. and W. part of Tama Co., also in north-central part of Marshall Co. and in S. part of Grundy Co.

Named for Le Grand, Marshall Co.

Lehigh limestone.

Middle Ordovician: Northeastern Pennsylvania (Lehigh and Northampton Counties).

E. C. Eckel, 1904 (U. S. G. S. Bull. 225, pp. 449, 450). *Trenton ls. (Lehigh cement rock)*, underlies Hudson sh. and overlies Kittatinny ls. in Lehigh dist. of Pa. and N. J. Thickness 150 to 250 ft.

F. B. Peck, 1911 (Pa. Topog. and Geol. Surv. Rept. No. 5, p. 30). *Lehigh ls.*—Shaly argill. ls., 0 to 200 ft. thick. Uncon. underlies Martinsburg sh. and overlies Nazareth ls. Reaches max. development where it crosses Lehigh River. It is the rock generally called "Cement Rock." Is unquestionably=Trenton of N. Y.

Lehigh Valley cement rock.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 563).

Evidently same as Lehigh ls. of Peck.

Lehmer limestone member. (In Admire shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 5, 9). *Lehmer ls.*—Gray, usually weathering brownish, soft, porous; 3 to 4 ft. thick. Top memb. of Falls City ls. fm. Underlies West Branch sh. fm. and overlies Reserve sh. memb. of Falls City ls. fm. Is top bed at old Lehmer quarry, 4 mi. SW. of Falls City [Richardson Co.], Nebr.

Leidecker sand.

A subsurface sand, 25 ft. thick, of early Penn. (Cherokee) age, in central eastern Okla., which is reported to correspond to one of the sands of Dutcher sand series. In Boynton pool, Muskogee Co., it lies at 1,400 ft. depth, the Booch sand at 1,000 ft., and the Boynton sand at 1,500 ft.

Leigh dolomite member (of Bighorn dolomite).

Upper Ordovician (Richmond): Western Wyoming.

Leigh dol. memb. of Bighorn dol. was approved for U. S. G. S. publications in Jan. 1916, having been originally submitted to U. S. G. S. by E. Blackwelder in May 1913. It composes middle part of Bighorn dol. The first appearance of *Leigh* in print appears to be in paper by C. W. Tomlinson, Jour. Geol., 1917.

C. W. Tomlinson, 1917 (Jour. Geol., vol. 25, pp. 118, 255–257). *Bighorn dol.* is divisible into 9 members, of which members Nos. 6 and 7 compose *Leigh fm.* The lower memb. of the Leigh (No. 6, with a thickness of 93 ft.) contains lowest Richmond fauna, and in western Wyo. (Crandall Creek, Dead Indian Creek, Teton Range, and Absaroka Range) it is uncon. on memb. No. 5 (of Trenton age), with, on the two creeks mentioned, a basal breccia at its base. The upper memb. (No. 7) has a thickness of 38 ft. and is uncon. with overlying memb. (No. 8), which is also of Richmond age. Blackwelder (personal note) proposes recognition of members Nos. 6 and 7 in Teton Range, and of corresponding strata in Gros Ventre Range, as a distinct fm., to be called *Leigh*, from typical development on Leigh Creek, Teton Range. In view of fact that this group of strata, in its type loc., is bounded both above and below by uncon., and is lithologically quite distinct from underlying massive memb., which is not present in Teton River section, its recognition as separate fm. seems justified.

E. Blackwelder, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 419). *Leigh dol. memb. of Bighorn dol.*—From Teton Range eastward at least to middle of Wind River Mtns and N. into Absaroka Range, the massive memb. of well-known Bighorn dol. is overlain by a thin but persistent layer which deserves special recognition. In almost every section it is 30 to 40 ft. thick, and in most if not all localities it is limited both above and below by discon. Differs from rest of Bighorn in being characterized by thin, dense, and brittle flaggy strata with smooth milk-white surfaces. Is discon. overlain by Darby fm. (Dev.). Although it appears generally to be barren of organic remains, a characteristic fauna, consisting largely of ostracods with some pelecypods and gastropods, has been found at several localities. This fauna is assigned by Ulrich and Kirk to Richmond horizon of late Ord. The memb. is named for Leigh Canyon, on W. slope of Teton Range, for on S. side of that valley there are excellent exposures of the dol. in its typical condition. [Detailed section of Leigh dol. in Wind River Range is given.]

Leighton gray shale member (of Pembroke formation).

Silurian (post-Niagaran): Southeastern Maine.

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, pp. 6–7). *Leighton gray sh. memb.*—Chiefly bluish gray sh. distinctly stratified; thin bedded; in many places forming flagstones. Only here and there does it contain calc. layers. Some beds are largely fine volcanic débris, which grade into distinctly tuffaceous beds. Lower sh. memb. of Pembroke fm. Separated from underlying

Edmunds fm. by diabase tuffs and flows (the basal memb. of the Pembroke) and from overlying Hersey red sh. memb. by rhyolite flows and tuffs. Named for exposures on Leighton Neck, Pembroke Twp, Washington Co.

†Leighton's Cove series.

Silurian: Southeastern Maine.

N. S. Shaler, 1886 (Am. Jour. Sci., 3d, vol. 32, pp. 53, 56). *Leighton's Cove series* consists in main of shales, generally thin bedded and containing but little lime. About 200 ft. in thickness is exposed, but of this only upper half is fossiliferous. Fossils [listed] show relation to Clinton and Niagara in N. Y. Included in Cobscook series.

Replaced by *Leighton gray sh. memb. of Pembroke fm.*

Named for exposures at Leighton's Cove, Cobscook Bay dist., E. coast of Washington Co.

Leipers limestone.

Upper Ordovician (Maysville): Western Tennessee.

C. W. Hayes and E. O. Ulrich, 1903 (U. S. G. S. Columbia folio, No. 95, p. 2). *Leipers fm.*—Granular crystalline ls. in W. half of quad., changing in E. part of quad. to knotty earthy ls. overlying certain shaly and highly fossiliferous beds, and there divisible into 8 members. Thickness 0 to 100 ft. Contains Lorraine fossils. Uncon. underlies Fernvale fm. and uncon. overlies Catheys ls.

In Waynesboro quad. is overlain by Arnheim ls. of Richmond group and underlain by Hermitage fm.

Named for Leipers Creek, Maury Co.

†Leipers Creek limestone. (In Richmond group.)

Upper Ordovician: Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 432–433). *Leiper's Creek bed*, including the lss. and clays carrying Richmond group fauna. Consists of a so-called marble bed (gray, crinoidal, and coralline rock, spotted with red and having a flesh-colored appearance, associated with red, gray, and green layers) 6 to 10 ft. thick, overlain by about 6 ft. of clay sh. Similar beds occur near Fernvale Springs. Underlies Clinton ls. [In 1903 (Jour. Geol., vol. 11, pp. 41–43) Foerste excluded from his Leipers Creek ls. the upper clay sh., which he correlated with the beds there named by him "Mannie sh."]

Is lower part of Fernvale fm., and name conflicts with later but better established name *Leipers ls.*, which is of Maysville age.

Named for exposures on Leipers Creek, Maury Co.

Leitchfield marl. (In Chester group.)

Mississippian: Western central Kentucky.

C. J. Norwood, 1876 (Ky. Geol. Surv. vol. 1, n. ser., pt. 6, pp. 12, 13). *Leitchfield marls.*—Green, purple, red, and blue marly shales, 25 to 60 ft. thick, in middle of Chester group. Separated from underlying Big Clifty ss. [not true "Big Clifty"] by 20 to 70 ft. of ls. and shaly ss.

According to C. Butts (personal communication in 1918) the ss. referred to is not the "Big Clifty," which is absent at Leitchfield, but is either Tar Springs ss. or Hardinsburg ss., both of which are present at Leitchfield, and the marl described therefore lies in either Glen Dean ls. or Buffalo Wallow fm. According to P. N. Moore, 1878 (Ky. Geol. Surv., 2d ser., vol. 4, pt. 11, btw. pp. 423 and 444), 30 ft. of Leitchfield marls of Norwood are finely exposed in Buffalo Wallow, Hancock Co., about 3 mi. from Cloverport.

Named for exposures at Leitchfield, Grayson Co.

Leitchfield formation. (In Chester group.)

Mississippian: Western Kentucky (Webster and Edmonson Counties).

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 60). *Leitchfield fm.*—Oldest rocks exposed at surface in Webster Co. Thickness 400–600± ft. A series of lss., sss., shales, and marly clay; shales believed to be of Leitchfield age. Seemed not practical to subdivide. Has been mapped as one fm. called *Leitchfield*. Underlies Caseyville fm. May all belong to Birdsville fm., or may represent Birdsville and Tribune. Deep well on W. A. Duncan farm penetrated 598 ft. of Miss. rocks and ended at top of ss. that may be Cypress ss. The Leitchfield is underlain by older (unexposed) Miss. lss., sss., and shales.

J. M. Weller, 1927 (Ky. Geol. Surv., ser. 6, vol. 28, p. 136). *Leitchfield fm.*—Greenish gray and variegated shales, 0 to 125 ft. thick, underlying Caseyville fm. and overlying (probably uncon.) Glen Dean ls. in Edmonson Co. In part of county is completely eroded away. Is same as Buffalo Wallow fm. of Butts, except that Butts excluded Tar Springs ss. from Buffalo Wallow fm., but as this ss. is only locally developed in Edmonson Co. it is here treated as basal memb. of Leitchfield fm.

Leithsville formation.

Middle and Lower Cambrian: Eastern Pennsylvania (Lehigh Valley district).

E. T. Wherry, 1909 (Sci., n. s., vol. 30, p. 416). *Leithsville fm.*—Gray dol. with abundant sandy and cherty layers and buff-colored sh. beds. Thickness 1,500 ft. Underlies Allentown ls. and overlies Hardyston qtzite. Assigned to Middle and Lower Camb.

Probably named for Leithsville, Northampton Co.

Lemieux Creek formation.

Carboniferous (?): British Columbia.

J. F. Walker, 1931 (Canada Geol. Surv. Summ. Rept. 1930, pt. A, p. 131).

Lemont argillaceous limestone member (of Carlim limestone).

Lower Ordovician (Chazy): Central Pennsylvania (Blair to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 526, 533, 537). *Lemont argill. ls. memb.*—Richly fossiliferous ls. forming top memb. of Carlim ls. Underlies Lowville ls. Carries Chazyan fauna, which correlates with Crown Point ls. of N. Y. Named for Lemont, near State College, Center Co. [Thickness 0 to 105 ft.]

Lenapah limestone.

Pennsylvanian: Northeastern Oklahoma and southern Kansas.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 6, 10, 11, 12). *Lenapah ls.*—A ls. lying at approx. horizon of Upper Parsons or Coffeyville ls. of Kans. Basal memb. of Sapulpa group. Rests on Tulsa group.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4). *Lenapah ls.*, 8 to 20 ft. thick, overlies Nowata sh. (top fm. of Tulsa group) and underlies Curl fm.

D. W. Ohern and R. E. Garrett, 1912 (Okla. Geol. Surv. Bull. 16). *Lenapah ls.* underlies Coffeyville fm. and overlies Nowata sh. Is well exposed in quarry N. of Lenapah, Nowata Co., Okla. Not known to extend S. of Nowata, its position to S. being marked approx. by Dawson coal. [This is commonly accepted definition of Lenapah ls.]

In Kans. Lenapah ls. has been treated as top memb. of Parsons fm., which as defined was overlain by Dudley sh. and underlain by Bandera sh. But R. C. Moore has recently abandoned both Dudley and Parsons, and treats Lenapah ls. as a distinct fm. (See Kans. Geol. Surv. Bull. 22, 1936.) The U. S. Geol. Survey has not yet had occasion to consider these changes in definitions and classification.

Lennep sandstone. (Of Montana group.)

Upper Cretaceous: Central southern Montana (Little Belt Mountains to Bighorn County).

R. W. Stone and W. R. Calvert, 1910 (Econ. Geol., vol. 5, p. 746). *Lennep ss.*—Dark-colored ss. with intercalated sh. Thickness 250 to 400 ft. Underlies Lance fm. and overlies Bearpaw sh. Not definitely correlated with Fox Hills ss. Named for Lennep Station, on C., M. & P. S. R. R., at N. end of Crazy Mtns.

Lenoir limestone. (Of Stones River group.)

Lower Ordovician (Chazy): Eastern Tennessee, northern Alabama, and western Virginia.

J. M. Safford and J. M. Killebrew, 1876 (Elements of geol. of Tenn., pp. 108, 123, 130–131, 137). *Lenoir ls.*—Soft blue shaly fossiliferous ls. 100 to 600 ft. thick. Same as *Maclurea* ls. of Rept. on geol. of Tenn. In W. part of valley, next to Cumberland Plateau, is not separated from overlying ls. by any well-marked characters. Is of Chazy age. Older than Lebanon [Stones River] group. Overlies Knox dol.

There is no conclusive evidence to show whether Mosheim ls. (Ulrich, 1911) was originally included in Lenoir ls. or in Knox dol. It is uncon. separated from overlying and underlying beds, and according to E. O. Ulrich and C. Butts it differs from the Lenoir in lithology, color, and fauna, but is of Chazy age, as is the Lenoir. According to A. Keith (personal communication) all of the chertless lss. were excluded from the Knox by Safford in his definition and in his mapping.

The Lenoir ls. is now considered by E. O. Ulrich and C. Butts to be top fm. of Stones River group of eastern Tenn. and western Va., where it overlies Mosheim ls., and this is adopted definition of U. S. Geol. Survey.

Named for exposures at Lenoir Station, Loudon Co., Tenn.

Lenore erosion cycle.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 319–340). Interglacial erosion cycle following Bull Lake glacial stage and preceding Pinedale glacial stage. Valleys cut during this cycle locally accommodate ranches at Lenore.

Lenox limestone member (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 37, map, sections). *Lenox ls. memb. of Bingham qtzite.*—In Lenox mine consists of dark siliceous ls., either bluish or blackish. Much of silica is in chert nodules and layers, but more is disseminated through ls. mass in microscopic grains. Top passes by sandy lss. and marbles into overlying qtzites. About 50 ft. below top is a layer of ls. cgl. a few ft. thick. At 50 ft. below the cgl. are layers of qtzite that grade through calc. ss. into the lss. above and below. Thickness 200± ft. in Lenox mine but considerably less at other places. [Sections show Lenox ls. as lying much lower than Jordan ls. memb. of Bingham.]

Lenoxdale moraine.

Pleistocene (Wisconsin stage): Western Massachusetts (Berkshire County). (See F. B. Taylor, 1903, Jour. Geol., vol. 11.)

Leon series.

Upper Cambrian and Lower Ordovician(?): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxii, 295–301). *Leon series.*—Consists of (descending): Compact ls. (Hoover div.); siliceous mag. lss. (Wyo div.); sandy, shaly, buff, sometimes yellow, dol. (Beaver div.). Overlies Katemcy series (Potsdam) and underlies San Saba series.

Is a part of Ellenburger ls.

Named for Leon Creek, Mason Co.

Leona formation.

Pleistocene: Southern Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 253–254, 275–276). *Leona fm.*—Pleist. flood-plain deposit of fine calc. silt grading down into coarse gravel, composing first wide terrace of Nueces and Leona Rivers below level of Uvalde fm., and flood-plain deposit extending W. from Uvalde, on Leona River, to Nueces River. May ultimately be correlated with Onion Creek marl of central Tex.

Named for Leona River, Uvalde and Zavalla Counties.

Leona rhyolite.

Tertiary (Pliocene?): Western California (San Francisco region).

A. C. Lawson. 1914 (U. S. G. S. San Francisco folio, No. 193). *Leona rhyolite.*—Pyritic lava that forms a discontinuous belt along W. front of Berkeley Hills, from Hamilton Gulch in Berkeley nearly to Decoto, a distance of 21 mi. Reaches max. width a little S. of Leona Heights, Alameda Co. Is in general an acidic or rhyolitic lava, but includes local masses of darker, more basic rock. Is of about same age and same chemical composition as Northbrae rhyolite, but has certain physical differences. Thickness about 500 ft. Classified as Plio., but its age is not proved, and it may belong to some other series of the Tert.

Leonard formation.

Permian: Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex., Bur. Econ. Geol. and Tech. Bull. 44, p. 51). *Leonard fm.*—In Leonard Mtn and to N, consists of (descending): (1) Thinly laminated yellowish ss. interbedded with layers of gray ls., yellow chert, and gray shales; (2) heavy and thinly bedded gray ls., in part conglomeratic or containing pebbles of different sizes; (3) shales and soft sss. interbedded with a dark gray ls.; (4) at base cgl. 20 to 200 ft. thick. Thickness of fm. 1,800 to 2,300 ft. Underlies Word fm. and uncon. overlies Haymond fm. (Penn.). [Included Hess fm. of later repts.]

J. A. Udden, 1917 (Univ. Tex. Bull. 1753, pp. 43–46, pl. 3). *Leonard fm.*—Upper 600 ft. consists chiefly of sh. intercalated with well-cemented calc.-sh. breccias; in lower two-thirds lss. and cgls. are predominant, but cherty and sandy shales are interbedded, also some ss. beds. Thickness 206 to 1,878 ft. in Glass Mtns. Distinguished from underlying Hess fm. by regular development of bedding planes, by far less perfect sorting of clastic components, and by general abundance of fossils. Distinguished from overlying Word fm. by coarser and less well sorted nature of its sands and by relatively less amount of bituminous material in lss. and sands. It makes greater part of S. face of Leonard Mtn.

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). Lower half of beds provisionally referred by Udden to Leonard fm. on Leonard Mtn is in reality Hess, a fact suspected by Udden.

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 57–69). [See 1931 entry under *Hess fm.*] Leonard fm. thins from W. to E. across Glass Mtns, and can be divided into a western and an eastern facies. The W. facies is 1,800 ft. thick in vicinity of Lenox, where it consists of lss., mostly in thin beds of radiolaria-bearing siliceous shales and cherts, and of sss. and shales. The ls. and ss. beds are nearly all conglomeratic. The E. facies as exposed E. of Hess Canyon resembles the W. facies but is only 300 ft. thick. It is 900 ft. thick N. of Leonard Mtn, 7 mi. from Sullivan Peak, where it is 1,800 ft. thick. The E. and W. facies interfinger, but the Hess and Leonard fms., although in part contemp., do not seem to intergrade. Conformable with overlying Word fm. NE. of Word Ranch, but W. of Leonard Mtn contact is not well enough exposed over distances great enough to furnish decisive evidence as to relations.

P. B. King, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 337–354). There is good evidence to show a partial lateral intergradation btw. Leonard and Hess fms., and even a probability that the whole of one fm. is actually the lateral facies of the other.

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–798). The Hess fm. of previous repts is contemp. with and grades into lower part of Leonard fm. It is therefore here designated *Hess thin-bedded ls. memb. of Leonard fm.* [This is definition of Leonard fm. now recognized by U. S. Geol. Survey.]

Forms greater part of S. face of Leonard Mtn, Hess Canyon quad., Brewster Co.

†Leopard sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, p. 456). The "*Leopard*" *sss.* of old Hancock quarry underlie Nonesuch sh. group.

†Leptauchenia beds.

A paleontologic name that has been applied to upper part (*Leptauchenia* zone) of Brule clay (Olig.) of western Nebr. and S. Dak.

Lequire sandstone member (of McAlester shale).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, McIntosh, and adjacent counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Lequire ss. memb. of McAlester sh.*—Massive ss.; medium texture; friable; brown to gray; plant remains. Thickness in Muskogee-Porum area 12 to 25 ft. Lies 8 to 40 ft. above Warner ss. memb. and 40 ft. below Cameron ss. memb. Named for exposure a little N. of Lequire, secs. 4 and 5, T. 7 N., R. 22 E., and secs. 32, 33, and 34, T. 8 N., R. 22 E.

Leray limestone member (of Lowville limestone).

Middle Ordovician: Central to eastern New York.

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 138, p. 72), mentioned the "cherty ls. or the *Leroy* [misprint for Leray] *memb.* of the Lowville fm."

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 145, pp. 79–90, 97). *Leray ls. memb.*—The uppermost part of Lowville beds, which has been mentioned by earlier authors as "cherty beds," has been found by Professor Cushing and writer to be quite distinct from typical Lowville beds and separated from them by uncon. It has for that reason been here distinguished as a subdivision under name *Leray ls.* Underlies Watertown ls. and rests on lower part of Lowville fm., here called *Lowville ls. s. str.* Named for exposures in town of Leray [Lerayville, Jefferson Co., according to W. Goldring, 1931 rept. cited below].

See further explanation under *Lowville ls.*, of which Leray ls. constitutes top memb., according to present classification of U. S. Geol. Survey and N. Y. State Survey (W. Goldring, 1931, N. Y. State Mus. Hdb. 10).

†Leroux formation.

Upper Triassic: Northern Arizona.

L. F. Ward, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 401–413). *Le Roux beds.*—Consist of (descending): Calc. marls. sometimes worn into buttes, 200 ft.; mortar beds, 80 ft.; ls. ledge, 20 ft.; ss. ledge, 100 ft.; and variegated marls, argill. and calc., 400 ft. Underlie Painted Desert beds and rest on Shinarump cgl.

Is upper part of Chinle fm. of present nomenclature. See U. S. G. S. P. P. 93, 1917, by H. E. Gregory.

Named for Le Roux Wash, Navajo Co.

†Le Roy shale.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 110). *Le Roy shales.*—Sh. and ss., 150 ft. thick, underlying Burlington or Garnett ls. and overlying Carlyle ls. in section along Neosho River from Indian Territory to White City, Kans.

In broad sense in which name was subsequently used it represents all of Douglas group as originally defined except Oread ls.; in restricted sense it is same as Weston sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 139, 140, 146, 152). †LeRoy sh. of Haworth and Kirk (1894) included Weston sh., Iatan ls., Stranger fm., and Haskell ls., and is discarded.

Named for development in vicinity of LeRoy, Coffey Co.

Le Roy moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. Regarded as probably=Cerro Gordo moraine.

Lester limestone member (of Dornick Hills formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 14). [See under *Bostwick memb.*]

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 32–33). Above Bostwick memb. of Dornick Hills fm. occur 5 or 6 richly fossiliferous lss., which were included by Goldston in his Cup Coral memb. to N. of Ardmore, but in his Deese memb. to S. of Ardmore. The lowest of these which is substantial enough to be mappable for considerable distances is called *Lester ls. memb.*, from a good exposure on D. B. Lester farm beside the paved highway, about 800 ft. S. of NE. cor. sec. 13, T. 4 S., R. 1 E. It is white, rather coarsely crystalline, and carries considerable oolite at type loc., but much less elsewhere. Max. thickness 20± ft. This ls. at type loc. was mapped by Goldston as Otterville. Interval btw. Bostwick and Lester members N. of Ardmore is 400 to 500 ft., but to S. increases to twice this figure. Included in this interval are 2 or 3 other highly fossiliferous lss. from a few in. to 2 ft. thick.

Lester River group.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 143–146). *Lester River group.*—Succession of heavy distinct beds of fine-grained brown rocks, largely of "ashbed" type; some diabase porphyrites, ordinary diabases, two or three belts of granite porphyry; amygdaloids almost unknown, and no detrital material. Thickness 2,600 ft. Included in Keweenaw series. Overlies Duluth group and underlies Agate Bay group.

Named for exposures on Lester River, Minn.

†Lesueur dolomite.

Upper Cambrian or Lower Ordovician: Southeastern Missouri.

C. R. Keyes, 1895 (Mo. Geol. Surv. Sheet Rept. No. 4 (vol. 9), pp. 18, 52–53). *Lesueur dol.*—Very cherty dol., 250 ft. thick, overlying Fredericktown ls. and underlying Recent alluvium in Mine La Motte dist.

C. R. Keyes, 1901 (Am. Geol., vol. 28, pp. 51–53). *Le Sueur dol.* (Keyes, 1895) represents only lower third of Winslow's (1896) Potosi ls., and it is doubtful if it occurs at all in Potosi ls. farther N. near typical Potosi locality.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 41–42). *Lesueur ls.*, 200 ft. thick, overlies Fredericktown ls. and underlies Decaturville ls. (=Proctor ls.).

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12). *Lesueur ls.* is=Gasconade ls. [broad sense], which overlies Elvins fm. and underlies Roubidoux fm. [Same definition was given by G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 67).]

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 254). *Le Sueur dol.*, 250 ft. thick, is older than Davis fm. and overlies Fredericktown ls.

J. Bridge, 1930 (personal communication). Lesueur dol. includes some Gasconade at top and Eminence and Potosi at base, with Proctor dol. and Gunter ss. absent in Lesueur region.

Named for Lesueur Hill, St. Francois Co.

Letchworth shale.

Upper Devonian: Western New York (Genesee River region).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96–99, 193). I am proposing now to restrict *Gardeau* to that part that is common to Clarke's and Hall's usages, calling all those shales that Hall included in his original Portage, but which Clarke transferred to the Gardeau, namely, those beginning with *Table Rock ss.* at top of lower Portage Falls, by the new name *Letchworth sh.*, derived from Letchworth Park (State reservation) [SW. of Mount Morris, in Livingston Co.], in which they are completely displayed. *Table Rock ss.* is basal stratum of this sh., which underlies Portage (Nunda) ss. in type section of Portage on Genesee River.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included this sh. in *Chemung group*.

Levanna shale. (In Hamilton formation.)

Middle Devonian: Western and central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 217+). *Levanna sh.* is here proposed for the sh. btw. Stafford or Mottville memb. of Skaneateles fm. and Centerfield memb. of Ludlowville fm., where it is essentially the "Marcellus or Leiorhynchus facies" of Skaneateles fm. and can not be differentiated into members.

Clarke in 1903 proposed *Shaffer sh.* for Skaneateles equiv. on Schaffer Creek. But Shaffer sh. only represents part of the Skaneateles; the sh. is poorly exposed along this creek; and *Shaffer sh.* is dropped in favor of *Levanna sh.*, taken from a locality where the rocks are better exposed and the section is complete. The Levanna memb. extends from Cayuga Lake to Lake Erie. It is mostly dark gray or black sh. characterized by fauna with a Marcellus facies. To W. black sh. increases. To E. of type section (in Skaneateles Lake region) the Levanna can be divided into several members. It is Second *Leiorhynchus* zone of Cleland. Thickness 45±ft. (at Lake Erie) to 250± ft. (at Seneca Lake). [His diagrams show that his Levanna sh. comprises all of Skaneateles sh. except Stafford ls. (3 to 15 ft. thick) at base, which has heretofore been included in Marcellus sh. Probably named for Levanna, Cayuga Co.]

This is only record of this name.

†Levant series.

Nongeographic name introduced by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to include "waterlime fm." of N. Y. at top and all intervening rocks to base of Medina group of N. Y. Redefined by Rogers in 1858 (Geol. Pa., vol. 1, pp. 105, 126–131, 271+, and vol. 2, p. 753) and restricted to Medina group and Oneida cgl. Divided into (descending): *Levant white ss.* 450 ft. thick (divisions II, III, and IV of Medina ss. of N. Y.); *Levant red ss.* (lowest memb. of div. I of Medina ss. of N. Y.), 500–700 ft. thick in Centre and Huntingdon Counties, Pa.; and *Levant gray ss.* (Oneida cgl. of N. Y.), 250–400 ft. thick in Centre and Huntingdon Counties.

Named to indicate "sunrise period of great Appalachian Palaeozoic day," according to Rogers, 1844 citation.

†Levant sandstone.

See under †*Levant series*.

Leverett breccia.

Upper Triassic: Western Massachusetts (Sunderland).

D. D. Reynolds and D. H. Leavitt, 1927 (Am. Jour. Sci., 5th, vol. 13, pp. 167–171). *Leverett breccia*.—A typical breccia, unlike any other encountered in Conn. Valley. Forms core of E. scarp of Mount Toby, just W. of old station, with height of about 200 ft. and width of about ⅛ mi. About 70 percent of fm. consists of a dark fine-grained metamorphic rock, which in places composes all of deposit. Elsewhere there are basic schists, a gray granite, a pink coarse-grained granite, and small amounts of quartz. Color gray to black. Contains no trace of water action. Grades into Mount Toby cgl. through a reddish transition zone. Is believed to be a talus breccia in midst of alluvial fan forming Mount Toby cgl. Named for nearest town.

Levias limestone member (of Ste. Genevieve limestone).

Mississippian: Western Kentucky and adjacent part of southern Illinois.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430, 439). The Ohara as originally defined should not be considered a strat. unit, because it transgresses an important uncon. and is capable of easy subdivision. The part that has been termed "Upper Ohara" is strictly=the Renault of Ill. The "Lower Ohara" is a well-defined memb. of the Ste. Genevieve and is worthy of a distinctive name. Were it not for persistent use of Ohara by Butts and Ulrich for beds of Renault age in western Ky. and probably elsewhere, this name might be redefined and restricted to lower part of original memb. Under the circumstances, however much the writers regret doing so, it seems advisable to reject *Ohara* as a name made useless by nearly 30 years of misinterpretation, and the name *Levias*, with type loc. just E. of town of that name in Crittenden Co., Ky., is now proposed for *uppermost memb. of the Ste. Genevieve* btw. Rosiclare ss. [below] and Renault fm. [above] in western Ky. and adjacent part of southern Ill.

Levis formation.

Ordovician and Cambrian: Quebec.

W. E. Logan, 1863 (Canada Geol. Surv. Rept. 1843–63, pp. 225–297). *Levis fm.*—Lower Sil.; eastern Canada; exact synonym of Calciferous; included in Quebec group.

Canada Geol. Surv. repts continued to include this fm. in Ord., but W. A. Parks, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 788), suggested Camb. (?) age.

The paleontologists of U. S. Geol. Survey interpret the faunas of Levis fm. as Lower Ord. and Upper Camb.

Levis shale.

Devonian: Quebec.

J. F. McMahon, 1933 (Canada Dept. Mines, Mines Branch Pub. 726, p. 56). *Levis sh.*, Devonian, Quebec.

†Levyville formation.

Eocene (upper): Northern Florida.

L. C. Johnson, 1888 (Am. Jour. Sci., 3d, vol. 36, pp. 230–236). *Levyville fm.*—Possibly these irregular deposits may be remnants of Nummulitic ls., which is really in stratum overlying the Vicksburg rocks, well seen at old iron works near Levyville, Levy Co. At Levyville it is a beautiful soft porous building stone, about 20 ft. thick, which was utilized in erection of Confederate iron-works. It is often struck in artesian borings and easily identified by the peculiar nummulites. It has a greater thickness under the Neocene fms. to E. In these western regions it has probably suffered general removal by erosion. Apparently conformable in deposition with the Vicksburg stage; the Levyville fm. is evidently not identical with it, and demands a further investigation. It is a mistake, however, to suppose that this Nummulitic fm. everywhere hides the Vicksburg rocks of the *Orbitoides Mantelli*, or ever did overlie the whole of it. Numerous exposures prove the contrary. In many places, especially in Alachua Co. and northward, the outcrops can not be distinguished from the rocks of Vicksburg and of the Chickasawhay, Miss.

Now considered to be same as Ocala ls., and older than Vicksburg group, which it was originally supposed to overlie.

Lewes River series.

Triassic: Canada (Yukon).

E. J. Lees, 1934 (Roy. Canadian Inst. Trans., vol. 20, pt. 1).

Lewis shale.

Upper Cretaceous (of Montana age): Western Colorado, northwestern New Mexico, southern and central Wyoming.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60). *Lewis sh.*—A series of more or less sandy shales and clays, of gray or drab color, very similar in character to Mancos sh. Includes, in varying abundance, thin calc. lenses or concretions of impure ls. Only 200 or 300 ft. of fm. now remains in this quad., but in adjoining Durango quad. the entire thickness of 2,000 ft. is exposed. Rests on Mesaverde fm. It occurs as a band btw. the Mesaverde and *Piedra* [not defined in this or any subsequent rept. by Cross; probably refers to deposits later called "Laramie fm." in this area] fms. as far as these divisions of the Cret. have been traced in this part of Colo. Is the "Sand Shale Group" of Holmes' general section of SW. Colo. [which was defined as overlain by Pictured Cliffs ss.]. In this quad. it is overlain by Pleist. gravels. Named for occurrence at Fort Lewis, in La Plata Valley [sec. 3, T. 34 N., R. 11 W., La Plata Co.]. Its fossils are of Pierre age.

N. M. Fenneman and H. S. Gale, 1906 (U. S. G. S. Bull. 297). In Yampa coal field of NW. Colo. the beds here called *Lewis sh.* consist of 1,000 to 2,000 ft. of soft dark-gray or black clay sh., with layers or lenticular beds of a compact blue ls. and secondary calcite seams. They grade, through rapid transition, into overlying Laramie fm. [so-called] and into underlying Mesaverde fm., and are thought to be entirely analogous to typical Lewis sh. of SW. Colo. The entire fm. is of late Montana age.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). The marine *Lewis sh.* of N. side of San Juan Basin of SW. Colo. is in part contemp. with major upper part of Mesaverde group of W. and S. sides of that basin and is in part younger. It can be traced continuously some distance N. from type loc., and except for some interruptions on E. side has been identified clear around San Juan Basin. It has not been identified, if present, to W., S., or E. of San Juan Basin. The time interval of typical Lewis sh. is unquestionably represented outside of San Juan Basin by sediments that cover wide areas. It is impossible, however, to fix upon its equiv. exactly. In a general way it is synchronous with some part of middle and upper portions of Pierre sh. to E. of Rocky Mtns, but more exact correlation must wait upon a more detailed knowledge of the ranges of species within the Montana group. The so-called Lewis sh. of various parts of Wyo. certainly is not the same as Lewis sh. of San Juan Basin. In Wyo., at several localities, the upper part of the fm. contains a true Fox Hills fauna, later than fauna of any part of Lewis sh. or Pictured Cliffs ss. of San Juan Basin, and it does not fit the lithologic definition of Lewis sh., because it contains at many places thick fresh-water deposits with coal beds and heavy sss.

†Lewis series.

A term applied by R. A. Daly (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 49, table opp. p. 178, 1913) to rocks in Lewis Range (Montana-British Columbia) which he assigned chiefly to Lower, Middle, and Upper Camb., but which he correlated with rocks classified by U. S. Geol. Survey as pre-Camb. Includes Kintla argillite (at top) down to Waterton dol. (at base), the latter not known to be present in Mont.

†Lewisburg limestone.

Mississippian: Virginia and West Virginia.

W. M. Fontaine, 1876 (Am. Jour. Sci., 3d, vol. 11, pp. 276–284, 374–384). *Umbral or Lewisburg ls.*, the base of the Umbral series of New River region, W. Va. Is more than 822 ft. thick. Rests on Vespertine series and is overlain by 320 ft. of blood-red shales and sss.

W. M. Fontaine, 1877 (Am. Jour. Sci., 3d, vol. 13, pp. 37–48, 115–123). The *Lewisburg or Lower Carbf. ls.* is absent in Pa. It is probably = St. Louis and Chester groups. Rogers put it in his Umbral. It rests on Vespertine or No. X group. Along Greenbrier River it is underlain by 250 ft. of red beds which lie on the coal-bearing memb. of the Vespertine.

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, pp. 521, 536), reported 49 ft. of Lewisburg ls. in Pa., and stated that in Greenbrier Mtn, Pocahontas Co., W. Va., it is 822 ft. thick.

Same as Greenbrier ls., the better-established and commonly accepted name. Probably named for Lewisburg, Greenbrier Co., W. Va.

†Lewisburg group.

Upper Triassic: Central southern Pennsylvania (Dauphin and York Counties).

G. H. Ashley, 1931 (Topog. and Geol. Surv. Pa. Bull. G_1, p. 77). *Lewisburg group.*—Soft red sh. with some red ss., 3,500 ft. thick, underlying Lisbon group and overlying Conewago group in Dauphin and York Counties. All of Upper Tr. age. [Credited to [M. H.] Bissell. "Lewisburg" (preoccupied) is apparently a misprint for *Lewisberry* and "Lisbon" (preoccupied) is apparently a misprint for *Lisburn*. When the Triassic of New Cumberland quad. (in which occur the geographic features *Lisburn* and *Lewisberry*) was differentiated for 1931 geol. map of Pa. these rocks were included in Gettysburg sh.]

Lewisport limestone.

Pennsylvanian: Western Kentucky (Hancock County).

D. B. Chisholm, 1931 (Ky. Geol. Surv., ser. 6, vol. 41, pp. 221, 225). *Lewisport ls.*—Lies near top of Tradewater fm. in Hancock Co., Ky. Present at many places in county. Rests on Lewisport coal. Is overlain by 90 ft. of shales and sss. in which are interbedded 1 or 2 thin coals. Very fossiliferous, and of same color and physical characteristics, both when fresh and weathered, as Lead Creek ls., which lies 85 ft. lower in Tradewater fm. Fossils not so large as those in Lead Creek ls. [Probably named for Lewisport, Hancock Co.]

Lewis Run sand.

Drillers' name for a sand in Bradford dist., McKean Co., NW. Pa., lying 60 or 70 ft. below 3d Bradford sand and 70 or 80 ft. above 1st Kane sand. Probably=*Windfall sand*, which is called the Fourth in NE. part of Bradford dist. These sands do not seem to occur outside Bradford dist. (See Pa. Geol. Surv., 4th ser., Bull. M19, 1933, pls. 17, 20, p. 28.)

†Lewiston shale.

Upper Ordovician (Richmond): Western New York and Ontario.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). *Lewiston sh.* (*Richmond*).—The "lower Medina" of [C. A.] Hartnagel's early descriptions. Is true time equiv. of Richmond beds. These shales are continuous with underlying Oswego ss., of Lorraine div., and underlie, with suggestion of discon., *true Medina ss.* [Medina restricted].

Replaced by *Queenston sh.*, which has slight priority of publication.

Named for exposures at Lewiston, Niagara Co., N. Y.

Lewiston limestone.

Devonian and Silurian: Appalachian region.

See *Lewistown ls.*

Lewistown limestone.

Devonian and Silurian: Central Pennsylvania.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 1–9). *Lewistown ls.* included in Lower Helderberg series. Underlies Oriskany ss. and overlies Waterlime series. [As thus defined the name applied to rocks now called Helderberg group and differentiated into several named fms., but as used in some repts it included beds of Cayuga age.]

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, pp. xvii–xxxii). Lower Helderberg ls. divided into *Lewistown ls. sh.* and *Lewistown ls.*, the latter resting on the Waterlime. The Lewistown ls. consists of heavy bed of subcrystalline bluish gray ls.; in some places it carries a bed of chert at top. The ls. is 185 ft. thick at Lewistown [Mifflin Co.], 215 ft. thick at McVeytown, and only 35 ft. thick at Mount Union.

This ls. has also been called "Lewiston ls." In parts of central Pa. it has been divided into several named units. (See Pa. chart.)

Lewistown limestone shale.

Lower Devonian: Central Pennsylvania.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, pp. xvii–xxxii). Lower Helderberg ls. divided into (descending) *Lewistown ls. sh.* and Lewistown ls. The *Lewistown ls. sh.* consists of a shaly ls., an argill. and in part siliceous sh., with some thin beds of hard blue ls. It is 140 ft. thick at Lewistown [Mifflin Co.], 130 ft. thick at McVeytown, and 18 (?) ft. thick at Mount Union. Underlies Oriskany shales.

†Lewistown chert lentil.

Lower Devonian: Northeastern West Virginia.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Lewistown chert-lentil.*—Cherty ls., 130 to 300 ft. thick, forming top memb. of Lewistown ls. Underlies Monterey [Ridgeley] ss.

Apparently same as Shriver chert.

Lewisville marine member (of Woodbine sand).

Upper Cretaceous (Gulf series): Northeastern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 114–115, 297). *Lewisville beds.*—Lignitic sandy clays and sands, frequently accompanied by sulphate of iron, mag. salts, etc. Thickness not determined. Middle part of Woodbine sand. Replaces "Timber Creek bed." Overlies Dexter sands and underlies less ferruginous sands and clays composing upper part of Woodbine. [The latter ferruginous sands and clays are now known to belong to the Eagle Ford.]

Is upper memb. of Woodbine sand.

Named for exposures at Lewisville, Denton Co.

†Lexington group.

Pennsylvanian: Western Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. Rept. on Iron Ores, pt. 2, pp. 169, 187). *Lexington group*.—Shales and lss., with little ss. and clay, 70 ft. thick, including beds Nos. 43 to 55 of detailed section of lower Coal Measures from Sedalia to Kansas City. Underlies Holden group and overlies Warrensburgh group.

Replaced by better-established name *Henrietta fm.*, of which it is approx. equiv.

Probably named for exposures at Lexington, Lafayette Co.

Lexington limestone.

Middle Ordovician: Central western Virginia.

J. L. Campbell, 1879 (Am. Jour. Sci., 3d vol. 18, p. 29). [See under *House Mtn. shales.*]

J. L. Campbell, 1880 (The Virginias, vol. 1, pp. 41–45). *Lexington lss.*—Of Trenton age. Underlie House Mountain shales and overlie Coralline lss. in Great Valley of Va., central Va.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). Liberty Hall ls. replaces Lexington ls., preoccupied. Mohawkian fossils are abundant in lower beds.

Lexington limestone.

Middle Ordovician: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 2). *Lexington ls.*—Thin-bedded gray ls., with chert nodules at base and persistent band of chert at top; 140 to 160 ft. thick. Overlain by Flanagan chert and underlain by Highbridge ls.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2), placed top of *Lexington stage* at top of the cherty horizon, which is Flanagan chert of Campbell.

J. M. Nickles, 1905 (Ky. Geol. Surv. Bull. 5), A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7), and A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 317–342), drew top of *Lexington ls.* at top of Perryville.

G. C. Matson, 1909 (U. S. G. S. W. S. P. 233), treated *Flanagan chert memb.* as top div. of Lexington ls., and described it as 75 ft. thick and usually lighter-colored and more cherty than underlying beds of Lexington ls.

The *Flanagan ls.* is now treated as a distinct fm., and the underlying Lexington ls. of Campbell has been divided into several named units. (See Ky. correlation chart.)

Named for development at and around Lexington, Fayette Co.

See also under *Bourbon series*.

Leyden argillite.

Silurian (?): Central northern Massachusetts and southeastern Vermont (Windham County).

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Leyden phyllite* (argillite).—Overlies Conway schist.

B. K. Emerson, 1894, as reported by R. Pumpelly (U. S. G. S. Mon. 23, pp. 29–30). *Leyden argillite*, with intercalated quartz schist, overlies Conway schist.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 196–208). *Leyden argillite* consists of dark coarse sl. or fine-grained mica schist, with chiastolitic contact zone at base. Thickness 300 ft. Rests on Conway schist. Named for occurrence in Leyden [Twp], Mass. Is widespread in Vt. [See also B. K. Emerson, U. S. G. S. Bull. 597, 1917.]

Lias.
Liassic. } Terms applied by European geologists to Lower Jurassic series.

Liberty formation.
Liberty limestone (in Ohio). } (In Richmond group.)

Upper Ordovician: Southeastern Indiana, southwestern Ohio, and north-central Kentucky.

J. M. Nickles, 1903 (Am. Geol., vol. 32, p. 207). *Liberty or Strophomena planumbona beds.*—Even-bedded lss. in layers averaging 3 inches in thickness, prevailingly blue in color, with intervening clayey and shaly layers, also usually of blue color, thickness 35 ft. Overlain by Whitewater or *Homotrypa wortheni* beds and underlain by Waynesville or *Bythopora meeki* beds.

In many subsequent repts the overlying fm. was stated to be Saluda ls. (see under *Saluda ls.*), but more recent repts describe Saluda as a wedge in lower part of Whitewater fm., and define Whitewater as resting on Liberty fm. The U. S. Geol. Survey still treats Saluda ls. as a distinct fm.

J. J. Wolford, 1930 (Ohio Jour. Sci., vol. 30, No. 5, p. 304). Base of Turkey Track ls. layer has been designated by Dr. Geo. M. Austin as plane of div. btw. Whitewater and Liberty fms. in SW. Ohio.

Named for Liberty, Union Co., Ind.

†Liberty Hall limestone.

Lower Ordovician (Chazy): Central western Virginia.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). *Liberty Hall ls.*—Usually a succession of rather evenly banded beds of fine-grained dark-blue ls. and darker, more argill. ls. that weathers shaly. Upward in the fm. calc. sh. predominates and ls. beds are less frequent. Thickness 1,000± ft. Mohawkian fossils abundant in lower beds. Is same as Lexington ls. (preoccupied) of J. L. Campbell, 1879. Overlies Murat ls. Named for old historic ruin, which is constructed on and of this rock, which has been standing for more than a century and is as well known as Lexington itself.

E. O. Ulrich, 1913 (12th Int. Cong. Geol., Canada, p. 22). Upper part of Liberty Hall ls. is of Black River age. Age of lower part is in doubt.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 1). *Liberty Hall ls.* is all of *late* Black River age and = Moccasin ls.

R. S. Bassler, 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51). [Same as 1915.]

The Moccasin ls. was in 1922 assigned to Lowville epoch (lower Black River) by E. O. Ulrich.

Now considered by C. Butts to be same as Athens ls. (older name) and has been discarded. The Athens is classified as Lower Ord.

Lick Creek sandstone member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 9). *Lick Creek ss. memb.*—Cgl. and thin-bedded ss. of wide extent, the cgl. varying somewhat in character. Thickness about 50 ft. Is a memb. near middle of Pottsville fm. in Warrior coal field. Is overlain by Jagger coal in some places, and in other places the Jagger coal is included in the ss., near its top. The Lick Creek ss. overlies Ream coal.

Named for exposures along Lick Creek in vicinity of Kimberly, Jefferson Co.

Lick Creek sandstone member. (In Pottsville formation.)

Pennsylvanian: Southwestern Illinois (Carbondale quadrangle).

J. E. Lamar, 1925 (Ill. State Geol. Surv. Bull. 48, pp. 23, 85–91, and map). In general the Lick Creek ss. memb. of Pottsville fm. is a massive medium to coarse-grained brown to buff ss. Locally, where it is conglomeratic, it contains pebbles of vein quartz. The conglomeratic materials occur mostly in zones or beds from ½ to 10 ft. thick, averaging about 3 ft. and are lenticular. In places sh. is present and the ss. is in part thin-bedded. Cross-bedding is pronounced throughout the memb. Thickness 80 to 140 ft. in W. part of quad. and 125 to 170 in central and E. parts of quad. Lies, probably conformably, on Wayside sh. and ss. memb. and is conformably overlain by Drury sh. and ss. memb. of the Pottsville. Named for village of Lick Creek, Union Co., where it is prominently exposed in that part of Pottsville scarp known as Cedar Bluff.

Licking shale.

Mississippian: Central Ohio.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, p. 216). *Licking shales.*—Top fm. of Waverly group in central Ohio. Consists of 100 to 150 ft. of beds, divided into (descending): (1) 3 to 10 ft. of compact fine-grained fossiliferous drab ss.; (2) friable earthy gray or olive shales; and (3) fossiliferous shaly drab ss. which comprises about one-third of whole. Underlain by Black Hand cgl. and Granville beds, and overlain by Coal Measures cgl.

Named for Licking River, from Newark to Black Hand.

Light House granite.

Pre-Cambrian: Central southern Connecticut.

F. Ward, 1909 (Am. Jour. Sci., 4th, vol. 28, p. 131 and map). *Light House granite.*—Medium-grained pink or reddish granite. Named for Light House Point, its most westerly occurrence. Extends to Branford Harbor. Imperceptibly grades into Branford granite. The Light House and Branford granites are subdivisions of Branford granite gneiss, are very much alike mineralogically and chemically, and are both phases of same original magma.

Is a pink feldspar facies of Branford granite gneiss.

Lightning Creek diorite.

Miocene (?): British Columbia and Washington.

R. A. Daly, 1913 (Canada Dept. Int., Rept. Chief Ast. 1910, vol. 2, p. 490).

†Lignite formation. (†Great Lignite formation.)

†Lignitic group.

Late Cretaceous and Eocene: Rocky Mountain States.

Terms applied in early repts (1852 to 1876 and later) to coal-bearing rocks of Rocky Mtn region now known to range in age from Upper Cret. to mid Eocene.

In 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 415–435) F. B. Meek and F. V. Hayden called the "Lignitic group" of previous repts the *Fort Union or Great Lignite group,* and assigned it to Eocene (?), describing it as consisting of 2,000+ ft. of clay and sand, with round ferruginous concretions and numerous lignite seams, overlying Fox Hills beds and underlying Wind River deposits in Nebraska (which at that time included Wyo., Mont., and Dak). In 1874 Hayden, who had studied these rocks over wide areas, stated (U. S. Geol. and Geog. Surv. Terr. Bull. 1, No. 2, pp. 1–2): It seems conclusive that the lignitic group began in Cret. period, in marine seas, and continued upward, through brackish-water times, into purely fresh-water deposits. Later Hayden and King agreed to replace the descriptive term "Lignitic group" with the geographic name *Laramie group.* (See quotations under *Laramie fm.*) The Laramie as they defined it everywhere rested on Fox Hills ss. King assigned the deposits to latest Cret., and described them as overlain, in the region covered by 40th Par. Surv., by "*Vermilion Creek Eocene* (=Wahsatch group of Hayden)"; but Hayden stated (U. S. Geol. Surv. Terr. 8th Ann. Rept., pp. 20–27, 1876): "I still regard the lignitic group proper as transitional or Lower Eocene, and shall so regard its age until the evidence to contrary is much stronger than any which has been presented up to present time. When, however, the proof is sufficient to decide the Cret. age of the group I shall accept the verdict without hesitation. It is somewhat doubtful whether the age will ever be decided positively to the satisfaction of all parties." In the same year (U. S. Geol. Surv. Terr. Bull. 5, pp. 405–411) Hayden stated that those who worked from S. and SW. toward the N. have been thoroughly impressed with Cret. age of "Lignitic group," while those who have studied the deposits from the N. and NW. toward interior basin received their first impressions they were of Tert. age.

In 1878 (U. S. Geol. Surv. Terr. Rept., Mon. 7, pt. 2, p. iv) Hayden stated that his "Lignitic group" included Laramie and Fort Union and that the latter was identical with the whole, or at least a part, of Wasatch group. (See quotation under *Laramie fm.*) The Fort Union fm. is now generally recognized as underlying Wasatch fm. and overlying Lance fm., of Upper Cret. age.

For further explanations see under *Laramie fm.*, *Fort Union fm.*, and *Lance fm.* The descriptive term "Lignitic group" has long since fallen into disuse.

†Lignite group.

†Lignitic beds.

†Lignitic group.

Early Eocene: Gulf Coastal Plain.

Descriptive terms applied in early repts on Gulf Coastal Plain (1) to Wilcox group; (2) to Wilcox and Midway groups; (3) to Wilcox group and most of Claiborne group; (4) to Claiborne group; and (5) to lower part of Claiborne group. The Claiborne group has also been called "Upper Lignitic," and the Wilcox and Midway combined have been called "Lower Lignitic," "Northern Lignitic group," and "Eo Lignitic." The Wilcox group alone has also been called "Lower Lignitic" and "Lignitic." The Yegua fm. alone in La. has also been called "Upper Lignitic," as has St. Maurice fm. of La. The name was introduced by J. M. Safford, of Tenn., in 1856 (Geol. reconn. State of Tenn., pp. 162–163), as "*Lignite group*, sands, laminated clays, and lignite, overlain by post-Pliocene Bluff and Drift series and underlain by Orange Sand group;" and was subsequently applied in Miss., Ala., La., Ark., and Tex. repts.

†Ligonier sandstone.

See *Connellsville ss. memb.*, which replaces it.

Lilac argillite.

Lower Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 896–897). *Lilac ss.* (also *Lilac fm.*).—Calc. dark-gray ss. and argillite, 725 feet thick, occurring at various localities along W. base of Mount Jura and elsewhere. Carries middle Lower Jurassic fossils; the upper zone *Parapecten praecursor;* the lower zone *Euechioceras exoletum.* "Rests on Middle Triassic volcanics, the oldest rocks in Mount Jura column." [Derivation of name not given. Does not say whether geographic or nongeographic.]

Lilley formation.

Silurian (Niagaran): Southwestern Ohio (Highland and Adams Counties).

A. F. Foerste, 1917 (Ohio Jour. Sci., vol. 17, pp. 189, 190). *Lilley memb.*—Upper memb. of West Union fm. at Hillsboro, Highland Co. [West Union as here used extends up to base of Cedarville dol.] Consists of 2 or 3 ft. of clay underlain by 20 ft. of massive ls. Exposed at various localities on Lilley Hill. Overlies Bisher memb. (lower memb. of West Union) and immediately underlies Cedarville dol.

A. F. Foerste, 1919 (Ohio Jour. Sci., vol. 19, pp. 367–375). *Lilley memb. of West Union fm.* is 20 to 30 ft. thick. Overlies Bisher memb. of West Union, but at any distance from Hillsboro area it has proved so rarely possible to discriminate

Bisher and Lilley members, if indeed the latter is present, that a collective term seems desirable. For this service *West Union*, used by Orton [but not in sense used by Orton], has been regarded as serviceable and as much more in keeping with exposures at West Union, Ohio, where no trace of Lilley memb. can be identified. It corresponds to Upper or Blue Cliff of Orton, who incorrectly identified it with Springfield dol. Is faunally distinct from Bisher memb.

A. F. Foerste, 1923 (Denison Univ. Sci. Lab. Jour., vol. 20, pp. 41–43). *Lilley fm.* of Hillsboro area, Highland Co., was erroneously identified many years ago by Prof. Orton as the Springfield stone. It is overlain by beds here tentatively called Guelph dol. The base of this so-called Guelph in quarries in E. part of Hillsboro is formed by a *Pentamerus* horizon which corresponds approx. to Springfield dol. of Green, Clarke, Miami, Montgomery, and Preble Counties. A fauna somewhat similar to underlying Bisher fauna is contained in beds immediately beneath Springfield ls. along creek ½ mi. W. of Port William, NE. of Wilmington, Ohio, but no trace of Lilley fauna is to be found so far N.

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173) assigned these rocks to Lockport epoch. Further details regarding *Lilley fm.* were given by Foerste in Denison Univ. Bull., Jour. Sci. Lab., vol. 30, 1935, pp. 127–202.

Lillibridge sandstone member.

Upper Devonian: Southwestern New York (Olean region).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 62, pp. 59, 63). *Lillibridge ss. memb.*—Basal memb. of Chadakoin stage. Hitherto known as "Quarry ss.," from occurrence in stone quarries (now abandoned) in and about Olean, N. Y. Named for outcrops along Lillibridge Creek, which flows S. to Allegany River 1 mi. NE. of Portville, N. Y., and in quarries adjacent to the creek. Is predominantly flaggy, with intercalated shales. Usually pinkish to purple red, and not abundantly fossiliferous.

G. H. Chadwick states (letter dated Jan. 2, 1936) that when Caster published *Lillibridge ss.* he thought it was the same ss. as that named *Hinsdale* by Chadwick, but that the ss. exposed in Lillibridge Creek Valley lies up in Haymaker beds of Chadwick or higher.

Lillis formation.

Tertiary (Oligocene?): Southern California (North Coalinga region).

J. H. Ruckman, as reported by J. C. Merriam, 1915 (Am. Phil. Soc. Trans., n. s., vol. 22, pt. 3, p. 194), placed *Lillis fm.* (in table of North Coalinga region) opposite *Olig.*, and called the overlying Mio. beds *Monterey* ("*Temblor*") and the underlying beds *Tejon Eocene*. No description of lithology, thickness, or derivation of name was given.

J. H. Ruckman, as reported by O. P. Jenkins (Min. in Calif., Rept. State Min., vol. 27, No. 2, April 1931, pp. 159–161, 178, 179), after examination of Ruckman's *unpublished* thesis, entitled "Faunal succession of the Coalinga East Side field, Fresno Co., Calif.," on file in Univ. of Calif. Under heading *Eocene-Oligocene*, Ruckman described "*Lillis group*," which he said includes "Domengine sands" and overlying "*Oilfield shales*" with every evidence of conformity btw. the two. Jenkins stated that the beds btw. Domengine sands and Temblor oil sands consist of white and brown diatomaceous shales "which it is apparent correspond to Kreyenhagen sh. as mapped by Robert Anderson and Pack." In these shales Jenkins discovered 2 unconformities. He gave Ruckman's detailed section of the beds, which aggregates 951 ft., and listed fossils enumerated in Ruckman's ms. The upper 100 ft. of this section he called *Leda zone*, at base of which Jenkins reported an uncon., which "apparently was not known to Ruckman." Lower down he found another uncon. Jenkins proposed to restrict *Kreyenhagen sh.* to beds beneath the lower uncon. and above Domengine sands, which he stated are probably Eo. but possibly are Olig. (See also Jenkins, 1931, under *Kreyenhagen sh.*)

G. D. Hanna, F. M. Anderson, and C. C. Church, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 1, pp. 302, 303, 305, 306), applied *Lillis sh.* to the younger sh. to which *Kreyenhagen* had been applied in earlier repts on area N. of Coalinga, and stated that it is probably Mio.

G. D. Hanna, 1933. [See 1933 entry under *Kreyenhagen sh.*]

Lillydale shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 437). *Lillydale sh.*—Dark green or greenish gray at top; black and carbonaceous at base; fissile; some included lenses of iron carbonate and ls.; marine fossils. Thickness 80 to 125 ft. Underlies Glenray ls. and overlies Greenbrier series. Is basal memb. of Bluefield group [fm.]. Includes Edray ss. 0 to 50 ft. above base. Type loc. about 4 mi. SW. of Union, in vicinity of Lillydale, Monroe Co. Also observed in Mercer and Summers Counties, W. Va., and in Tazewell Co., Va. Can be traced to head of Greenbrier Valley.

Lime Creek shale.

Upper Devonian: Central northern Iowa.

H. S. Williams, 1883 (Am. Jour. Sci., 3d, vol. 25, pp. 97–104), causally used *Lime Creek beds* for fossiliferous beds exposed along Lime Creek near Rockford, Iowa, and said to contain same fauna as High-point beds of Chemung of N. Y.

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 46–47). *Lime Creek shales.*—Rather dark-colored argill. shales, highly fossiliferous. Strat. position not fully understood. It seems best therefore to retain name usually applied to them, since Rockford has proved unavailable. Thickness 100 ft. [In columnar section (pl. 2 of book cited) *Lime Creek shales* are shown as highest Dev. fm. in Iowa, and as overlain by Kinderhook and underlain by Montpelier ss., which is said to contain one Hamilton species.]

S. Calvin, also W. H. Norton, in 1897 (Iowa Geol. Surv., vol. 6, p. 148, and vol. 7, pp. 161–170) divided *Lime Creek sh.* into Owen substage above and Hackberry substage below. According to C. L. Fenton their Hackberry substage included the pre-Owen part of Webster's Hackberry plus Sheffield fm. of Fenton. The name *Lime Creek sh.* as for many years used in geol. literature of Iowa usually applied to the beds of northern Iowa btw. Kinderhook above and Cedar Valley ls. below. Some repts apparently included Montpelier ss. in the Cedar Valley, and some writers have regarded Sweetland Creek sh. of SE. Iowa as contemp. in whole or in part with Lime Creek sh., while other authorities consider Sweetland Creek as younger than Lime Creek, and some regard it as of Kinderhook age. E. O. Ulrich classifies it as Upper Dev. and=Genesee sh. and upper Tully of N. Y. C. L. Fenton (Am. Jour. Sci., 4th, vol. 48, pp. 355–376, 1919) applied *Sheffield fm.* to basal part of Lime Creek sh., and A. O. Thomas (Iowa Geol. Surv., vol. 30, p. 116, footnote, 1925) replaced that name by *Juniper Hill fm.* The Nora ls. as originally defined by Thomas (1913) was included in Lime Creek sh., but C. L. and M. A. Fenton (1924) included it in Cedar Valley ls.

A. C. Trowbridge, M. A. Stainbrook et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, pp. 256+), divided Lime Creek sh. into (descending) Owen, Cerro Gordo, and Juniper Hill members, and placed it beneath Sheffield and above Shellrock, which they excluded from Cedar Valley. This corresponds to present usage of U. S. Geol. Survey.

Named for exposures on Lime Creek, in Cerro Gordo and Floyd Counties.

Limekiln conglomerate.

Upper Ordovician: Quebec (Percé).

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 163+).

Limerick keratophyre.

Triassic (Middle?): Northwestern Nevada (Humboldt Range).

C. P. Jenney, 1935 (Univ. Nev. Bull., vol. 29, No. 6, pp. 18–23, map, etc.). *Limerick keratophyre.*—Dark greenish-gray schistose tuffs and flows of andesitic appearance and spotted with phenocrysts of feldspar. Thickness 6,000+ ft. Basal div.

of Koipato fm. Best exposed on Lone Mtn, covering considerable area on N. side of Limerick Canyon, in upper Sacramento Canyon, and in Spring Valley E. of area mapped.

Limestone Creek beds.

Oligocene: Southeastern Mississippi.

M. A. Hanna and D. Gravell, 1934 (11th Ann. Field Trip Shreveport Geol. Soc., pp. 17, 41, and table opp. p. 30). *Limestone Creek beds* is upper fm. of Limestone Creek group, and rests on Bucatunna memb. [According to B. W. Blanpied (p. 17 of book cited above) this is same as Blanpied's *Lower Chickasawhay memb.* In section of Limestone Creek, Wayne Co., on p. 41, the beds are called *Lower Chickasawhay memb.*]

Limestone Creek group.

Oligocene: Southeastern Mississippi.

M. A. Hanna and D. Gravell, 1934 (11th Ann. Field Trip Shreveport Geol. Soc., table opp. p. 30). *Limestone Creek group*, includes Limestone Creek beds [=Lower Chickasawhay of Blanpied] and underlying Bucatunna memb.

Limon clays.

Pliocene: Costa Rica.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 337).

Limon beds.

Cretaceous: Mexico.

E. T. Dumble and E. R. Applin, 1924 (Pan-Am. Geol., vol. 41, p. 336).

Limpia.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 65, No. 1, Feb. 1936, pp. 42, 45, 46) to "the great Limpia or Wylie reef, characterized by the narrow Limpia ls. ridge 2,200 ft. in thickness. The Wylie or Limpia reef appears to have had this narrow Limpia ls., of the Limpia, Apache, or Davis Mtns, as its reef-rock, landward of which were the lagoon sands and silts, known as the Eddy sss., or by the Texan name Delaware fm."

Lincoln porphyry.

Eocene: Central Colorado (Alma, Tenmile, and Leadville districts).

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230) and 1886 (U. S. G. S. Mon. 12, p. 78). *Lincoln porphyry*.—Light-gray porphyry, consisting of quartz, orthoclase and plagioclase feldspar, and biotite. [Petrographic description by Whitman Cross on p. 328 of Mon. 12.]

Belongs to Gray porphyry group of Emmons.

Named for fact it forms summit of Mount Lincoln, N. of Alma, Park Co.

Lincoln limestone member (of Greenhorn limestone).

Upper Cretaceous: North central and western Kansas.

W. N. Logan, 1897 (Kans. Univ. Geol. Surv. vol. 2, p. 216). *Lincoln ls.*—Two to five layers of hard, flinty, bluish gray ls. intercalated with shales, lying near base of Russell fm. of Benton group. Thickness 15 ft. Rests conformably on bituminous sh. forming basal part of Benton group. Overlain conformably by Flagstone horizon of Russell fm.

Adopted as basal memb. of Greenhorn ls. (See W. W. Rubey and N. W. Bass, Kans. Geol. Surv. Bull. 10, 1925.) Is separated from overlying Jetmore chalk memb. by 28 to 40 ft. of chalky sh. with some chalk beds, which in 1926 were named *Hartland sh. memb.*

Named for Lincoln, Lincoln Co., where it is quarried.

Lincoln slate.

Pre-Cambrian: Eastern Massachusetts (Boston Basin).

Walter E. Hobbs, 1899 (Am. Geol., vol. 23, pp. 109–115). *Lincoln sl.*—Micaceous sl. or schist, including lenticular masses of impure cherty ls., one of which yielded borings of Annelida about 1 mi. NW. of R. R. Station of South Lincoln. Overlies Kendall Green sl. and lies stratigraphically uncon. lower than Roxbury cgl.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks at and around Lincoln, Middlesex Co., as Marlboro fm. The Marlboro includes considerable sl.

Lincoln formation.

Oligocene: Southwestern Washington and Puget Sound region.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). In southern Thurston Co. strata occur containing a fauna having a very close relationship to underlying Tejon. No distinct uncon. can be recognized btw. them. So far as observed the strata are entirely marine. Area so small it has not been shown on accompanying map. Best exposed on Lincoln Creek near bdy btw. Lewis and Thurston Counties, hence designated *Lincoln fm.* Thickness less than 1,000 ft. Grades up into *Porter shales,* which are correlated with lower part of Blakeley fm. in type section in Kitsap Co. Many species at Lincoln Creek are identical with those at Porter, but fauna as a whole contains more Tejon species. Assigned to Olig.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 605), in referring to Weaver's 1912 paper (see under *Lincoln fm.*) made the following statements: *Lincoln Creek fm.* is very vaguely defined. [Weaver used *Lincoln fm.*] The area shown on map comprises 2 different things, Chehalis beds underlying the basalts of Balch syncline, and a conformable sequence of a late phase of San Lorenzo fm. and an early phase of the Seattle. The fauna listed appears to have come from basal San Lorenzo beds at Oakville, about 15 mi. away.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). *Lincoln fm.,* the ***Molopophorus lincolnensis*** zone, occupies a small isolated area of 40 sq. mi. in SW. Thurston Co. and NW. Lewis Co. Is lowest Olig.

D. L. Frizzell and R. E. Blackwelder, 1933 (Micropal. Bull., vol. 4, No. 2, p. 61), assigned fauna of this fm. to middle Olig., and stated that fm. is uncon. on Eo. sed. and volcanic rocks.

Lincoln Creek formation.

See 1913 entry under *Lincoln fm.*

Lincolnville chert. (In Boone limestone.)

Mississippian: Northeastern Oklahoma (Ottawa County).

S. Weidman, 1932 (Okla. Geol. Surv. Bull. 56, p. 17). A thick bed of cherty ls. in upper part of Boone fm. is exposed along Spring River 10 mi. below Baxter Springs at "Devils Promenade," in SE¼NW¼ sec. 5, T. 28 N., R. 23 E. This cherty ls. has been referred to as the "Lincolnville chert" and the "Quapaw chert," as it was approx. from this zone that the lower runs of ore at Lincolnville and Quapaw were mined.

Lindavista terrace material.

Quaternary: Southern California (San Diego County).

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). *Lindavista terrace material.*—Sand and gravel scattered over Lindavista terrace, a cut terrace in La Jolla quad. Color prevailingly red and brown. Boulders largely from Poway cgl. Thickness 25 to 100 ft. No fossils found, so that its marine origin has not been determined with certainty.

Linden group.

Lower Devonian (Helderberg): Western Tennessee.

J. M. Safford and J. B. Killebrew, 1876 (Elements of geol. of Tenn., pp. 108, 142, 146–148). *Linden ls.*—Blue, highly fossiliferous thin-bedded, sometimes shaly ls., 0 to 100 ft. thick. Of Helderbergian age. Underlies Black sh. at Linden, Perry Co. Overlies Clifton ls.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 732–755). *Helderbergian or Linden group.*—Divided into (descending) Decaturville chert, Birdsong sh., Olive Hill fm., and Rockhouse sh. Discon. overlies Decatur ls. and uncon. underlies Quall ls. (basal fm. of Oriskanian group).

C. O. Dunbar, 1919 (Tenn. Geol. Surv. Bull. 21, pp. 113–115), gave 3 sections at Linden, showing absence there of all fms. btw. Birdsong sh. and the much younger Hardin ss., except 2½ ft. that may represent Quall ls.

Lindley sand.

A subsurface sand in Chester group (Miss.) of Bond Co., Ill.

Lindside sandstone. (In Pocono sandstone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 505, 518). *Lindside ss.*—Greenish gray or reddish brown, sometimes ferruginous; 0 to 50 ft. thick. Lies 0 to 9 ft. below Merrimac coal and overlies Langhorne coal, all members of Pocono series [ss.]. Type loc. in Monroe Co., on Dry Creek, about 0.6 mi. SE. of Lindside and just S. of Ernest Fleshman coal prospect. Also observed in Greenbrier Co., W. Va., and in Montgomery Co., Va.

Lindsley Bay granite porphyry.

Pre-Cambrian: Northwest Territory.

C. Riley, 1935 (Jour. Geol., vol. 43, No. 5, p. 504).

Lindwurm member.

Middle Devonian: Southeastern Wisconsin (Milwaukee County).

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 262, 265). *Lindwurm memb.* (*novum*).—Middle memb. of Milwaukee fm. Consists of hard, dull-gray, shaly ls., in beds of moderate thickness. Weathers to stocky mud full of weathered-out fossils and blocks of vitreous fossil ls. Many fossils (listed). In lower 3 ft. a rather distinct faunule. Thickness btw. 30 and 45 ft. Underlies North Point memb. and overlies, possibly uncon., Berthelet memb. Type loc. in Milwaukee Cement Quarry.

Probably named for village in Milwaukee Co.

Lineham member.

Cretaceous: Alberta.

R. L. Rutherford, 1927 (Alberta Sci. and Indus. Research Council, Geol. Surv. Div. Rept. 17, p. 26).

Lingle limestone.

Middle Devonian: Southwestern Illinois and eastern Missouri.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 171, 176). *Lingle ls.*—Dark-colored, somewhat shaly hard, brittle ls., carrying characteristic Hamilton fossils (listed). Conformably overlies Misenheimer sh. along a branch of Lingle Creek, in SW¼ sec. 26, T. 13 S., R. 2 W. [Union Co.], Ill. Where Misenheimer sh. is absent the Lingle rests uncon. on Grand Tower ls. or older beds. Underlies Upper Dev. Alto fm. in SW. Ill. In eastern Mo. is overlain by post-Dev. rocks and underlain by Grand Tower ls.

According to T. E. Savage, 1925 (Ill. Acad. Sci. Trans., vol. 18, p. 408), his Mountain Glen sh. (Upper Dev.) "does not appear to be represented in Mo." According to C. F. Bassett, 1925 (p. 362 of same pub.), the Lingle ls. in eastern Mo. is uncon. overlain by Mountain Glen sh. Thickness is 75 to 90 ft.

Linietta clay.

Mississippian: Central northern Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, pp. 145, 156). *Linietta clay.*—Great mass of clays, 40 ft. thick, with phosphatic nodules. Included in base of Waverly series. Occupies about same horizon as Bedford clay of Ohio, but may include a greater part of Waverly series. Overlies Ohio sh.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, p. 15). *Linietta clay* is identical with New Providence sh. of Ind.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 32). *"Linietta clay"* of Foerste is New Providence fm.

C. B. Read, 1936 (Jour. Pal., vol. 10, No. 3, pp. 215–216), stated that Linietta clay of Foerste is 40 ft. thick at its type loc.; that it represents only lower part of New Providence sh. of Butts at that place; that its basal 2 ft. has yielded a flora of New Albany (Upper Dev.) age; that overlying part of the clay (or clay shales, as Read describes it) is barren. Read suggests this basal bed be transferred to underlying New Albany sh. (The U. S. Geol. Survey now includes this basal bed in New Albany sh.)

Named for exposures in immediate vicinity of Linietta Springs, near Junction City, Boyle Co.

Linley conglomerate.

Tertiary (post-Eocene?): Central southern Montana (Carbon County).

W. R. Calvert, 1916 (U. S. G. S. Bull. 641, p. 203). *Linley cgl. (post-Eocene).*—Conglomeratic ss., bedded throughout, composed mainly of grains and well-rounded pebbles, 6 in. or less in diam., of greenish porphyry, with smaller amounts of ls. and pink granite, all presumably originating in Beartooth Mtns. Maximum thickness 300± ft. To N. thins to mere film. No fossils. Is not of glacial age or origin, but was laid down as a fan or delta deposit by Red Lodge Creek. Is overlain by glacial drift. Lies with marked uncon. on highly tilted and eroded Fort Union rocks. Occupies about 5 sq. mi. btw. Linley, Carbon Co., and Beartooth Mtns. Named for development in vicinity of Linley.

†Linville slates.

Cambrian and pre-Cambrian: Western North Carolina.

W. C. Kerr, 1869 (N. C. Geol. Surv. Rept. 2, pp. 13–36). *Linville slates.*—Semimetamorphic argill. slates and shales, sss., lss., and gneissoid grits. Limit Buncombe group on SE. Is narrow belt stretching for most part along the Blue Ridge. Beyond the Blue Ridge it has a breadth of 2 to 3 mi. and consists of ash-colored and bluish slates and shales and lss. with occasional outcrops of thin-bedded light-colored ss. or qtzite. Linville Mtn consists almost exclusively of ss. and qtzitic slates, in places very thin bedded and flexible (itacolumite) and in a few places interbedded with thin layers of a greenish shaly sl. In this fm. E. of Blue Ridge there are frequent interpolations of rocks having a gneissoid aspect, as in the light-colored coarse-grained ledge at foot of Table Rock and many other points E. of that, and again in the apparently very coarse porphyroidal gneiss 1 mi. S. of Blowing Rock on the turnpike.

The rocks described above are now divided into many fms. (See North Carolina chart.)

Named for exposures on Linville Mtn, on bdy btw. McDowell and Burke Counties.

Linville metadiabase.

Pre-Cambrian: Western North Carolina and eastern Tennessee.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 3). *Linville metadiabase.*—Altered dull yellowish-green diabase and gabbro. Near line of Blue Ridge is associated with Montezuma schist, Flattop schist, and Camb. qtzites, and in several narrow bands S. of Blue Ridge in Cranberry granite.

Named for Linville, Mitchell Co., N. C.

Linwood shale.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 87, 97). *Linwood sh.*—A lower memb. of Stanton ls. along Kansas River. Underlies Meadow ls. memb. of Stanton and overlies Naish ls. memb. of Stanton. [Derivation of name not stated. On p. 46 *Linwood sh.* is described as consisting of 1 to 2½ ft. of gray aren. sh.]

R. C. Moore and G. E. Condra also used this name in their Oct. 1932 revised classification of Penn. of Kans. and Nebr., but there is no other record of the name. R. C. Moore in his 1936 classification of Penn. rocks of Kans. (Kans. Geol. Surv. Bull. 22) dropped this name, without explanation, and defined *Captain Creek ls.* as basal memb. of Stanton ls., underlying Eudora sh. memb. and overlying Vilas sh. The bed appears to be included in his Captain Creek ls.

Linwood member (of Cedar Valley limestone).

Upper Devonian: Eastern Iowa.

A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, pp. 36, 434). *Linwood memb.*—Basal memb. of Cedar Valley fm. At Linwood quarry, Scott Co., the type loc., it consists of 7 ft.

of cherty shaly ls., underlying Littleton memb. [restricted] of the Cedar Valley and overlying Davenport memb. of Wapsipinicon fm.

See also M. A. Stainbrook, 1935 entry under *Littleton memb.*

Lion sandstone.

Miocene (lower): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 375–376, 378, and map). *Lion ss.*—Ss. containing small marine fauna consisting of forms found by Kew in Carrizo Creek region, which are regarded by T. W. Vaughan as not older than lower Plio. This fauna belongs to that of Gulf of Calif. and not to that of southern Calif. coast. Is older than Hathaway fm. and younger than Potato ss.

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1–25). Lion ss. of F. E. Vaughan is late lower Mio. and of same age as marine Imperial fm. as here redefined.

Named for Lion Canyon, Riverside Co., near which (on third ridge to W. of canyon) it crops out.

Lion Canyon sandstone member (of Williams Fork formation).

Upper Cretaceous: Northwestern Colorado (Meeker quadrangle).

E. T. Hancock and J. B. Eby, 1930 (U. S. G. S. Bull. 812, pp. 197, 206). *Lion Canyon ss. memb.*—Lies in Williams Fork fm., about 3,000 ft. above Trout Creek ss. memb. Projects boldly toward main road immediately E. of mouth of Lion Canyon, forms prominent ledge along W. side of west fork of Lion Canyon, 3 mi. W. of Meeker, and occurs at other places.

Lion Canyon coal group. (In Williams Fork formation.)

Upper Cretaceous: Northwestern Colorado (Meeker quadrangle).

E. T. Hancock and J. B. Eby, 1930 (U. S. G. S. Bull. 812, pp. 197, 206). The group of coal-bearing beds that crops out in the 1,000 ft. of Williams Fork fm. immediately above Lion Canyon ss. memb. is called *Lion Canyon coal group.*

Lion Hill formation.

Mississippian (upper): Central northern Utah (Ophir district).

S. G. Olmstead, 1921 (Econ. Geol., vol. 16, p. 452). Humbug fm. is locally known, in Ophir dist., as *Lion Hill* or *Utah Queen.* Exposed over a large area on Lion Hill.

Lion Mountain sandstone member (of Cap Mountain formation).

Upper Cambrian: Central Texas (Burnet region).

J. Bridge, 1937 (U. S. G. S. P. P. 186L). *Lion Mtn ss. memb.*—Top memb. of Cap Mtn fm. in Central Mineral Region of Tex. Named for Lion Mtn, NW. part of Burnet quad.

Lipalian.

Term proposed by C. D. Walcott, 1910 (Smithsonian Misc. Coll., vol. 57, p. 14), "for the era of unknown marine sedimentation between the adjustment of pelagic life to littoral conditions and the appearance of the Lower Cambrian fauna. It represents the period between the formation of the Algonkian continents and the earliest encroachment of the Lower Cambrian sea."

†Lipan beds.

Eocene: Southern Texas Coastal Plain.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, pp. 424–436). *Lipan beds.*—The lower or true Fayette. Consists of a series of lignitic clays and sands with bands of ss., qtzite, volcanic ash and beds of peaty material, capped by an indurated ss. with a highly reticulated surface. Thickness probably 150 ft. Uncon. underlies Whitsett beds (previously included in Fayette) and overlies Yegua fm. Exposed in Lipan Hills, E. of Campbellton [Atascosa Co.], and their extensions to NE. and SW., where they form a north-facing escarpment which is traceable in a broken line for 20 mi. or more.

For several years considered same as Fayette ss.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 680, 685, 686). *Lipan memb. of Fayette fm.* underlies Whitsett memb. of the Fayette in central and southern Tex., and is=McElroy and Caddell members of Fayette as now defined in eastern Tex. It is limited at top by the ss. that caps Lipan Hills and at base by Yegua fm.

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, p. 1311). The Whitsett fm. of this paper includes all beds from top of Manning beds of McElroy fm. to base of the Frio; therefore it includes *Lipan beds* and Whitsett beds of Dumble.

Lisbon formation.

Ordovician or Cambrian: Northwestern New Hampshire (Ammonoosuc River region).

C. H. Hitchcock, 1874 (Am. Jour. Sci., 3d, vol. 7, pp. 468–476). *Lisbon group.*—Greenish cgl., hydro-mica and cupriferous schists, qtzites, and dolomites. To W. abounds in copper schists. Comprises: (1) Diabase at top; (2) hydromica schists with cupriferous layers, 3,539 ft., often including nodular mass of nearly white quartz 50 to 150 ft. thick; (3) hydromica cgls., 756 ft. Older than Lyman group and younger than gneiss somewhat allied to Bethlehem gneiss. Included in Huronian. Named for Lisbon.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2). *Lisbon group (Huronian)* overlies Swift Water series (also Huronian).

C. H. Hitchcock, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 461–482), stated that *Lyman schist, Lisbon,* and Swiftwater "may be Ord."

C. H. Hitchcock, 1905 (Geol. of Littleton, N. H., Univ. Press, Cambridge), assigned *Lisbon "group"* and overlying *Lyman schists* to *Lower Sil.* [Ord.] *or Camb.*

C. P. Ross, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 267–302). *Lisbon fm.*—Fairly coarse schistose cgls. and sandy schists, with very subordinate amount of calc. sediment; greenish and grayish color; includes hydromica and cupriferous schists, qtzites, and dolomites; much of material is of volcanic origin. Corresponds to Lisbon group of Hitchcock. Includes Hitchcock's "copper belt," which he included in original definition. Is younger than Swift Water fm. and appears to be older than Lyman and Littleton fms. No fossils, but considered to be Ord. or Camb.

M. Billings in 1934 (see 1934 entry under *Swift Water fm.*) dropped Lisbon, Lyman, and Swift Water from the nomenclature of Littleton and Moosilauke quads. and assigned the rocks to Upper Ord. (?). (See N. H. correlation chart.)

Exposed over large area in Lisbon Twp and at Lisbon Station, in NW. part of Grafton Co., N. H.

Lisbon formation. (In Claiborne group.)

Eocene (middle): Southwestern Alabama and Mississippi.

T. H. Aldrich, 1886 (Ala. Geol. Surv. Bull. 1, pp. 44–60), divided the Claiborne into (descending) Claiborne sand, Calcareous sand bed, and *Lisbon horizon,* the latter overlying the Buhrstone (excluded from the Claiborne).

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, p. 30), gave a detailed section of Lisbon bluff, on Alabama River, and explained relations of the beds in that bluff (which constitute basal beds of their Claiborne—from which they excluded the †Buhrstone) to the beds in Claiborne bluff, farther down the river. The two lowermost beds in Claiborne bluff are stated to be same as two uppermost beds in Lisbon bluff. In explanation of this section the term *Lisbon beds* is casually used once.

D. W. Langdon, 1891 (Geol. Soc. Am. Bull. 2, pp. 598–604). *Claiborne series* is divided into (descending): *Scutella* bed, 25–30 ft.; Ferruginous sands or Claiborne proper; *Ostrea sellæformis* bed, 75 ft. of gray calc. sand; and *Lisbon bed,* 45 ft. The latter differs from above mainly in fossils, and appears to be confined to region drained by Alabama and Conecuh rivers. It rests on the Buhrstone [excluded from the Claiborne].

G. D. Harris, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 303–304). *Lower Claiborne stage* is divided into (descending) *Ostrea sellæformis* beds (substage), *Lisbon beds* (substage), and Buhrstone (substage). [The rocks are not described.]

In present usage of names the Claiborne group in Ala. is divided into (descending): Gosport sand (highly glauconitic sands in which *Ostrea sellæformis* zone is included); Lisbon fm.; and Tallahatta fm. (†Buhrstone). The Lisbon fm., according to E. A. Smith (Ala. Geol. Surv. Undgd. water res. Ala., 1907), consists of 115 ft. of calc., clayey sands and sandy clays. In Miss. the Lisbon consists of fossiliferous calc. sands, clay, and greensand underlying the Yegua fm. and overlying the Tallahatta, and is now divided into an upper (unnamed) memb. 100 to 120 ft. thick, underlain by Kosciusko ss. memb., 25 to 400 ft. thick, succeeded below by Winona sand memb., 45 to 350 ft. thick. It has not been subdivided in Ala. It is middle fm. of Claiborne group, and of marine origin.

Named for exposures in Lisbon Bluff, on Alabama River, in Clarke Co., Ala.

†Lisbon shale.

Upper Cretaceous: Northwestern Kansas and eastern Colorado.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 52). *Lisbon shales.*—Fossiliferous dark-bluish and brownish shales containing concretions of yellow phosphate of iron. Supposed to be lower Fort Pierre. Overlie Smoky Hill chalk and underlie Arickaree shales. Named for Lisbon, Logan Co., Kans.

Preoccupied and same as Pierre sh., older name.

†Lisbon group.

Upper Triassic: Central southern Pennsylvania (Dauphin and York Counties).

G. H. Ashley, 1931 (Topog. and Geol. Surv. Pa. Bull. G1, p. 77). *Lisbon group.*—Purplish nonfeldspathic ss., red sh., and cgl., 10,500 ft. thick. Top fm. of Upper Triassic in Dauphin and York Counties. Overlies Lewisburg group. [Credited to [M. H.] Bissell. "Lisbon" (preoccupied) is apparently a misprint for *Lisburn,* and "Lewisburg" (preoccupied) is apparently a misprint for *Lewisberry.* When the Triassic of New Cumberland quad. (in which occur the geographic features *Lisburn* and *Lewisberry*) was differentiated for 1931 geol. map of Pa., these rocks were included in Gettysburg sh.]

†Lisbon quartzite.

Pre-Silurian (Upper Ordovician?): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings, 1933 (Am. Jour. Sci., 5th, vol. 25, No. 146, p. 149), placed *Lisbon qtzite* beneath what he called "Swiftwater-Lyman fm." in this paper on Littleton and Moosilauke quads. of Ammonoosuc River region. In Jan. 19, 1934, issue of Sci., pp. 55–56, he applied new name *Albee qtzite* to 4,000 ft. of qtzite and sl. occupying similar position, and assigned his Albee to pre-Sil. (Upper Ord.?).

M. Billings, 1935 (letter dated July 19). *Lisbon qtzite* was a term taken from C. H. Hitchcock, who, however, called it *Lisbon group.* As far as I can find, Hitchcock is not very specific as to his type loc., but there can be no question but what it was Lisbon Twp, and, more specifically, the outcrops in the village itself and for 1 mi. to NW. I have since abandoned *Lisbon qtzite* in favor of *Albee fm.* [For Hitchcock's *Lisbon group* see under *Lisbon fm.*]

Lisburne limestone.

Mississippian (upper): Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 241). *Lisburne fm.*—Medium-bedded lss., with some sh., 3,000 ft. thick. Assigned to Dev., tentatively, on basis of fossils in surface fragments near top of mtns. Rests, apparently conformably, on Stuver series.

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Lisburne ls.* (Miss.) extends from Cape Lisburne, on Arctic Ocean, east almost if not quite continuously for 600 mi. to int. bdy. It is composed of ls. and chert.

Named for Cape Lisburne, NW. Alaska. Fossils of upper Miss. age have been obtained from the fm.

Liskeard formation.

Ordovician: Ontario and Quebec (Lake Timiskaming).

G. S. Hume, 1925 (Canada Geol. Surv. Mem. 145, pp. 13, 14).

L'Islet formation.

Cambrian: Quebec.

J. K. Knox, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 234).

†Lisman formation.

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Lisman fm.*—Chiefly soft shales, in places colored and calc., with some ss. and thin lss. (including Madisonville ls.), and, at base, Anvil Rock ss. Thickness 900 to 1,000 ft. Rests uncon. on Mulford fm. (Penn.) and uncon. underlies Dixon fm. (Penn.).

Corresponds to McLeansboro fm., older name.

Apparently named for Lisman, Webster Co.

Lismore formation.

Carboniferous (Pennsylvanian): Nova Scotia.

W. A. Bell, 1925 (Canadian Min. and Met. Bull. 158, p. 607).

Lissie formation.

Pleistocene: Eastern Texas and northwestern Louisiana.

A. Deussen, 1914 (U. S. G. S. W. S. P. 335, pp. 27, 78–80). *Lissie gravel.*—Gravels and coarse sands, with some small lenses and pockets of red clay in places, and limy clays, gravels, and limy cgls. or "adobe" in other places. Thickness thin to 900 ft. Underlies Beaumont clay. Lies higher than Uvalde and Dewitt fms. Where the Dewitt is replaced seaward by marine Mio. beds the Lissie rests directly on latter.

Later work resulted in dropping *Uvalde fm.* for *Reynosa fm.* Still later, *Reynosa fm.* was replaced by Tex. Geol. Surv. (Univ. Tex. Bull. 3232, 1933) with *Goliad sand*, upon which Lissie fm. rests. The Beaumont clay is uncon. on Lissie (p. 789). Still later, certain deposits of Plio. (?) age were removed from the Lissie and named *Willis sand*, q. v.

Named for Lissie, Wharton Co., Tex.

Lista Blanca complex (or division).

A term applied by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, 1900, and vol. 31, 1902) to a volcanic complex of andesitic lavas, aggls., and tuffs, 2,000 ft. thick in Sonora, Mexico, and Cochise Co., SE. Ariz. Assigned by him to Triassic, but now assigned to Comanche series of SE. Ariz.

Listmore formation.

Pennsylvanian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 245).

Liston Creek limestone member (of Liston Creek formation).

Silurian (Niagaran): Northeastern Indiana (Wabash County).

E. R. Cumings and R. R. Shrock, 1927 (Ind. Acad. Sci. Proc., vol. 36, pp. 75–76). *Liston Creek ls.*—A series of thin slabby ls. beds with considerable associated chert, 26 ft. thick along Liston Creek, Wabash Co. Lower part is slabby and contains less chert than upper part. Top of fm. unknown. In a few outcrops a drusy brown or yellow very fossiliferous dol. is associated with the Liston Creek. Exact position of this dol. is not certain. It may represent an overlying fm. distinct from the Liston Creek, or it may be only a local development of it found only adjacent to the coral reefs. Niagaran fossils sparingly throughout. Rests on Red Bridge ls.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 71–94). *Liston Creek ls.* treated as a *memb. of Liston Creek fm.*, as explained under *Liston Creek fm.* Fossils listed. Thickness 0 to 60 ft. Underlies Huntington ls. and overlies Red Bridge ls. memb. of Liston Creek fm.

Liston Creek formation.

Silurian (Niagaran): Northeastern Indiana (Wabash County).

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 53, 71–94). *Liston Creek fm.*—In view of fact that Red Bridge ls. is rather local bed belonging stratigraphically with Liston Creek ls. as defined by authors in 1927, the authors now prefer to include it as basal bed of *Liston Creek fm.*, which they would define as consisting of the strata lying btw. top of Mississinewa sh. and base of overlying Huntington dol., with both of which it is conformable. As thus defined *Liston Creek fm.* consists of Red Bridge ls. memb. (0 to 12 ft. thick) at base and *Liston Creek ls.* (few to 60 ft. thick) at top. Good exposures at mouth of Liston Creek, Wabash Co., where the *ls.* is 28 ft. thick. In following discussion the Red Bridge and Liston Creek lss. will be considered as individual units. Where Red Bridge ls. memb. thins out there is no evidence of discon. btw. Liston Creek ls. memb. and underlying Mississinewa sh. Along Pipe Creek ½ mi. NW. of Bunker Hill the Liston Creek ls. is discon. overlain by Dev. lss. We believe Louisville ls. is represented in Liston Creek fm.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 159). *Liston Creek fm.* not known S. of Ingalls, near S. line of Madison Co.

Litchfield marl.

Mississippian, Grayson County, Ky. See *Leitchfield marl*, 1876.

Litchfield norite.

Age (?): Western Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 74, 111). *Litchfield norite.*—Certain dark gray rocks forming parts of Mount Prospect, near Litchfield, have been called by Prof. Hobbs [unpublished?] *Litchfield norite.* Does not form large masses, but is associated with granodiorite, diorite, and amphibolite.

Litchfield sand.

A subsurface sand in Pottsville fm. (Penn.) of western Ill. (See Ill. Geol. Surv. Bull. 54, index.)

†Lithodendron member.

†Lithodendron formation.

Upper Triassic: Northern Arizona.

L. F. Ward, 1905 (U. S. G. S. Mon. 48). *Lithodendron memb.*—Cgls. and cross-bedded sss., often with pink and white striped clay lenses interstratified with gray argill. shales and variegated marls. Thickness 800 ft. Underlie Leroux memb. and uncon. overlie Moencopie [Moenkopi] fm. Lithodendron Creek lies in region where Lithodendron beds attain their max. development and only a short distance from Petrified Forest.

Includes Shinarump cgl. and lower part of Chinle fm. of present nomenclature.

†Lithographic limestone.

A descriptive term applied in early Missouri repts to the Miss. fm. later named *Louisiana ls.*

Lithopolis member. (In Cuyahoga formation.)

Mississippian: South-central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 670). *Lithopolis memb.*—Thin, horizontal, interbedded sss. and shales; sss. usually light gray or bluish, moderately fine-grained and evenly bedded; shales argill. and usually sandy and gray. Thickness 118 to 140 and possibly 200 ft. Basal memb. of Cuyahoga fm. in central Fairfield and Hocking Counties. Underlies Fairfield memb. of Cuyahoga and overlies Sunbury sh. Lower 50 ft.=Buena Vista memb. of Prosser and Cumings.

Named for Lithopolis, Fairfield Co.

Littig glauconitic member (of Kincaid formation).

Eocene: Eastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 535, 536, 550, 554). *Littig glauconite memb.*—A bed of greenish-black calc. glauconitic sand, from 8 in. to 15 or more ft. thick, forming basal memb. of Kincaid fm. Underlies Pisgah memb. Weathers yellowish green or buff; contains phosphate nodules, small pebbles, shark's teeth, casts of fossils, and spherical calc. concretions. Type exposure is in the road 1½ mi. by road S.-SW. of Littig, Travis Co., on S. side of Wilbarger Creek.

Little lime.

Drillers' term; western Pa.; applied to upper part of Greenbrier ls. memb. of Mauch Chunk fm. (Miss.).

Little Alvord Creek rhyolite.

Tertiary (late): Southeastern Oregon (Steens Mountain).

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, p. 66). [See under *Pike Creek volcanic series*.]

Little Bell Island formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Little Bell Island fm.*—Sss. carrying *Lingulella billingsi*, uncon. underlying Lance Cove fm., and overlying Kelly Island fm. Included in Bell Island series. [Derivation of name not stated.]

Little Brazos limestone lentil. (In Claiborne group.)

Eocene (middle): Eastern central Texas (Brazos, Robertson, and Burleson Counties).

B. C. Renick and H. B. Stenzel, 1931 (Univ. Tex. Bull. 3101, pp. 78, 92). In Crockett clay memb. of Cook Mtn fm., from 24 to 28 ft. above Moseley ls. lentil and from 65 to 70 ft. below top of Crockett memb, is another impure argill. glauconitic ls., 2 to 4 ft. thick, sometimes occurring as a concretionary bed. It is here named *Little Brazos ls. lentil*, because it is best exposed and has its best faunal representation along Little Brazos River in neighborhood of the old interurban crossing on W. T. James est., 70 acres, W. Matthis survey, about 1.4 mi. NE. of Bryan Junction. Also exposed at other places in Brazos, Robertson, and Burleson Counties. The clays separating Little Brazos ls. from overlying Yegua fm. are gray, buff, and gypsiferous.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 612), showed *Little Brazos ls.* lying higher in the Crockett than Moseley ls.

Little Cabin sandstone memb. (of Cherokee formation).

Pennsylvanian: Northeastern Oklahoma (Craig County) and southern Kansas.

C. L. Cooper, 1928 (Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 7, pp. 160-164). *Little Cabin ss.*—Named by D. W. Ohern in unpublished ms. on geol. of Vinita and Nowata quads. A series of distinct beds lying close together, making a heavy memb. 10± ft. thick, in lower part of Cherokee sh. Forms prominent scarp just S. of Miami and extends southward, W. from Afton and along W. bank of Little Cabin Creek (Craig Co.) as far S. as Vinita. Is not traceable farther S. Lies 150± ft. below Bluejacket ss. memb. of Cherokee sh.

Little Chief porphyry.

Mesozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930 (Econ. Geol., vol. 25, p. 311). *Little Chief porphyry.*—Intrudes Telescope group (lower Paleozoic?). [Derivation of name not stated.]

F. MacMurphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July-Oct. 1932, p. 351 and map). *Little Chief porphyry* (*granite porphyry*) forms crest of S. part of Panamint Range near head of Surprise Canyon. Intrudes Telescope group. Assigned to Mesozoic (?). [Derivation of name not stated and not apparent from his map.]

Little Clarksburg ls. (In Conemaugh formation.)

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M7, p. 250), applied this name to a ls. btw. Connellsville and Morgantown ss. members, which is position of Clarksburg ls.

Little Compton shales.

Pre-Cambrian: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 281–283, 383). *Little Compton shales.*—A series of greenish slates and shales with thin dol. layers, which evidently constitute a geol. unit. Extend from Browns Point to S. side of Pachet Brook southward, within ½ mile of road running N. from Little Compton, thence westward and along the shore as far as the granite area. Believed to be pre-Carbf. and may be Camb.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped the rocks of the area described as Marlboro fm. (pre-Camb.).

†Little Cottonwood granite.

A name that has been applied by some geologists to the stock of quartz monzonite (of late Cret. or early Tert. age) in Little Cottonwood region of central northern Utah. It is exposed in Little Cottonwood Canyon. Has also been called *Cottonwood granite.* (See S. F. Emmons, 1903, Am. Jour. Sci., 4th, vol. 16, pp. 141–147, and F. F. Hintze, Jr., 1913, N. Y. Acad. Sci. Annals, vol. 23, pp. 85–143.) As there is only one quartz monzonite in the region, the U. S. Geol. Survey has not adopted a geographic name for the rock, but uses the term "Little Cottonwood stock" for the structural feature which it forms.

Little Dry glacial stage.

Pleistocene: Northeastern Utah and southwestern Wyoming.

W. H. Bradley, 1936 (U. S. G. S. P. P. 185–I, pp. 194–195). Oldest glacial stage in Uinta Mtns of NE. Utah and SW. Wyo. Named for Little Dry Creek, which flows along W. side of a large terminal moraine on Cottonwood bench, a broad remnant of Bear Mtn surface btw. Little Dry and Cottonwood Creeks, NE. Utah.

Little Dunkard sand.

Drillers' name for a sand in Conemaugh fm. (Penn.) of SW. Pa. that lies at or near horizon of Saltsburg ss. memb. In W. Va. the name is applied to an older sand, which is believed to correspond to Buffalo ss. memb. Named for Dunkard Creek, Greene Co., SW. Pa.

Little Falls dolomite.

Upper Cambrian: East-central and eastern New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 16 and chart). *Little Falls dol.* is employed to express the highly mag., sparsely fossiliferous phase of "Calciferous sandrock" [Beekmantown] in Mohawk Valley. [Assigned to "Champlainic or Lower Siluric," and shown as uncon. underlying Lowville ls. and overlying *Greenfield ls.* (Camb.). The latter he defined as heavy beds of ls. overlying the shore deposits of Potsdam ss. in Saratoga Co. *Greenfield* being preoccupied, it was in 1910 replaced by *Hoyt ls.*, which has been both included in and excluded from Little Falls dol., as explained below.]

In 1905 (N. Y. State Mus. Bull. 77, map) H. P. Cushing mapped *Beekmantown fm. and Little Falls dol.* in Little Falls quad., and assigned them to Lower Sil. [Ord.]. In 1907 (N. Y. State Mus. Bull. 114) C. A. Hartnagel assigned *Beekmantown dol.* (*Little Falls dol.*) to "Champlainic or Lower Siluric." In 1908 (Geol. Soc. Am. Bull., vol. 19, p. 171) H. P. Cushing excluded Little Falls dol. from Beekmantown, and stated that it is uncon. with overlying Beekmantown. In 1909 (Sci., n. s., vol. 29, pp. 351–356) A. W. Grabau considered Little Falls dol. a local subdivision of the Beekmantown. In 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 780–781) E. O. Ulrich and H. P. Cushing restricted *Little Falls dol.* of Mohawk Valley (type region) to lower part of the fm. as heretofore defined, as explained in item 11 under *Beckmantown group*, and assigned it to "late Camb. (Saratogan or Ozarkian)." The same year (N. Y. State Mus. Bull. 140) they described *Little Falls dol. as thus restricted* as consisting of (descending): (1) Dol., largely dark-gray, finely crystalline beds running up into more coarsely crystalline very light-gray beds which are apt to be full of chert and containing a ponderous Cryptozoon reef 30 ft. below top at Little Falls and other Cryptozoon reefs lower down; (2) *Hoyt ls.*, a local basal phase, called *Greenfield ls.* by Clarke, which rests on Theresa fm. (passage beds to Potsdam ss.). They assigned the Little Falls to "Saratoga (Ozarkic)," stated that it is everywhere uncon. with overlying Tribes Hill ls., gave many details and several sections, and stated that "the gastropods described by Cleland from the upper chert zone of the Little Falls dol. at Little Falls are clearly Ozarkic types."

In 1910 (N. Y. State Mus. Bull. 145, p. 97) H. P. Cushing and R. Ruedemann treated Hoyt ls. as distinct fm. btw. Little Falls dol. and Theresa fm. and assigned all three to Saratogan. In 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135-144) H. P. Cushing treated *Hoyt ls.* "as a local calc. phase of basal portion of Little Falls dol.," assigned it to Saratogan, stated that Walcott had determined its fauna to be Upper Camb., and that it was very local, its exposures being confined to immediate vicinity of Saratoga. In 1911 (Geol. Soc. Am. Bull., vol. 22, p. 643) E. O. Ulrich treated *Hoyt ls.* as distinct from Little Falls dol. and from *Theresa passage beds*, although on pl. 27 of that vol. he placed it as=lower part of [typical] Little Falls dol. of east-central N. Y.; and he assigned Little Falls, Hoyt, Theresa, and Potsdam ss. to Saratogan epoch of his Ozarkian system. He showed Little Falls dol. of Champlain Valley as=div. A and lower part of div. B of Beekmantown [of Brainerd and Seely] and as uncon. below Beekmantown, which he restricted to divisions E, D, C, and upper part of B. He also showed basal part of Chepultepec dol. of Ala.=top part of Little Falls dol., the rest of the Chepultepec being absent in both type Little Falls region and in Champlain Valley. In 1912 (Smithsonian Misc. Coll., vol. 57, No. 9) C. D. Walcott assigned *Hoyt ls.* fauna to Upper Camb. In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel treated *Hoyt ls.* as a fm. btw. Little Falls dol. (above) and Theresa dol., and assigned all three to Camb. He stated that the name is now extended to strat. equiv. of the fm. in Champlain Valley. In 1914 (N. Y. State Mus. Bull. 169) H. P. Cushing and R. Ruedemann transferred *Hoyt ls.* to Theresa fm., calling it *Hoyt ls. memb.*, and classified the Little Falls and Theresa as "Upper Cambric or Ozarkic of Ulrich."

In 1915 (U. S. Nat. Mus. Bull. 92, vol. 1, p. vii, and vol. 2, pls. 1 and 2) R. S. Bassler, who collaborated with Ulrich, correlated top part only of *Little Falls dol.* of Champlain Valley, N. Y., with Chepultepec of Ala. and with Gasconade of Mo., placed them all as older than Beekmantown, and showed a big hiatus in midst of Little Falls dol. The part of the Little Falls beneath this hiatus he assigned to div. A and lower part of div. B of Brainerd and Seely's subdivisions of Beekmantown, which parts have not for many years been included in Beekmantown.

In 1916 W. J. Miller (N. Y. State Mus. Bull. 182) included Little Falls and Theresa in Camb. The same year (Geol. Soc. Am. Bull., vol. 27, p. 589) A. W. Grabau stated that Little Falls dol. is lowest Beekmantown and that Theresa or *Hoyt lss.* are transitional beds to Little Falls dol. In 1919 (N. Y. State Mus. Bull. 213, 214) W. J. Miller assigned Little Falls dol. to Upper Camb.

In 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51) R. S. Bassler divided *Little Falls dol.* of Champlain Valley into: "Little Falls dol. (top bed), upper Ozarkian," lying uncon. below Beekmantown (including divisions E, D, C, and part of B) and separated by a big hiatus from "Little Falls dol. (div. A and B), lower Ozarkian." Bassler correlated this top bed of Little Falls dol. with Gasconade of Mo. and Chepultepec of Ala., and showed it as absent in "east-central N. Y.," where occurs type loc. of Little Falls dol. He placed all of his Ozarkian in the Camb., including the top bed of Little Falls dol. of Champlain Valley. The latter bed is not shown as=any part of div. B.

In 1923 (Smithsonian Misc. Coll., vol. 67, No. 8) C. D. Walcott treated *Hoyt ls.* as a fm. btw. Little Falls and Theresa dolomites, and assigned Hoyt, Theresa and Potsdam to "Ozarkian," which he recognized as a distinct system, although he stated (pp. 469, 470) that fauna of *Hoyt ls.* and upper part of Potsdam ss. is comparable with that of lower Mons of Alberta, and that fauna of lower Mons is "predominantly Upper Cambrian."

In 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34 and Bull. 31, p. 16) Ulrich showed Tribes Hill as basal fm. of his Canadian system, and uncon. on Chepultepec, top fm. of his Ozarkian system.

Repts give thicknesses of *Little Falls dol.* of 74 to 124 ft. in Hamilton Co.; 160 to 200 in Broadalbin quad. (Fulton and Saratoga Counties); and 300 to 400 at Saratoga Springs and vicinity; and of *Hoyt ls.* as 100+ and 120 ft. in Saratoga Co., and 300+ ft. in Dutchess Co., where according to E. B. Knopf (Am. Jour. Sci., 5th, vol. 14, pp. 429–458, 1927) it consists of aren. ls. and dol. carrying Hoyt fauna, overlain by Rochdale ls. and discon. underlain by Stissing dol.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 412, 414), assigned *Little Falls dol.* to Upper Camb. and placed it above Theresa fm. and uncon. below Amsterdam ls. (Black River).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 241, 242, 263). Late studies show *Little Falls dol.* (formerly included in Beekmantown) to be uppermost memb. of Lower Ozarkian series in N. Y. and to be separated from overlying Tribes Hill ls. of Canadian system by uncon. It overlies *Hoyt ls.*, which is a more calc. and more fossiliferous phase of lower part of Little Falls dol. [On p. 233 she stated Hoyt is "basal phase" of Little Falls. In tables on pp. 191 and 194 she assigned Little Falls dol. to "Ozarkian (Saratogan) = Uppermost Cambrian of authors," and placed it above Hoyt ls., which she excluded from Theresa. The U. S. Geol. Survey treats Hoyt as a memb. of Theresa fm.] She also stated: The Little Falls consists of light-gray to dark-gray crystalline or subcrystalline dol.; black and gray cherts are found frequently at certain horizons, and certain layers are full of nodules of crystalline calcite; the summit is very apt to be formed of a massive *Cryptozoon* reef, often heavily silicified; max. thickness of fm. 200± ft.; except for the *Cryptozoon*, fossils are very scarce.

In Jan. 1936 the U. S. Geol. Survey further restricted *Little Falls dol.*, to the lower (major) part of the beds included in it since 1910, as explained under *Beekmantown group.*

The U. S. Geol. Survey treats *Hoyt ls.* as a memb. of Theresa dol. and classifies it and *Little Falls dol. restricted* as Upper Camb.

Named for exposures at the pass in Mohawk Valley at Little Falls, Herkimer Co., east-central N. Y.

Little Genesee conglomerate.

Upper Devonian: Southwestern New York.

C. S. Prosser, 1892 (Rochester Acad. Sci. Proc., vol. 2, pp. 55, 57, 93, 94, 96). *Little Genesee cgl.*, exposed N. of Little Genesee, Allegany Co., is believed to be same as Olean cgl.

†Little Grizzly Creek beds.

Pennsylvanian: Northern California (Taylorsville region).

H. W. Turner, 1894 (Am. Geol., vol. 13, pp. 230–231). *Little Grizzly Creek beds.*—At SW. base of Mount Ingalls [Plumas Co., in Downieville quad.], by road to Cascade gravel mine and to E. of Little Grizzly Creek, there occurs a highly metamorphic tuff, in a fine-grained part of which fossils were collected, which were identified by Charles Schuchert as Upper Carbf. and closely related to Robinson beds. These beds are stratigraphically nearly in line with Robinson beds.

H. W. Turner, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, p. 448). *Little Grizzly Creek beds,* which consist of highly metamorphic tuff containing many fossils, will probably be correlated with Robinson fm. [In Downieville folio, No. 37, these beds were mapped by Turner as Robinson fm. The latter name has priority over "Little Grizzly Creek beds."]

Little Hominy limestone member (*of Pawhuska limestone*).

Pennsylvanian: Central northern Oklahoma (Osage County).

K. C. Heald and K. F. Mather, 1919 (U. S. G. S. Bull. 686M, pp. 150, 152). *Little Hominy ls.*—Light-gray on weathered surface, somewhat darker where freshly broken, and very coarsely crystalline. In many places uppermost 3 to 6 in. consists of very impure conglomeratic ls. containing many shell fragments. Few fossils. In S. half of T. 25 N., R. 8 E., and wherever seen in T. 24 N., R. 8 E., it is unusually sandy, and in places impossible to separate from overlying massive ss. that forms top memb. of Pawhuska ls. The abrupt disappearance of this ls. at many localities is probably due to its transition from a sandy lime into a calc. ss. that is indistinguishable from overlying sands. Thickness 3 to 15 ft. Lies 12 to 30 ft. above Deer Creek ls. memb. of Pawhuska ls. Named for outcrops on Little Hominy Creek in SW. part of T. 25 N., R. 8 E.

†Littlehorn limestone.

Mississippian (lower): Northern Wyoming (east side of Bighorn Mountains).

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). *Little Horn ls.*—Light-gray massively bedded ls., many of lower beds of darker color and containing some sand admixture; uppermost 100 ft. of fm. is pure ls. Total thickness 1,100 ft. Typical Miss. fossils at several horizons. No fossils from basal 25 to 30 ft., and Dev. and Sil. may possibly be represented. Is in main = Madison ls. of Mont. and Pahasapa ls. of Black Hills. Overlies Bighorn ls. and underlies Amsden fm. without apparent uncon. Named for fine exposures in Little Horn Canyon, on E. side of Bighorn Mtns.

Same as Madison ls.

Little Kaw limestone member.

Pennsylvanian: Central eastern and northeastern Kansas.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pt. 1, pp. 76–79). *Little Kaw ls. memb.*—Bluish gray blocky ls., 2± ft. thick, forming top memb. of Stanton ls. in Johnson and Miami Counties. Underlies Weston sh. and overlies Victory Junction sh. memb. of the Stanton. Named for Little Kaw Creek, N. of Loring, Leavenworth Co.

See also N. D. Newell, 1936 (Jour. Geol., vol. 44, No. 1, pp. 23–31); R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22); and Kans.–Nebr. chart compiled by M. G. Wilmarth, 1936.

Little Loop oil sand.

A subsurface sand in lower part of Rico fm. (Perm.) in southern San Juan Co., SE. Utah.

Little Medicine tongue (*of Dinwoody formation*).

Lower Triassic: South-central Wyoming (Rattlesnake Hills-Medicine Bow-Laramie Basin region).

H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1664, 1669). *Little Medicine tongue of Dinwoody fm.*—A tongue of Dinwoody consisting of a widespread bed of variegated limy ss., separated from the older Ervay tongue of Phosphoria fm. by a tongue of red Chugwater sh., and overlain by upper part of the Chugwater. Thickness usually about 10 ft. Type along N. bank of Little Medicine Bow River (locally known as the "Little Medicine") in the Flat Top anticline 8 mi. N. of town of Medicine Bow on road from Medicine Bow to Casper. The tongue is also exposed in Rattlesnake Hills of Natrona Co., at Alcova, in Freezeout Hills, in Ferris and Seminoe Mtns, and at places in Laramie Basin. Not yet known which bed in type section of the Dinwoody represents Little Medicine tongue.

Little Missouri lignites or ligneous shales.

Eocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 50, 188). *Little Missouri lignites or ligneous shales*, with white sand btw. layers, of same character as those seen at mouth of the Little Missouri. Thickness 20 ft. Occur near top of Camden series. Underlie 32 ft. of laminated sand with greensand specks and overlie 10 ft. of buff-colored micaceous sand and clay shales which change on exposure to pink or light yellow.

Probably belong to Wilcox fm.

Little Oak limestone.

Lower Ordovician (late Chazy): Northern central Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 112). *Little Oak ls.*—Generally thick-bedded dark, rather coarsely crystalline ls., in places containing many chert nodules. At top a considerable portion of fm. is very argill. Thickness 0 to 500 ft. Fossils of latest Chazy age. Uncon. overlies Athens sh. Occurs in Cahaba Valley. Named for exposures on W. front of Little Oak Ridge, S. of Leeds, Jefferson Co.

†Little Pine Ridge sandstone.

Upper Cretaceous: Central Wyoming (Salt Creek oil field, Natrona County).

C. E. Jamison, 1912 (Wyo. State Geol., ser. B, Bull. 4, p. 19). *Little Pine Ridge ss.*—Bluish gray ss., 50 to 90 ft.; in upper part 2 coal beds, 10 in. to 3 ft. thick. Forms ridge which usually bears sparse growth of pine trees, from which it derives its name. Lies 570 ft. below top of Pierre fm. in Salt Creek oil field, and 480 ft. above Parkman ss. memb. of Pierre fm.

V. H. Barnett, 1915 (U. S. G. S. Bull. 581, pp. 109, 113, on Big Muddy dome). A ss., lying 320 ft. above Parkman ss. and 400 ft. below top of Pierre fm. in Big Muddy dome [SE. of Salt Creek oil field], seems to agree in strat. position and character with ss. described by Wegemann in U. S. G. S. Bull. 452 as forming Little Pine Ridge, E. of Salt Creek oil field. When Wegemann's rept was published the geographic extent and value of this ss. as a key were not known, but work of Hares W. of Casper and of writer E. of Casper has shown it is probably most easily identified memb. of Pierre fm., and it seems desirable to map and name it. Wegemann stated this memb. forms Little Pine Ridge, a name given by him to an escarpment of ss. next E. of that formed by Parkman ss., but he did not apply the name to the ss. As *Little Pine Ridge* is cumbersome name, and not in current use in the county, it is thought best to name the ss. *Teapot ss. memb.*, from "Teapot Rock," a well-known topog. feature carved from this ss., about ½ mi. E. of Casper-Salt Creek road. The memb. consists of gray and buff ss., including some carbonaceous sh., and is 50 ft. thick at type loc. and 160 ft. thick in Big Muddy dome.

It seems apparent Jamison's use of this name was unknown at time Barnett's rept was published, as it is not listed in U. S. G. S. alphabetic list of geologic names in the literature, and was only recently (1936) discovered by the compiler of this lexicon. Barnett treated this ss. as a memb. of Pierre sh., but later work resulted in differentiating (1915) the deposits of Pierre age in this region into Mesaverde fm. (above) and Steele sh. (below), and the Teapot ss. has for many years been treated as a memb. of Mesaverde fm.

†Little Pittsburgh limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

F. Platt, 1877 (Pa. Geol. Surv. Rept. H_3, pp. 55–104). *Little Pittsburg ls.*, 4 to 5 ft. thick, underlies Little Pittsburg coal and lies 50 ft. below Pittsburg coal.

[As thus defined is same as Upper Pittsburgh ls. memb. of Conemaugh fm. of present nomenclature.]

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 305–308). In NW. part of Allegheny Co. *Upper Little Pittsburg ls.* lies 30 ft. below Pittsburg coal and *Lower Little Pittsburg ls.* lies lower, the two being separated by variegated shales.

Little Pittsburgh member. (In Conemaugh formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include Lower Pittsburgh ss., Little Pittsburgh coal, and Pittsburgh ls.

Little River.

Lower Cretaceous: Arkansas.

See *Upper Little River ls.*

Little River group.

Silurian or Devonian: New Brunswick.

G. F. Matthew, 1863 (Canadian Nat., vol. 8, pp. 244, 251–253).

Little Saline limestone.

Lower Devonian (Oriskany): Eastern Missouri (Ste. Genevieve County) and southwestern Illinois.

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser., pp. 88, 174; name taken from unpublished ms. by S. Weller). *Little Saline* underlies Grand Tower ls. and overlies Bailey ls.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 170–171). *Little Saline River ls.* uncon. overlies Bailey ls. in Mo. and uncon. underlies Clear Creek chert.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 136–141). *Little Saline fm.*—Has not heretofore been recognized. Name taken from exposures at quarries of Ozora Marble Co., in E. bank of Little Saline Creek, just S. of abrupt bend of the stream from a northerly to an easterly direction, a little less than 1¼ mi. W. of road crossing S. of Ozora, where max. thickness of 103 ft. is exposed. No known occurrence outside of Ste. Genevieve Co. Is a very pure thick-bedded, more or less coarsely crystalline ls., nearly white or with slight pinkish tint, and filled with fossils in lower half. One bed toward top is decidedly crinoidal. Resting in the lower fossiliferous crystalline beds is a 10 ft. bed of dense hard, close-textured, nearly white ls. with great numbers of bryozoans resembling *Lichenalia*, and a similar bed 8 ft. thick occurs at top of fm. The fm. is apparently entirely free from chert. Rests uncon. on Bailey ls. Conformably [?] overlain by Grand Tower fm. Fossils (listed) correlate it certainly with Upper Oriskany.

T. E. Savage, 1925 (Am. Jour. Sci., 5th, vol. 10, pp. 139–144), extended *Little Saline ls.* into Ill., and substituted it for his *Backbone ls.* of Jackson Co.

†Little Saline River limestone.

Same as *Little Saline ls.*

Littles Corner limestone member.

Devonian or Carboniferous: Northwestern Pennsylvania (Crawford County).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 202). Hayfield sh. memb. of Knapp fm. includes *Littles Corner ls.*, new name. [All there is about *Littles Corner ls.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 120). *Littles Corner ls. memb.*—A rather persistent, hard, bluish gray siliceous ls. in upper part of Hayfield sh., which in past has been known as *Cussewago ls.* Was called *Hayfield ls.* by Chadwick. It lies from 15 to 20 ft. below Berea (Corry) ss.; in one or two instances has been reported to lie immediately below Corry ss. Is of restricted distribution. Named for village of Littles Corner in Cussewago Valley, Crawford Co. [On p. 116 he says Cussewago ls. of I. C. White is Hayfield ls. of Chadwick.]

Littleton formation.

Lower Devonian (Oriskany): Northwestern New Hampshire (Ammonoosuc River region).

C. P. Ross, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 267–302). *Littleton argillite.*—Almost wholly fine black argillite. Contains 2 types of rock, one a group of black argillite and the other a group of alternating bands of black argillite and lighter colored rock, both of which are present in both of mapped areas (in Ammonoosuc mining dist.). Few fossils indicate Lower Dev. marine. Is the "clay slates" of Hitchcock and correlates with "banded argillites" and "dark gray ss. with dark sh. layers" of upper part of Lahee's Blueberry Mtn series. Younger than Lyman fm. Named for Littleton Twp. Grafton Co.

M. Billings, 1934 (Sci., Jan. 19, pp. 55–56). *Littleton fm.* (Lower Dev.) consists of 5,000 ft. of sl., ss., and volcanics, overlying Fitch fm. (middle Sil.). [This corresponds to Littleton argillite of Ross, but is applied over larger area where volcanic rocks are present and included.]

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., pp. 17, 23). C. P. Ross's suggested name "Littleton argillite" is not very satisfactory, as the rocks are slates, sss., and volcanics. The term *Littleton fm.*, from the Twp in which the rocks are typically developed, is proposed instead. More specifically the type loc. is around Slate Ledge, Walker Mtn, and dist. lying a mi. to SW. The fm. is dominantly black sl. and black and gray ss. with one important volcanic memb. that lies 700 to 1,000 ft. above base of fm. That part of fm. below the volcanic memb. is dominantly sl., well exposed in quarry at Slate Ledge. The first 1,000 ft. above the volcanic memb. is a hard, resistant, black ss. The upper part of fm. is interbedded ss. and sl., in which the individual beds are 1 to 6 inches thick. The volcanic memb. consists of (ascending): (1) Porphyritic greenstone metamorphosed to andesite or basalt; (2) white volcanic cgl. of well-rounded boulders 1 to 18 inches diam.; (3) greenish-gray rock which microscope shows to be altered basalt. Fossils are Lower Dev., Oriskany.

Littleton member (of Cedar Valley limestone).

Upper Devonian: Eastern Iowa.

C. L. and M. A. Fenton, 1930 (Am. Mid. Nat., vol. 12, No. 1, pp. 12–13). On right bank of Wapsipinicon River, near town of Littleton, Buchanan Co., is an exposure of Dev. rocks of Cedar Valley age, which are considered as the typical exposure of *Littleton sub-stage of the Cedar Valley.* [Details of 11 beds are given, all fossiliferous ls., except one 3 in. bed of sh., and aggregating 15 ft. 10 in.] Forms lower part of Cedar Valley stage. Overlain by 12 ft. of highly fossiliferous, shaly, yellowish ls. weathering to chips and calc. clay, and composing rest of Cedar Valley.

A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., figs. 1, 2, and pp. 36, 424). *Littleton memb. of Cedar Valley fm.*—At Linwood quarry, Scott Co., it consists of 30 ft. of very fossiliferous ls. underlain by 13 ft. of cherty shaly ls., and overlies Linwood memb. of Cedar Valley fm. Is older than Coralville memb. of Cedar Valley fm.

M. A. Stainbrook, 1935 (pp. 249 and 255 of 1935 vol. cited above), restricted Littleton of Fentons, by removing from its base 7 ft. of beds, which he transferred to Linwood memb., "to which they belong faunistically and lithologically." At Littleton thickness of *Littleton memb.* is 21 ft., at Brandon 30 ft., in Johnson Co. 55 ft., and in Buffalo-Linwood region 67 ft. Lithology varies as to locality, being mostly ls., but often argill. and shaly phases predominate. Underlies Coralville memb. of Cedar Valley.

†Little Traverse group.

Same as *Traverse fm.*

Little Traverse Bay limestone.

Middle Devonian: Michigan (northwestern part of Lower Peninsula).

C. C. Douglass, 1839? (Mich. Leg. H. Doc. 27, btw. pp. 97 and 111). *Little Traverse Bay ls.*—Limestone intermixed with clay and chert. Thickness 26 ft. Corresponds in geol. position and character to lss. of cliff of Thunder Bay. Underlies Corniferous ls. (light-gray ls. containing beds of hornstone) and overlies black bituminous ls.

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14). Douglass's loosely defined locality of outcrop of his "Little Traverse Bay ls." exhibits several distinct strat.

units, and since he unquestionably applied this term to all beds occurring on shores of Little Traverse Bay, it is suggested that the term be dropped, to avoid conflict with *Traverse group*.

†Little Traverse Bay group.

Same as *Traverse fm.*, which see.

Little White River beds.

Pliocene: Central southern South Dakota.

C. C. O'Harra, 1920 (S. Dak. Geol. Surv. Bull. 13, p. 36). *Little White River beds*, the lower Plio. *Hipparion* zone of White River Badlands. Uncon. overlies upper Mio. *Procamelus* zone or Nebraska beds in Little White River valley and the valley of the Niobrara. Fossiliferous. Local names have been used to designate the beds in the localities where fossil hunting has been carried on. Among these names are Snake Creek, Oak Creek, Little White River, Niobrara River, and Spoon Butte.

See also under *Oak Creek fm.*

Livengood chert.

Mississippian: Yukon Basin, Alaska.

J. B. Mertie, Jr., 1926 (Wash. Acad. Sci. Jour., vol. 16, No. 3, p. 79). Southward, in Yukon Basin, several fms. of Carbf. rocks are known. The Miss. rocks include Rampart volcanics, Calico Bluff fm. (composed of thin-bedded sh. and ls.), *Livengood chert fm.*, and a chert-argillite group of rocks. These fms. occur at different localities, and strat. relations btw. them are therefore obscure. [All there is about the fm.]

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Livengood chert (Miss.)*.—Dominantly chert; some interbedded ls., chert cgls., and argill. rocks. Intrusive rocks are not separated on map. Exposed in vicinity of Livengood, on Livengood Creek, at Livengood Dome, and elsewhere. Thickness probably several thousand ft.

Livermore gravel.

Pliocene (upper): Northern California (Mount Diablo region).

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 774, 779, pls. 15, 20). *Livermore fm.* (also *Livermore gravels*), upper Plio., S. of Livermore Valley, Mount Diablo region, = major part of Siesta fm. Rests uncon. on Briones (middle Mio.). [On p. 779 he says Livermore gravels are Plio. (?) and of continental origin.]

Liverpool cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a portion of lower part of Carbondale fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 2. Derivation of name not stated.

Livingston limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Clark County).

A. H. Worthen, 1875 (Ill. Geol. Surv., vol. 6, pp. 11–19). *Livingston ls.*—Two beds of ls. separated by 7 to 8 ft. of sh. with a thin coal (No. 12?); upper ls. of gray color and 5 to 8 ft. thick; lower ls. 7 to 8 ft. thick. Underlain by 30 to 35 ft. of argill. and sandy shales overying coal No. 11 (?).

Named for Livingston, Clark Co.

See also 1934 entry under *LaSalle ls. memb.*

Livingston formation.

Upper Cretaceous and Eocene: Central southern Montana.

W. H. Weed, 1893 (U. S. G. S. Bull. 105) and 1894 (U. S. G. S. Livingston folio, No. 1). *Livingston beds*.—Waterlaid and assorted volcanic material, including sss. shales, grits, cgls., and intercalated beds of true volcanic aggl. Thickness 7,000 ft. Uncon. underlie Fort Union fm. and uncon. overlie Laramie fm. Typically developed in vicinity of Livingston, Mont.

R. W. Stone and W. R. Calvert, 1910 (Econ. Geol., vol. 5, pp. 551–557, 652–669, 741–764). *Livingston fm.* is a lithologic unit, of limited geographic extent, consisting of andesitic material, 1,000 to 7,000± ft. thick, and includes equivalents of (descending order) Lebo andesitic memb. of Fort Union fm., Lance fm., Lennep ss., Bearpaw sh., and Judith River and Claggett fms. The underlying beds (called Laramie by Weed) are in reality Eagle ss. [This is present generally approved definition.]

Livingston conglomerate. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky (Rockcastle County).

A. M. Miller, 1908 (Ky. Geol. Surv. Rept. Prog. 1906, 1907, p. 28). *Livingston cgl.*—Cgl. in Lee fm. in dist. somewhat central about Livingston, Rockcastle Co., Ky., that can not be positively identified with Rockcastle cgl. Rests on or close to Lower Carbf. ls. and appears to fill erosion channels in it.

A. M. Miller, 1910 (Ky. Geol. Surv. Bull. 12). The very pebbly cgl. showing up suddenly at mouth of Roundstone Creek and extending in a narrow belt up the drainage area of this stream to the head and over onto headwaters of Silver Creek, and which also appears in patches on Horse Creek and has been somewhat doubtfully correlated by Campbell with his Rockcastle, appears to writer to be in all probability a different lens of ss. It lies in a channel cut out of St. Louis ls., and is doubtfully of marine origin. The name *Livingston cgl.* is suggested for it.

Llajas formation.

Eocene (middle): Southern California (Simi Valley, Ventura County).

J. H. McMasters, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, pp. 217–218). *Llajas fm.*, middle Eo., is typically exposed immediately NW. of mouth of Las Llajas Canyon, on NE. side of Simi Valley, Ventura Co. It was recently extensively cored in Richfield Oil Co. well "Tapo No. 42." Surface and subsurface data afford basis for accurate opinion of strat. and paleontology of the fm. Two zones are recognized, the upper or *Cyclammina* zone, and the lower or *Discocyclina clarki* zone. The 2 zones aggregate 2,020 ft. in the well and approx. 1,150 ft. in most easterly complete surface exposure of the fm. Study of 150 core samples and many surface samples not only verifies previous correlations of Llajas fm. with Rose Canyon sh. of San Diego region, but also indicates that it correlates with both type Domengine ss. and underlying "Meganos" sh. of dist. N. of Coalinga.

T. F. Stipp and F. B. Tolman, 1934 (Pan-Am. Geol., vol. 62, No. 1, p. 79). *Llajas fm.* on N. side of Simi Valley is divisible into 6 mappable members. It is overlain with apparent conformity, by "Sespe fm." (upper Eo.-Olig.?) and underlain by Santa Susanna fm.

Llanfair sandstone member (of Allegheny formation).

Pennsylvanian: Southern central Pennsylvania (Cambria County).

C. Butts, 1905 (U. S. G. S. Ebensburg folio, No. 133). At Llanfair, Cambria Co., a heavy ss. crops out in gorge opp. Henriette shaft No. 1, and, as shown in shaft section, extends to within 40 ft. of Lower Kittanning coal. It has considerable extent in this region and is called *Llanfair ss.* Its top is exposed along the track near Llanfair shaft No. 2, about 2 mi. S. of Llanfair, where it is very coarse and heavy. On Bens Creek the Lower Kittanning coal is closely overlain by a heavy ss. that may be a downward extension of Llanfair ss. [Columnar section shows Llanfair ss. as lying in interval btw. Upper Kittanning and Middle Kittanning coals and as in part of area extending down to near top of Lower Kittanning coal.]

Llano series.

The provincial series of metamorphosed sed. rocks of pre-Camb. age present in central Tex. Is divided into Valley Spring gneiss below and Packsaddle schist above. Originally called Llano "group." For definition see U. S. G. S. Bull. 769, pp. 120–121.

Llano de Oro formation.

Pleistocene (Wisconsin stage): Southwestern Oregon (Josephine County).

P. J. Shenon, 1933 (U. S. G. S. Bull. 846B). *Llano de Oro fm.*—Terrace deposit, consisting of poorly assorted clay and sand with small rock fragments and lenses of gravel. Uncon. overlies Tert. cgl. and is overlain by later Pleist. deposits. Thickness 1 to 80+ ft. Is probably of early Wisconsin age. Named for exposures at Llano de Oro mine, Takilma-Waldo dist.

†Llano Estacado formation.

Pliocene: Western Texas (Panhandle) and southeastern New Mexico.

R. T. Hill, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 87–100; Am. Geol., vol. 10, pp. 108–109). *Llano Estacado fm.*—Unconsolidated porous sediments of Llano Estacado, consisting mostly of waterworn gravel, sand, and silt in horizontal layers, averaging 200 ft. in thickness. Uncon. overlies Cret. and older rocks. Assigned to Neocene (Mio.-Plio.).

Replaced by *Ogallala fm.* (in this area all Plio.; no Mio. in this part of Tex., according to recent work).

Llano Estacadan series.

Tertiary: New Mexico.

C. R. Keyes, 1906 (Am. Jour. Sci., 4th, vol. 21, p. 298). *Llano Estacadan series.*—Shales, 200 ft. thick, overlying Arriban series and forming top div. of Tert. in N. Mex.

Probably same as †Llano Estacado fm., now replaced by Ogallala fm. (regarded as all Plio. in this region).

Llanos formation.

Pleistocene (?): Trinidad.

G. A. Macready, 1920 (Am. Inst. Min. and Met. Engrs., Trans., [preprint 1017], p. 8).

Lloyd sand.

Upper Cretaceous: Southeastern New York (Long Island).

A. C. Veatch, 1906 (U. S. G. S. P. P. 44, p. 21). *Lloyd sand.*—Yellow to white quartz sand and gravel, with occasional layers of clay; contains much decayed white chert and in one place marine fossils. Thickness 80 to 90 ft. Is overlain by varicolored clay 0 to 500 ft. thick and underlain by 0 to 200± ft. of clay. Extends into N. J., where it is an horizon in Raritan fm. about 200 ft. below top.

Named for occurrence in deep well at Lloyd Point, Lloyd Neck, Long Island.

Lloyd zone.

A subsurface oil zone, 2,620 ft. thick, in Repetto siltstone (lower Plio.) of Ventura Co., Calif. Top lies 1,300 ft. below base of Gosnell sh. Formerly included in Pico fm.

Lobelville shaly limestone member (of Brownsport formation).

Silurian (Niagaran): Western Tennessee.

W. F. Pate and R. S. Bassler, 1908 (U. S. Nat. Mus. Proc., vol. 34, pp. 410–432). *Lobelville fm.*—Upper 0 to 45 ft., called Coral zone, usually consists of whitish shales so prolific in fossils that their disintegration upon hillsides leaves ground covered with the specimens, and thin-bedded clayey ls. Lower 9 to 31 ft., called Bryozoan zone, consists of red and purple shales overlain by soft blue to white shales. Of Niagaran age. Top fm. of Brownsport group. Overlies Bob fm. and underlies Decatur ls.

Now treated as top memb. of Brownsport fm. (See H. D. Miser, Tenn. Geol. Surv., Resources of Tenn., vol. 7, 1917, p. 201; and Tenn. Geol. Surv. Bull. 26, 1921, p. 21.)

Named for Lobelville, Perry Co.

Lobo formation.

Triassic (?): Southwestern New Mexico (Deming region).

N. H. Darton, 1916 (U. S. G. S. Bull. 618, pp. 19, 39). *Lobo fm.*—Largely reddish and gray sh. and gray to pinkish impure ls., but includes much cgl. at base. Uncon. underlies Sarten ss. (Lower Cret.) and uncon. overlies Gym and older lss. in Deming quad. Thickness at Lobo Draw, on E. slope of Florida Mtns, 350± ft. In its overlap on granite SE. of Capitol Dome there is some basal arkosic ss. No fossils. May be Penn., Perm., Triassic, or even earliest Cret. Is tentatively classified as Triassic (?).

Lobster Lake series.

Silurian: Western Maine (Piscataquis County).

F. W. Toppan, 1932 (Geol. of Maine, Contr. Dept. Geol. Union Coll., Schenectady, pp. 70–72). *Lobster Lake series.*—Light-gray aren. lss. rich in stromatoporids, the entire group being strongly reminiscent of the Ripogenous lss., which contain Niagara fossils. At least 1,000 ft. thick. Well exposed on shores of Lobster Lake [Lobster Pond?], Piscataquis Co. Assigned to Sil.

Lockatong formation. (In Newark group.)

Upper Triassic: New Jersey and southeastern Pennsylvania.

H. B. Kümmel, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, pp. 40–47, and Jour. Geol., vol. 5, pp. 544–547). *Lockatong series.*—Hard dark-colored shales and dark-gray and green flagstones, much harder and darker than overlying Brunswick shales or underlying Stockton series. Also includes carbonaceous shales, hard massive black and bluish-purple argillites, dark-red shales, and some thin layers of highly calc. shales. Thickness 1,700 to 3,660± ft. Middle fm. of Newark system [group]. Named for Lockatong Creek, Hunterdon Co., N. J.

†Lockhart formation. (In Chester group.)

Mississippian: Western Kentucky.

F. J. Fohs, 1907 (Ky. Geol. Surv. Bull. 9, p. 67). *Lockhart fm.*—Lss., shales, and some ss., 100 to 175 ft. thick, composing topmost fm. of Chester group in Caldwell, Crittenden, and Livingston Counties. Overlain by Pottsville fm. and underlain by Birdsville fm. [See †*Birdsville fm.*]

May be=Clore ls.

Probably named for Lockhart, Livingston Co.

Lockport dolomite. (Of Niagara group.)

Silurian: New York, Michigan, and Ontario.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 289, 327). *Lockport ls.*—The ls. at Lockport [N. Y.] excavated for passage of the [Erie] canal. At this place the rock possesses in an eminent degree the geodiferous character which has hitherto given it its name. To E. it becomes a dark, nearly black, compact ls. Overlies Rochester sh. and underlies the red sh. [Salina fm.] forming basal part of Onondaga saliferous group. Is top fm. of Protean group of Vanuxem.

In subsequent repts the Guelph dol. has been both included in and excluded from Lockport dol. (See under *Guelph dol.*) The U. S. Geol. Survey uses the original and commonly accepted definition of Lockport dol., which includes the beds that carry the Guelph fauna. The Lockport consists largely of dol. and is treated as upper fm. of Niagara group, the Clinton fm. (including Rochester sh. memb. at top) being the lower fm. of that group. In some early repts the Lockport dol. was called "Niagara ls." The N. Y. State Survey now includes Guelph in Lockport dol. (See W. Goldring, 1931, N. Y. State Mus. Hdb. 10, pp. 191, 335.)

†Lockport group.

A name applied in some early N. Y. repts (L. Vanuxem 1842) to the blackish impure ls. and bluish slaty sh. underlying Onondaga salt group and overlying Clinton group, as he used the names. As thus used the term included Lockport dol. and Rochester sh. memb. of Clinton fm. of present nomenclature.

†Lockport group.

A time term used by E. O. Ulrich and R. S. Bassler (12th Int. Geol. Cong., Canada, pl. opp. p. 666, 1913; and Md. Geol. Surv. Sil. vol., pp. 244, 259–270, 1923) to include not only Lockport dol. of N. Y. but in Central States all beds btw. base of Laurel ls. and top of Louisville ls., the latter of post-Guelph age according to their charts. Ulrich's 1911 charts show some of these beds to be older and some younger than Lockport dol. of N. Y. The U. S. Geol. Survey uses *Lockport* in a rock or formational sense, applying it to the dol. that underlies Salina fm. and overlies Clinton fm. in N. Y. and Mich.

†Lockport marble.

†Lockport Encrinal marble.

Names applied in some early repts to Gasport ls. memb. of Lockport dol.

†Lockport moraine.

Same as *Barre moraine*. Named for Lockport, N. Y.

Loco diorite.

Eocene: Central Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Loco diorite.*—Granular rock forming stocks or central cores of Crazy Mtns. Prevailing form is a typical diorite grading into quartz diorite and even into granitite. At N. end of Loco Mtn stock the prevailing rock is an augite-biotite diorite with no hornblende and very little quartz. Assigned to Eo., as it cuts sed. rocks containing post-Cret. plants and is overlain by Neocene lake beds and cut by Neocene eruptives.

Locust Grove diorite.

Pre-Cambrian: Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). *Locust Grove diorite* closely parallels the granite near Locust Grove. Extends from 1 mi. E. of Verdiersville on R., F. & P. Ry. to 1½ mi. SW. of Flat Run P. O., a distance of 8½ mi. Is definitely older than Locust Grove granite and is probably pre-Camb.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped the diorite near Locust Grove as pre-Camb. quartz diorite, intrusive into Glenarm series.

Locust Grove granite.

Pre-Cambrian: Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). *Locust Grove granite* is typically developed near Locust Grove, Orange Co. Corresponds fairly closely to quartz monzonite. Is believed to be late pre-Camb. or Camb. Is younger than Locust Grove diorite.

A. I. Jones, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped the granite at and near Locust Grove as pre-Camb. and as intrusive into Glenarm series.

Locust Point formation. (In Borden group.)

Mississippian: Southeastern Indiana.

P. B. Stockdale, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, pp. 708–716). *Locust Point fm.*—Mainly massive or shaly siltstone in southern part of Ind. outcrop area. Northward the fm. becomes a succession of fine-grained ss. beds and alternating shaly zones. Fossils rare, aside from worm marks. Average thickness 125± ft. Underlies Carwood fm. and overlies New Providence fm. [In 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170) Stockdale named the beds underlying Carwood fm. and overlying New Providence fm. in southern Ind. the *St. Joseph,* a name that is preoccupied.]

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 52, 77, 94, 120–126+). *Locust Point fm.*—Underlies Carwood fm. and overlies New Providence fm. Is more sandy than latter. Includes rocks called "Knob sh.," "Upper Knobstone sh.," etc., by early Ind. writers and Rosewood sh. by Butts (Ky. Geol. Surv., ser. 4, vol. 3, 1915, pp. 157–158). For lack of a better term, and in absence of detailed strat. knowledge, *Rosewood sh.*, the most recent name, has been used with some misgiving in various writings that have appeared since Butts' 1915 proposal. The name *Locust Point fm.* here used is selected from a well-known topog. prominence on Ohio River bluff, about 1 mi. S. of Floyd-Harrison Co. line, S. center sec. 12, T. 4 S., R. 5 E., and from nearby Locust Point P. O., center SE¼ same section. The sandy sh. extending from base of bluff upward 127 ft. is this fm. [Describes and names many local *facies* of the fm.]

Lodgepole limestone. (Of Madison group.)

Mississippian (lower): Central northern Montana (Little Rocky Mountain region).

A. J. Collier and S. H. Cathcart, 1922 (U. S. G. S. Bull. 736 F, p. 173). In this part of Mont. (Little Rocky Mtn region) the Madison ls. becomes a group, divisible into two distinct fms., here named *Lodgepole ls.* (the lower one) and *Mission Canyon ls.* (the upper one). The Lodgepole ls. consists of 800 ft. of thin-bedded ls. and sh. containing many fossils. It overlies Jefferson ls. Named for exposure in Lodgepole Canyon.

Lodi shale member (of St. Lawrence formation).

Upper Cambrian: Southern Wisconsin and eastern Minnesota and Iowa.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 547). Trempealeau fm. is divided by E. O. Ulrich [unpublished at this time] into four members: Norwalk fine-grained dolomitic ss. at top, underlain by *Lodi yellow and purple sandy thin-bedded dol.*, locally called "sh.," which in turn rests on St. Lawrence or Black Earth dol. [restricted use of St. Lawrence]. Along Wisconsin River the Lodi "shales" predominate.

E. O. Ulrich, 1924 (Trans. Wis. Acad. Sci., Arts, and Lett., vol. 21, pp. 83, 86–87). *Lodi sh. memb.* (*of Trempealeau fm.*).—This term is proposed for the usually yellow, calc., sh.-like ss. that lies btw. Norwalk ss. and St. Lawrence ls. [Ulrich's restricted definition of St. Lawrence]. This sh. memb. is widely distributed, the outcrops being everywhere recognizable from Stillwater, Minn., and Osceola, Wis., on the N. to Spring Green on the S. and vicinity of Madison on the E. Locally the characteristically yellow sh. is interbedded with purple sh., as in vicinity of Mazomanie, or with layers of ss., and in other places with dolomitic ls., but even without considering the fossils there is seldom any difficulty in recognizing the Lodi sh. Thickness rarely less than 15 ft., with 50 ft. max. and 25 ft. approx. average. Usually fossiliferous, and so far as known its fauna is almost entirely confined to this memb.

The U. S. Geol. Survey at present treats these beds as a memb. of St. Lawrence fm., and does not use the name "Trempealeau fm." A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 21–79), also used *St. Lawrence fm.* instead of *Trempealeau fm.;* but in 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., passim) Trowbridge et al., expanded Trempealeau fm. so as to include at top *all* of Jordan ss. as well as overlying Madison ss., and treated Lodi and St. Lawrence [restricted] as members of the Trempealeau. This classification has not yet been adopted by U. S. Geol. Survey.

Type locality not stated, but presumably named for exposures at or near Lodi, Columbia Co., Wis.

Lodore formation (also **Lodore shale**).

Cambrian: Northwestern Colorado and northeastern Utah (Uinta Mountains).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 56, 58, 144–147). *Lodore group.*—A group of soft sss. and aren. shales, with cgls. at base, 465 ft. thick, conformably underlying Redwall group of lss. in Lodore and Whirlpool Canyons, where Green River cuts through eastern part of Uinta Mtns, and uncon. overlying Uinta ss. Believed to be same as Tonto group [Middle Camb.] of Grand Canyon, but assigned to Carbf. Named for Lodore Canyon [Moffat Co., NW. Colo.].

F. B. Weeks, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 432–434). *Lodore shales.*—Argill. and sandy green, red, purple, and black shales; green shales containing many nodules. Thickness 500 to 1,200 ft. in Uinta Range. Assigned to Camb. and correlated with Tonto group of Grand Canyon.

H. S. Gale, 1910 (U. S. G. S. Bull. 415, p. 48). *Lodore shales* not studied in connection with this rept on coal fields of NW. Colo. and NE. Utah. They are now thought to be of middle or upper Camb. age, although no authentic record of fossils from this fm. is known for this general region.

Logan formation.

Mississippian: Ohio and northeastern Kentucky.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 62, 76, 79, 80, 87). *Logan ss. group* (also *Upper Waverly or Logan ss.*).—Fine-grained buff-colored ss., 133½ ft. thick, underlying Maxville ls., or, where that is absent, the coal measures. Overlies 85 ft. of alternate fine-grained Waverly-like seams and cgl. exposed at Black Hand, where it is 50 to 60 ft. thick. [In this and later repts Andrews called this cgl. "Waverly cgl." But that name was later replaced by *Black Hand fm.*]

According to Jesse E. Hyde (Jour. Geol., vol. 23, p. 659, 1915) and C. S. Prosser (Ohio Geol. Surv., 4th ser., Bull. 7, p. 17, 1905) there is a difference of opinion regarding the rocks originally included in Logan ss. by E. B. Andrews, also regarding the correct definitions of Black Hand and Cuyahoga. (See under *Black Hand memb.* and *Vinton memb.*) Hyde's expanded Logan fm. (which includes, descending, his Vinton, Allensville, Byer, and Berne members) and his restricted Black Hand memb. appear to be the definitions at present followed by Ohio Geol. Surv. The U. S. Geol. Survey, however, has not yet adopted these modifications for its publications.

Named for Logan, Hocking Co., Ohio.

†Logan limestone or flint. (In Logan formation.)

Mississippian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 900–901, pls. opp. pp. 889, 900, 921, 933). *Logan ls. or flint* (also *Logan flint ls.*).—Thickness 1 to 2 ft. in Vinton and Jackson Counties. Overlain by iron ore and underlain by thin coal. Lies about 50 ft. above Waverly cgl. and about 55 ft. below Maxville ls.

Probably named for occurrence in Logan fm.

Logan fire clay. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 713, 901). *Logan fire clay.*—One of most valuable clay seams of Ohio, lying immediately above Maxville block ore and Maxville ls. in Perry and Hocking Counties. Probably belongs to same horizon as Sciotoville and Webster fire clays of Scioto Co.

Occurs in basal part of Pottsville fm. Appears to be a lower clay than the Sciotoville. (See Outlines of field trips in geol. in central Ohio, by C. S. Prosser and W. C. Morse, 1915, p. 16.)

Named for Logan, Hocking Co.

†Logan group.

Mississippian: Ohio.

E. Orton, 1880 (Review Strat. Geol. Eastern Ohio, p. 14). *Logan group.*—A series of shales, sss. and cgls., 150 to 250 ft. thick, held together by common fossils, included in Cuyahoga sh. by some authors, but overlying (Lower) Cuyahoga sh. and underlying Maxville ls. or a well-marked horizon of coal, fire clay, and iron ore. Includes Logan ss. and Waverly or Black Hand cgl. and contemporary beds.

Preoccupied by *Logan fm.*

Apparently named for Logan, Hocking Co.

Logan limestone.

Silurian: Central Pennsylvania (Mifflin County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 787, 790, 805). *Logan ls.*—A peculiar stratum, 3½ ft. thick, outcropping near Logan Furnace. Differs in character from the other ls. beds of Logan section, but may not have any strat. importance. Consists of 3 layers, the upper and lower ones being heavy compact dull-blue ls. breaking into square blocks and weathering blue gray. Between them is a very hard layer heavily charged with iron and breaking with rough semi-crystalline surfaces. Overlies Logan sh., 72 ft. thick. All included in upper part of Salina shales.

Logan shale.

Silurian: Central Pennsylvania (Mifflin County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, p. 787). *Logan sh.*, 72 ft. thick, underlies Logan ls. and overlies Salina Upper red sh. in Logan section. Included in Salina shales, lying much higher in section than Bloomsburg red sh.

†Logan sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 178). *Logan ss.*—Massive, persistent, gray, medium-grained, micaceous. Thickness 20 to 50 ft. Lies 0 to 5 ft. below Alma coal and 1 to 10 ft. above Little Alma coal. Named for Logan, Logan Co., W. Va.

C. E. Krebs and D. D. Teets, Jr., 1915 (W. Va. Geol. Surv. Rept. Boone Co., p. 443). Name of *Logan ss.* changed to *Monitor ss.*, because Logan is preoccupied.

Logan sills.

A name that has long been in use for pre-Camb. sills, of Keweenawan age, on NW. coast of Lake Superior, in northern Minn. and Canada. Name was given in honor of Sir Wm. E. Logan.

Logana bed.

Middle Ordovician (Trenton): Central Kentucky.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 9, 19). *Logana substage.*—Argill. ls. and sh., 10 ft. thick, characterized by *Modiolidon oviformis.* Overlies Curdsville ls. and underlies Hermitage ls. All included in Lexington stage.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7), and A. M. Miller, 1906 (Ohio Nat., vol. 6, pp. 447–448). *Logana* underlies Wilmore and overlies Curdsville.

A. F. Foerste and A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1). *Logana* is same as Hermitage of Tenn., and Wilmore overlies Logana.

Named for Logana, Jessamine Co.

†Loganian.

Name proposed in early repts for pre-Laurentian rocks of Great Lakes region which correspond to Keewatin series of U. S. Geol. Survey. For definition see U. S. G. S. Bull. 769, p. 135.

Logie Green.

Cretaceous: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

Lohali sandstones.

Jurassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 337). *Lohali sss.*, 250 ft. thick, underlie Mancos shales, and compose main body of Dakotan series as developed near Lohali, Apache Co., W. of Chinle, and NW. of Fort Defiance.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 65, No. 4, pp. 303, 306). *Zunian series* divided into (descending) McElmo shales, Lohali ss., Montezuma shales, and Arido ss. The latter 3 fms. correspond to La Plata beds of Cross, and are present in Colo, N. Mex., and Ariz.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 66, No. 1, pp. 71–72). *Lohali* is preoccupied and is here replaced with *Tyende ss.*

This ss. appears to correspond to Navajo ss. of U. S. G. S. classification. (See U. S. G. S. P. P. 183, chart opp. p. 37.)

Lohn shale member (of Thrifty formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 408). *Lohn bed.*—Fossiliferous, bluish, red, yellowish, and purple clay, with some shaly clay, sh., ss., and ls., and the Chaffin coal. Thickness 20 to 75 ft. Memb. of Cisco div. Underlies Parks Mtn bed and overlies Speck Mtn ls.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132), include this bed in Thrifty fm., of Cisco group. Named for Lohn, McCulloch Co.

Lohrville granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated), which occurs in a small mound not far from the mound of Waushara granite and which is similar to latter granite.

†Lolo series.

Pre-Cambrian (Belt series): Central western Montana (northern Bitterroot Mountains) and adjacent area in Idaho.

W. Lindgren, 1904 (U. S. G. S. P. P. 27, pp. 16, 34). *Lolo series.*—The sed. series of Lolo Fork, near extreme N. end of Bitterroot Range [in Mont., according to Lindgren's map]. Apparently does not enter watershed of Clearwater River, though continuing close to its limits. Consists of moderately metamorphosed qtzites, ls., and banded slates, some of purple color. Apparently conformable, but evidently folded, overturned, and repeated series. Probably identical and continuous with series occupying entire width of Coeur d'Alene Mtns, and extending from lake of same name on W. to Clark Fork of Columbia on E. No fossils ever found in either series. My belief is Lolo series should be coordinated with thick pre-Camb. series of central Mont.

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, p. 278). The Algonkian sed. rocks near Lolo Pass [just over the line in Idaho], described by Lindgren in U. S. G. S. P. P. 27, p. 16, are probably part of the same series that prevails in Coeur d'Alene Mtns, but, as shown by Lindgren, are cut off by the great granite batholith of central Idaho.

Lomita formation.

Pleistocene: Southern California (San Pedro Hills, Los Angeles Basin).

U. S. Grant, IV, and H. R. Gale, 1931 (Mem. San Diego Soc. Nat. Hist., vol. 1, pp. 42–43, 61). Las Posas zone in Los Angeles Basin is most characteristically exposed at Lomitas quarry and in Hilltop quarry. It uncon. underlies Timms Point zone (=Deadman Island "Plio." of repts) and overlies Santa Barbara zone. Correlation with Las Posas of Ventura Basin practically certain.

R. D. Reed, 1933 (Geol. Calif., pp. 259, 260, 261, 264, 303, 304). *Lomita fm.*—Marine deposits. To S. in San Pedro Hills the *calc. Lomita* underlies Timms Point fm. and overlies lower Plio.; to N., at San Pedro, the *sandy Lomita* underlies San Pedro ss. and overlies lower Plio. Repetto fm. The two facies are fairly well separated by a small anticline. Fossiliferous. Assigned to Pleist.

U. S. Grant, IV, 1935 (Pan-Am. Geol., vol. 64, No. 1, pp. 73–74). *Lomita fm.*, 0 to 300 ft. thick, underlies Timms Point fm. (both marine Pleist.) at San Pedro. Fossils listed.

Lonaconing sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 573). *Lonaconing ss.*—Underlies Franklin coal and overlies Lonaconing coal; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 68, pl. 6). *Lonaconing ss.*—A thin-bedded ss. found locally btw. Lonaconing and Franklin coals. Exposed at various places along Georges Creek S. of Lonaconing.

Lone quartzite.

Upper Cambrian: Southwestern New Mexico (Silver City region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 8). *Lone qtzite.*—Late Camb. section of alternating qtzites and metamorphosed lss. well displayed in Lone Mtn, near Silver City. Thickness 300 ft.

The Upper Camb. qtzite of Silver City region has for many years been called *Bliss ss.* by U. S. Geol. Survey.

†Lone limestone.

A name applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, p. 37), to the upper or Sil. part of Lone Mtn ls. of Nev.

Lone Butte limestone member.

Middle Devonian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 43 and passim). *Lone Butte ls. memb.*—Underlies Spotted Bear ls. and overlies Coopers Lake ls., all members of Jefferson ls. Known only in 5 sections: Lone Butte, Spotted Bear Mtn, Pentagon Mtn, Prairie Reef-White Ridge, and Dearborn; eroded in other sections. Thickest (637 ft.) on White Ridge; thinnest (87 ft.) on Monitor Mtn. Most striking characteristics are drab, dark-brown color, vitreous luster on fresh surfaces, and very petroliferous content. Type loc. on SE. side of S. spur of Lone Butte, in NE¼ sec. 26, T. 23 N., R. 13 W., where it is 421 ft. thick and consists of (descending): (1) Massive brown to steel-gray mag. petroliferous ls., thin-bedded in lower part, thicker-bedded and more massive upward, 170 ft.; (2) massive chocolate to chocolate-gray fine-grained mag. ls. that weathers white buff and to sharp angular surfaces; (3) steel-gray vitreous dolomitic aren. fine-grained petroliferous ls. that weathers light buff-brown, 141 ft.; (4) thick-bedded tan to steel-gray vitreous, very petroliferous aren. ls., porous in upper part, and weathering drab brown, 34 ft.

Lone Camp limestone. (In Mineral Wells formation.)

Pennsylvanian: Central northern Texas (Parker County).

G. Scott and J. M. Armstrong, 1930 (Tex. Bur. Econ. Geol., geol. map of Parker Co.), show *Lone Camp ls.* (5 ft. thick) beneath Salesville sh. and 40 ft. above Lake Pinto ss., but the name is not listed by E. H. Sellards in Tex. Univ. Bull. 3232, 1933. The Salesville sh. as defined overlies Lake Pinto ss.

†Lone Grove series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lv, 255–267). *Lone Grove series.*—Granites, gneisses, and allied rocks forming basal part of Burnetan system. Underlies Long Mtn series.

Same as Packsaddle schist.

Named for Lone Grove, Llano Co.

Lone Land formation.

Pre-Cambrian: Mackenzie.

M. Y. Williams, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 97, 458).

Lone Mountain limestone.

Silurian and Upper Ordovician: Eastern Nevada (Eureka region).

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 262, 267). *Lone Mtn ls.*—Light-gray siliceous rock, with all traces of bedding obliterated, and with black gritty beds at base. Thickness 1,800 ft. Uncon. overlies Eureka qtzite and underlies Nevada ls. (Dev.).

The fm. contains Sil. fossils (of Niagaran age) in upper part, and Upper Ord. fossils (of Richmond and probably Maysville age) in lower part.

Type loc., Lone Mtn, 18+ mi. NE. of Eureka. Has also been mapped by S. H. Ball (U. S. G. S. Bull. 308, 1907) in Inyo Co., Calif.

For slight modification of definition see under *Eureka qtzite,* E. Kirk, 1932.

†Lone Mountain dolomite.

Silurian: Mackenzie, Canada.

E. M. Kindle, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 44).

E. M. Kindle, 1936 (Sci., n. s., vol. 83, No. 2140, pp. 14–15). *North Nahanna River dol.* replaces *Lone Mtn dol.* (preoccupied).

Lone Oak limestone lentil. (In Kincaid formation.)

Eocene: Northeastern Texas (Hunt County).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 536, 539, 553). *Lone Oak ls. lentil.*—Impure oolitic ls. containing a few fossils. Typically exposed at Lone Oak quarry W. of Lone Oak, Hunt Co. Occurs near base of Pisgah memb. (upper memb. of Kincaid fm.), and can be traced some distance NE. and SW. of Lone Oak.

Lone Star formation.

Pre-Cambrian: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 7, 117° to 117°30′). *Lone Star fm.*—Dark-gray carbonaceous phyllite with quartz schist and qtzite. Overlies Beehive fm. and underlies Pend D'Oreille schist.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 158, tables at pp. 178, 194). *Lone Star fm.*—Chiefly dark-gray or greenish-gray, often carbonaceous phyllite, with some lighter-tinted greenish sericite-quartz schist and thin beds of light-gray qtzite. Extremely metamorphosed. Thickness 2,000 ft. Top fm. of Summit series. Overlies Beehive fm. with apparent conformity. Named for exposures on E. slope of Lone Star Mtn, [B. C. ?]. [Assigned to Middle Camb. but correlated with Striped Peak, Kintla, Sheppard, and other fms. which U. S. G. S. classifies as pre-Camb.]

Lone Tree white layer.

Name applied by W. D. Matthew and W. Granger (Am. Mus. Nat. Hist. Mem., vol. 9, 1909, p. 295) to "a persistent calc. stratum" marking base of their horizon D of Bridger fm. in Bridger Basin, Wyo., the Bridger being divided by them into (descending) Bridger E (500 ft. thick), D (375 ft.), C (350 ft.), B (450 ft.), and A (200 ft.).

†Lone Wolf sandstone.

Permian: Southwestern Oklahoma (Kiowa County).

L. T. Patton, 1926 (Am. Jour. Sci., 5th, vol. 12, pp. 194–196). Approx. 100 ft. below the dol. ledges forming top part of Double Mtn fm. in N. part of Kiowa Co. is a series of ss. ledges whose strike is approx. parallel to that of the dol. ledges. This ss. is gray and calc., and varies from thin-bedded to rather massive ledges 3 and 4 ft. thick. As many as three ledges separated by sh. occur in some localities. Forms basal memb. of Double Mtn fm. Rests on red and gray shales of Clear Fork fm. These ss. ledges were mapped by writer in summer of 1922 and in the unpublished rept rendered to Okla. Geol. Survey it was suggested that name *Lone Wolf* be given to them on account of their development near town of Lone Wolf. In a recent publication (Gould, C. N., A. A. P. G. Bull., vol. 7, No. 3, p. 325, 1924) the name Duncan ss. has been proposed for these beds, for reason that it is thought they are NW. extension of strata described by Wegemann in Stephens Co. A reference to Wegemann's paper cited in this connection shows, however, that Wegemann did not propose any name for these strata. The name Duncan has also been previously proposed for a fm. in Canada. For these reasons the name *Lone Wolf* [sandstone] is used in this paper.

Duncan ss. was adopted by U. S. Geol. Survey in 1924, Canadian geologic fms. that do not cross the bdy being treated as foreign.

Long Beards Riffs sandstone.

Upper Devonian: Western New York.

D. D. Luther, 1902 (N. Y. State Mus. Bull. 52, p. 619). A band of flags and thin sss. that appear in N. wall of ravine above the falls at Wiscoy, and in the sides and bottom of the river channel 1 mi. S. of Fillmore, where they form "Long Beards riffs." The lowest coarse sss. with fossils of Chemung group in immediate vicinity of Genesee River.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, pp. 630–631). [The name *Long Beard's riffs* appears in his Genesee River section as lying a short distance above Wiscoy shales, and is assigned to Chemung.]

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 25 and chart). *Long Beards riffs ss.* is basal memb. of Chemung series in Allegany Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 84–85). *Long Beards Riffs ss.* is from the riffs on Genesee River in Allegany Co., 8 mi. S. of Portage. Is lowest fm. in Genesee River section in which Chemung brachiopods have been found. Has not been traced far from type section. Is probably = Shumla ss. of Lake Erie section. Overlies Wiscoy sh.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 149–157), applied *Dunkirk sh.* to the 160 ft. of black shales overlying Wiscoy sh. in Cattaraugus Co., and stated that the fossiliferous *Long Beard Riff ss.* is included in the sss. that occupy lower half of Dunkirk sh.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 407). The sss. in Dunkirk black sh. increase until E. of Genesee Valley very little black sh. remains in lower 150 ft. of aren. beds with full Chemung fauna, and these beds are called *Canaseraga ss.* These sss. include Longbeards Riffs ss.

†Long Branch sand.

Eocene: Eastern New Jersey.

S. Weller, 1905 (N. J. Geol. Surv. Ann. Rept. 1904, pp. 147, 157, and Jour. Geol., vol. 13, p. 76). If it is thought worth while to designate the "yellow sand" facies of Vincentown fm. by a separate name, it may be called the *Long Branch sand*, as has been suggested [unpublished] by Knapp. The fauna is = that of Vincentown limesand.

A geographic name for this facies of Vincentown sand has been deemed unnecessary, and "Long Branch sand" is not in use.

Long Canyon member (of Las Posas formation).

Pleistocene: Southern California (Ventura County).

E. D. Pressler, 1929 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 13, pp. 325–345). *Long Canyon memb.* (also *Long Canyon horizon*).—Cross-bedded sands, some thin layers of calc. sand, and a group of tan to yellow, fine-grained sands. Thickness 200+ ft. Upper part of Las Posas fm. Contains a warmer water (marine Pleist.) fauna than underlying Kalorama memb. Occurs in Long Canyon, on S. slope of South Mtn, Ventura Co. Correlates with Upper San Pedro.

Long Creek limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 85, 88). *Long Creek ls.*—Named for exposures on Longs Creek, at foot of bluff W. of cemetery at Auburn, Nemaha Co., Nebr. Usually weathers buff to yellowish, somewhat cavernous and irregular. Thickness 3¼ to 5 ft. in Nebr. and 3 to 6 ft. in NE. Kans. Underlies Johnson sh. and overlies Hughes Creek sh., all in Elmdale sh. memb.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 8), extended Foraker ls. into Nebr. and divided it into (descending): Long Creek ls., 3 to 6 ft.; Hughes Creek sh., 36 to 38 ft.; and Americus ls., 2 to 3 ft.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Longdale limestone.

Lower Devonian: Central western Virginia.

R. J. Holden, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 137). *Longdale ls.*—Top memb. of Lewistown ls. Thickness 50 to 80 ft. Has two lithologic phases—(1) a flint-free ls. 30 to 50 ft. thick, and (2) flinty ls. 20 to 30 ft. thick. Is correlated with Becraft ls. Overlies Craigsville ls. [Probably named for Longdale, Alleghany Co.]

Longfellow limestone.

Lower Ordovician (Beekmantown) and Upper Cambrian: Southeastern Arizona (Clifton-Morenci region).

W. Lindgren, 1905 (U. S. G. S. P. P. 43). *Longfellow ls.*—Consists of lss., usually more or less dolomitic and gradually growing more siliceous near lower limit. Upper 150 ft. always form a prominent bluff of brownish ls.; lower 250 ft. contain more shaly strata. Rests conformably on Coronado qtzites, from which it is in places separated by an intrusion of porphyry. Is conformably overlain by Morenci sh. Is exposed in Longfellow incline and Longfellow mine, Morenci dist. Walcott says fossils from near base may be Camb. Fossils from top are early Ord. according to Ulrich.

Long Grove series.

U. S. G. S. Bull. 191, 1902, p. 244. Misprint for *Lone Grove series.*

†Long Island division.

W. W. Mather, 1843 (Geol. N. Y., pt. 1, p. 246). The strata that belong to the tertiary epoch, if they exist on Long Island, as they probably do, will in this report be embraced in the description of the *Long Island div.* Consists of clay, sand, gravel, and pebbles.

See *Far Rockaway gravels.*

Long Lake series.

Middle Devonian: Northeastern Michigan (Presque Isle and Alpena Counties).

A. W. Grabau, 1902 (Mich. Geol. Surv. Rept. 1901, p. 184). *Long Lake series.*—Shales and thin-bedded lss., 298 ft. thick, exposed N. and S. of Long Lake. Underlies Alpena ls. and overlies Bell shales; all included in Traverse group.

W. A. VerWiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, pp. 181–192), redefined Alpena ls. by adding to its base 91 ft. of ls. included in Long Lake series by Grabau. He stated that these 90 ft. of beds are same type of rock as Alpena ls. of Grabau, and that there is no good reason for not including them in the Alpena. He restricted *Long Lake* to members Nos. 7 to 14 of Churchill well, and placed max. thickness at 196 ft.

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14, p. 25), reporting from unpublished ms. of A. W. Grabau, showed *Long Lake beds* (top memb. of Presque Isle series) as separated from *Bell shales* (basal memb. of Presque Isle series) by Grand Lake ls. memb. of Presque Isle series.

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526), redefined *Long Lake stage* by including in its top the lower part of Alpena ls. of VerWiebe (which they named *Killians ls.*) and by treating Rockport ls. as a distinct fm. underlying Long Lake stage and overlying Bell sh. (See 1935 entry under *Traverse fm.*)

Probably named for Long Lake, in Presque Isle and Alpena Counties.

Long Lake gneiss.

Pre-Cambrian: Long Lake quadrangle, Adirondack Mountains, New York.

H. P. Cushing, 1907 (N. Y. State Mus. Bull. 115, pp. 463–469). *Long Lake gneiss* for most part consists of two sharply contrasted varieties of gneiss, both unquestionably of igneous origin, and without sed. admixture. Frequent intermediate varieties occur. Varies in composition from a red granitic gneiss to a black gabbroic one. Black amphibolitic gneisses constitute 20 to 30 percent of mass. Age relations to Grampus gneiss and Piercefield gneiss undetermined.

H. I. Alling, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 47–68). Cushing's *Long Lake gneiss* is the ancient granite that he later assigned to the Laurentian, with the associated metagabbro chiefly as inclusions.

Named for exposures on both sides of Long Lake, Hamilton Co.

Long Lake diorite.

Pre-Cambrian: Ontario.

B. C. Freeman, 1934 (Jour. Geol., vol. 42, No. 1, p. 29).

Longmeadow sandstone. (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 451–456). *Longmeadow brownstone* or the fucoidal ss. A central area of sss. in the Triassic of Mass.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). The deposits of the Juratrias comprise four sediments, which are partly contemp., namely: *Mount Toby cgl.*, a very coarse basal cgl. of sl. and crystalline rocks, along eastern shore; *Sugarloaf ss. or cgl.*, a coarse feldspathic ss. and cgl. (4,660 ft. thick) on western shore; *Longmeadow ss.*, a medium-grained feldspathic ferruginous ss. (1,000 ft.); and *Chicopee sh.*, a sandy carbonaceous sh. (200? ft.), which accumulated in central channel of the bay. These were cut through by volcanic eruptions of three distinct periods, the earlier two represented by t: interstratified lava beds (350 ft.) of *Holyoke diabase* and the *Granby tuff*, an aggl. of diabase (580 ft.) interstratified with the [Longmeadow] ss., and the latest by the volcanic cores and dikes of *Blackrock diabase*. The Longmeadow ss. was deposited in the shallower and quieter off-shore area, and in the central zone of this latter area, where the basin was widest, the still finer Chicopee sh. was laid down.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 91, 94–97). *Longmeadow ss.*, named for occurrence at Longmeadow, Mass., represents an offshore facies of the sediment spread over bottom of the Triassic valley. It is a quartzose brownstone, commonly somewhat feldspathic, and is cemented mainly by iron oxide. Abounds in ferruginous concretions. Many layers are covered with tracks of animals of every size, ripple marks, mud cracks, raindrop impressions, and a multitude of other unexplained markings. Is a fm. of Newark group. Overlies and is interbedded with upper part of Sugarloaf arkose to W. and Mount Toby cgl. to E. Middle and upper part is contemp. with Chicopee sh. Includes Holyoke diabase (flow) and Hampden diabase (flow). Upper part is contemp. with Granby tuff [and from description it appears to include the "rusty sands" overlying Granby tuff, mentioned in quotation under 1917 entry under *Chicopee sh.*].

†Long Mountain series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lv, lvi, 255–267). *Long Mtn series.*—Hornblende and pyroxene schists, schists containing garnets, and with these steatite or soapstone, actinolite, etc. Overlies Lone Grove series and probably underlies Bodeville series. Included in Burnetan system.

Same as Packsaddle schist.

Named for Long Mtn, Llano Co.

Long Point series.

Middle Ordovician: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 69).

Long Pond formation.

Cambrian: Newfoundland.

B. F. Howell, 1925 (Bulls. Am. Pal., vol. 11, No. 43, p. 59).

Long Rapids shale.

Devonian: Ontario.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 341, 373, 377).

Longs Peak granite.

Pre-Cambrian: Central northern Colorado (Larimer County).

M. B. Fuller, 1924 (Jour. Geol., vol. 32, pp. 51–63). Coarse pinkish granite with well-defined tabular crystals of feldspar. Intrudes Big Thompson schist and is intruded by Mount Olympus granite. Named for the famous peak, a large part of whose bulk is made of this porphyritic granite.

Long Trail shale member (of Great Blue limestone).

Mississippian (upper): Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Long Trail sh. memb. of "Great Blue" ls.*—Black carbonaceous sh., 85 ft. thick, lying about 500 ft. above base of "Great Blue" ls. Named for excellent exposures at head of Long Trail Gulch, in Ophir Canyon, Fairfield quad.

Longview limestone.

Lower Ordovician (early Beekmantown): Northern Alabama and eastern Tennessee.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34, and Bull. 31, p. 16). [*Longview dol.* used in chart for 1,000 ft. of beds underlying †Upper Canadian and uncon. overlying Chepultepec dol. in W. part of Valley of Tenn. and about same thickness in Knoxville trough of Tenn.]

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14). *Longview ls.*—Cherty ls. and dol., mostly ls., thick bedded and of light-gray color. The chert is compact but brittle and fragile, and differs from chert of underlying Chepultepec dol., which is mealy and cavernous. Thickness about 500 ft. Conformably underlies Newala ls. and uncon. overlies Chepultepec dol. Contains fossils characteristic of div. D of Beekmantown of N. Y. Named for fact that town of Longview, Shelby Co., Ala., is located on a rather wide area of the fm. Best exposures are on Little Cahaba River, in sec. 17, T. 24 N., R. 11 E.; on Buck Creek btw. Helena and Pelham; and in Cahaba Valley just N. of reservoir of Birmingham waterworks in NE¼ sec. 16, T. 18 S., R. 1 W.

Longwood shale.

Silurian: Northern New Jersey and southeastern New York.

N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 367, 382, 383). *Longwood red shales.*—Red beds, with green to buff layers, which break into sh. on exposure, overlain by about 12 ft. of light-colored thin-bedded qtzites. Thickness 150 ft. Underlie Waterlime memb. [Decker ls.] of Helderberg ls. [broad usage of Helderberg] and grade into underlying Green Pond cgl. Named for fact the most extensive exposures are along Longwood Valley E. of Milton [Morris Co.,] N. J.

According to C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 54), the Longwood sh. is in part, or perhaps wholly, the strat. equiv. of High Falls sh. and may include also the horizon of Binnewater ss.

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 657). *Bloomsburg red sh.* of NE. Pa. is continuous with *Longwood red ss.* of N. J. and *High Falls red beds* in SE. N. Y. One name should be used for the fm., and Bloomsburg has priority.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 342). *Longwood shales* (the red sh. above the Shawangunk in Orange Co., N. Y., and in N. J.) are considered=High Falls sh. and perhaps Binnewater ss. also. Assigned to Cayugan.

Lonsdale limestone member (of McLeansboro formation).

Pennsylvanian: Central western Illinois (Peoria region).

A. H. Worthen, 1882 (Econ. Geol. Ill., vol. 3, p. 258), in description of ls. exposed at Lonsdale quarries, Peoria, in two places called the bed *Lonsdale ls.*

L. E. Young, 1916 (Ill. Geol. Surv. Coöperative Coal Min. Ser. Bull. 17, pp. 23–24). *Lonsdale ls.*—In Longwall dist. consists of (1) 15 ft. of slightly argill. and more flaggy rock in which concretionary structures can nearly always be detected; underlain by 5 ft. of firmly cemented, largely organic ls., in beds 6 in. to 1½ ft. thick. Lies 50 to 75 ft. above coal No. 7 and lower than LaSalle ls.; all included in McLeansboro fm.

G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 26, p. 37 and later pages). *Lonsdale ls.* of Peoria dist. is same as Rock Creek ls. of Springfield dist. Has been traced into Fulton, Bureau, Livingston, and LaSalle Counties. Not identified S. of Sangamon Co. It is 7 to 15 ft. thick and lies 30 to 75 ft. above coal No. 7, the characteristic interval being 60 ft. It lies lower in section than coal No. 8. At Peoria it is 20 ft. thick. Named for exposures at old Lonsdale quarries, Peoria.

T. E. Savage, 1921 (Ill. Geol. Surv. Ext. from Bull. 38), placed Lonsdale ls. 50 to 60 ft. above coal No. 7.

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804), gave thickness of *Lonsdale ls.* as 25 to 35 ft.; placed its top 85± ft. below base of Carlinville ls., and 30± ft. below coal No. 8; and placed its base 45± ft. above coal No. 7.

Lookout sandstone. (In Pottsville group.)

Pennsylvanian: Northeastern Alabama, northwestern Georgia, and southern Tennessee.

C. W. Hayes, 1892 (Ala. Geol. Surv. Bull. 4, pp. 49–51). *Lookout ss.*—Argill. sh. or fire clay, sandy sh. and ss., with 10 to 70 ft. of cgl. [Sewanee cgl.] at top. Thickness 50 to 600 ft. In thicker portions contains at least two coal seams, in places of workable thickness. Basal fm. of Coal Measures. Overlies Bangor ls. and underlies Walden ss. Is=Lower Coal Measures and Millstone grit of Smith.

Lower part of Pottsville group. Is=Sewanee cgl. above and Gizzard fm. below, of central Tenn.

Named for exposures on Lookout Mtn, NE. Ala. and NW. Ga.

Lookout schist.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 634). *Lookout schist.*—Chiefly finely laminated greenish-gray quartz-sericite-chlorite schist containing small amounts of biotite; interbedded with many layers of metaqtzite, a few of brown marble, and one of gray magnetite schist. Thickness 1,200 ft. Conformably underlies Sugarloaf metaqtzite and conformably overlies Medicine Peak metaqtzite. Exposed on SE. shore of Lookout Lake. Assigned to early Algonkian.

†Lookout Mountain sandstone.

Name applied by S. W. McCallie (Ga. Geol. Surv. Bull. 12, 1904) to Lookout ss.

Loomis Peak dacites.

See under *Divide Peak andesite.*

Loon Lake granite.

Mesozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 87, map). *Loon Lake granite.*—Mesozoic batholithic mass, intrusive into Stevens series. Probably underlies whole county. Essentially potash, feldspar, quartz, plagioclase, biotite, and hornblende, the relative proportions of which vary greatly in short distances. Extends S. and SW. of Loon Lake in isolated patches as far W. as junction of Spokane and Columbia Rivers.

Loon River shale.

Upper Cretaceous: Canada (Alberta and Northwest Territory).

R. G. McConnell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 41D, 53D, 56D–57D).

Lopez fanglomerate.

Quaternary: Southern California (San Gabriel Mountains).

M. L. Hill, 1930 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 19, No. 6, pp. 141, 144). *Lopez fm.*—The older and topographically higher Quat. fangl., which blankets part of ridge tops on either side of Lopez Canyon. Composed of subangular and poorly sorted fragments of gneiss and granitic rocks up to 2 ft. diam. Is of browner color than the younger Kagel fm. Overlies Saugus fm. with angular uncon.

Loranger series.

Pre-Cambrian: Quebec.

F. F. Osborne, 1935 (Quebec Bur. Mines Rept. Minister Mines 1934–35, pt. E, pp. 18, 26, map).

Lorette formation.

Middle Ordovician: Eastern New York.

P. E. Raymond, 1916 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, p. 257). [In diagram on this page the Glens Falls [ls.] of Trenton Falls and Dolgeville sections is shown resting on *Lorette,* which overlies Leray [ls. memb. of Lowville ls.].

Loretto slate.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Menominee district).

R. C. Allen, 1919 (Am. Inst. Min. Met. Engrs. Bull. 153, p. 2593). *Loretto sl.*—Slates, 0 to 500 ft. thick. Included in Hanbury sl. of Bayley, but here included in Vulcan group and in Middle Huronian. Conformably overlies Curry iron-bearing memb. and underlies (in places conformably and in other places uncon.) Hanbury sl. [restricted]. There are doubtless many places where Hanbury sl. [restricted] is in undoubted contact with Curry fm., in apparent conformity. There are doubtless also places where Loretto sl. is in apparent conformity with the Hanbury. Best developed on property of Loretto mine.

Loretto moraine.

Pleistocene (Wisconsin stage): Southern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, p. 85). Included in Crow River morainic system. Village of Loretto, Hennepin Co., stands on this moraine.

Lorrain series.

Pre-Cambrian (Huronian): Quebec and Ontario.

Robt. Harvie, Jr., 1911 (Quebec Dept. Colonization, Mines, and Fisheries, Mines Branch, pp. 9, 19).

Lorrain granite.

Pre-Cambrian: Ontario.

W. G. Miller, 1913 (Ontario Bur. Mines Rept., vol. 19, pt. 2, p. 70).

Lorrain quartzite.

Pre-Cambrian: Ontario.

W. H. Collins, 1917 (Canada Geol. Surv. Mem. 95, p. 71). Included in Cobalt series.

Lorraine group.

Upper Ordovician: New York and Ontario.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. 2d dist., pp. 119–123, 401, 429). [See second item under *Pulaski sh.*]

As defined by Emmons in above-cited rept, and as since applied by most geologists, *Lorraine* included Pulaski shales and Frankfort sl. of Vanuxem, and is a synonym of †Hudson River group and †Hudson River sh. But a few geologists have used the name as a synonym of Pulaski, and a few have included the Utica in †Hudson River group. Repts give thickness of Pulaski sh. as 400 ft. and of Frankfort sh. as 300–1,800 ft.

In 1908 (Sci., n. s., vol. 28, pp. 346–348) G. H. Chadwick stated that Oswego ss. constitutes merely the closing episode of Lorraine div. In 1916 (Canada Dept. Mines, Geol. Surv. Mem. 83, pp. 4–13) A. F. Foerste extended Lorraine to include at top "*Salmon River ss.* (=*Grey ss. of Oswego*)," stating that this ss. is merely the upper less fossiliferous part of the Lorraine; and he excluded Frankfort sh. at base, stating that no evidence had been found of presence of Frankfort sh. at Lorraine; that the Frankfort contains an impoverished Utica fauna with some Trenton elements, and is unknown W. of Rome. But in 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138) Foerste appears to exclude Oswego ss. from Lorraine.

In 1925 (N. Y. State Mus. Bull. 258) R. Ruedemann treated the Lorraine as a group, including all beds underlying Oswego ss. and overlying Utica sh., and he introduced several new names for subdivisions of the group in different parts of the State. He included in it (descending) Pulaski sh., Moose Creek beds, Wood Creek beds, Whetstone Gulf sh., Atwater Creek sh., Deer River sh., and the in part contemp. Indian Ladder beds and Frankfort sh. He also proposed that "Lorraine gulf" be considered as type section, and he correlated the Lorraine with lower part of the Maysville group and the Eden of Ohio. Geologists generally are agreed that the Lorraine is of pre-Richmond age.

Los Angelan epoch.

Pleistocene: Southern California.

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pp. 1–29). *Los Angelan epoch* (*erosion*).—Represented by valley of Los Angeles River in city of Los Angeles. The three middle terraces of San Pedro Hill belong to this epoch, which preceded San Pedran epoch and followed Red Bluff epoch. [See under *Sierran.*]

Los Cerritos beds.

See under *Deadman Island beds.*

Losee diorite gneiss.

Pre-Cambrian: Northern New Jersey and eastern Pennsylvania.

A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). The group of foliated granitoid rocks here called *Losee gneiss* includes "Losee Pond granite" of Wolff and Brooks. They consist of more or less foliated medium- to coarse-grained granular rocks, in texture closely resembling granite. They are mainly light in color and in many weathered exposures nearly white. Distinguished lithologically from the varieties of Byram gneiss in containing oligoclase (soda-lime feldspar) instead of microcline or microperthite (potash feldspars). Differ from Pochuck gneiss in that they contain much quartz and only minor amounts of dark minerals. Regarded as an intrusive igneous rock younger than Franklin ls. and Pochuck gneiss, which they intrude. Relation to Byram gneiss not known, but the Pochuck is cut by granite and by masses of pegmatite. Named for development around Losee Pond, Sussex Co.

The Losee gneiss (predominantly diorite gneiss) is now considered as probably older than Byram gneiss (predominantly granite gneiss). It is classified by E. B. Knopf and A. I. Jonas (U. S. G. S. Bull. 799, correlation chart, 1929) as post-Glenarm. Intrudes Franklin ls. and Pickering gneiss.

†Losee Pond granite.

Pre-Cambrian: Northern New Jersey.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 439). Lying btw. the higher crest occupied by Edison gneiss and extreme western crest is a very characteristic and well-defined band of greenish-white gneissoid binary granite, which, from its exposures around Losee Pond, Sussex Co., is named *Losee Pond granite*. Does not differ much lithologically from the other granites represented by one color on the map, but it is so isolated that it has been thought best to give it a separate name and pattern.

In U. S. G. S. Passaic folio, No. 157, 1908, W. S. Bayley stated the Losee gneiss was called *Losee Pond granite* by Wolff and Brooks. In U. S. G. S. Franklin Furnace folio, No. 161, 1908, A. C. Spencer stated that Losee gneiss includes Losee Pond granite of Wolff and Brooks.

Los Esteros formation.

Eocene: Mexico.

W. A. VerWiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 491).

Los Guerras sandstone member (of Fayette formation).

Eocene (upper): Northeastern Mexico (Tamaulipas, opposite Starr County, Texas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1375, 1376, 1383, 1387). *Los Guerras ss. memb.*, at base of Fayette fm. in section measured on both sides of Rio Grande btw. Roma and Rio Grande City [Starr Co.], Tex. Consists of 48 ft. of soft gray ss. with chalcedony-replaced gastropods and thick bed of oysters at top; large biscuit-shaped harder ss. masses in softer sandy matrix in upper part; and lower part shows thin indurated hard brown layers as lenses in soft gray ss. making outcrop of banded appearance. *Venericardia* in some bedding planes near base. Crops out in Rio Grande at Los Guerras, Tamaulipas. Same as Salineno ss., which crops out at Salineno, Starr Co., Tex.

Losh Run shale.

Upper Devonian: Southern central Pennsylvania (Perry County).

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, p. 123). [His table of geologic fms. in Susquehanna Valley shows following subdivisions of Portage group (descending): Parkhead ss. (?), Trimmers Rock ss. (supplants Ithaca), *Losh Run sh.*, Braillier ss.-sh. [see *Braillier sh.*], Harrell sh., Burket sh. ("Genesee"), Tully ls. No further explanation of *Losh Run sh.*]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1195–1218). *Losh Run memb. of Fort Littleton fm.*—Chiefly dark-gray to brown sh. that weathers to rusty-brown irregular chunks. In places finely aren. Thickness 10 ft. in most exposures. Distinct faunally and lithologically. In Juniata Valley it underlies Trimmers Rock memb. and overlies Braillier memb. To W. the Braillier extends above the Losh Run as well as below, and upper part of the Braillier is offshore equiv. of Trimmers Rock ss. The Losh Run grades into both Braillier and Trimmers Rock members of Fort Littleton fm. Occurs in Lycoming, Luzerne, Perry, Huntingdon, and perhaps Fulton Counties. Named for stream in Perry Co. that enters the Juniata from the W. about 5 mi. N. of Duncannon.

Los Lamentos formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 334).

Los Muertos formation.

Cretaceous: Mexico.

J. E. Spurr and G. H. Garrey, 1908 (Econ. Geol., vol. 3, p. 689).

Losoya Creek conglomerate. (In Sabinetown formation.)

Eocene (lower): Southern Texas (Bexar County).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 575, 602). Contact of Sabinetown fm. (top fm. of Wilcox group) with underlying Rockdale fm. is not exposed in Sabine River bluffs. On Losoya Creek, at the bridge on South Flores road S. of San Antonio, Bexar Co., the marine Sabinetown strata lie uncon. upon the eroded surface of massive Rockdale ss. This contact is marked by a 1-foot bed of wave-worn beach pebbles and marine shells. [On p. 575 is a section of Seguin fm. in Bexar and other counties in which the basal bed of Sabinetown fm. is called *Lasoya Creek cgl.*]

Los Pinos member (of Hinsdale formation).

Tertiary? (Pliocene?): Central southern Colorado and northern New Mexico.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Los Pinos gravel.*—Stream-deposited gravel, sand, and boulders with some interbedded tuff and lava flows. Thickness 500+ ft. Underlies Hinsdale volcanic series and is contemp. with Bayfield and Bridgetimber gravels. Named by E. S. Larsen, for exposures in canyon of Los Pinos Creek, near town of San Miguel, in extreme N. part of N. Mex., about 10 or 12 mi. SW. of Antonito, Conejos Co., Colo.

E. S. Larsen, 1934 (U. S. G. S. Bull. 843). *Los Pinos memb.*—Included in Hinsdale fm. because so closely related to overlying rocks as to properly constitute a memb. of that fm.

Los Puertos limestone.

Tertiary (Oligocene or Miocene): Puerto Rico.

B. Hubbard, 1920 (Sci., n. s., vol. 51, p. 396).

†Lost Cabin formation.

Eocene (lower): Northern Wyoming (Bighorn Basin).

W. J. Sinclair and W. Granger, 1911 (Am. Mus. Nat. Hist. Bull., vol. 30, pp. 104–111). Wind River group in Wind River Basin divided into 2 conformable fms., named (descending) *Lost Cabin fm.* (*Lambdotherium zone*) and *Lysite fm.* The upper fm. is named for exposures to E. of Lost Cabin (village), where fossils were collected. [Sinclair and Granger in 1912 (Am. Mus. Nat. Hist. Bull., vol. 31, pp. 60–62) gave thickness of their Lost Cabin fm. as 325+ ft. and stated: Lost Cabin fm. is conformably overlain by Tatman fm.]

This is a geographic name for *Lambdotherium* faunal zone, forming upper part of Wind River fm., or *Wind River B*, according to H. F. Osborn (U. S. G. S. Mon. 55, 1929). Geographic names are not applied to faunal zones by U. S. Geol. Survey.

†Lost City limestone.

Pennsylvanian: Northeastern Oklahoma (Tulsa County).

C. N. Gould, 1911 (Okla. Geol. Surv. Bull. 5, p. 179). A ledge of ls. which forms a prominent exposure on high hills S. of Arkansas River a few mi. SW. of Tulsa is known as Lost City ls. It is quarried at town of Lost City.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 73). On hills S. of Arkansas River W. of Tulsa the Hogshooter ls., which has long been known as *"Lost City" ls.*, thickens to 20 ft.

Lost Creek limestone.

Silurian: Central Pennsylvania.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, p. xxvi). *Lost Creek ls.*—In middle of the grey sh. group forming a middle part of Clinton fm. of Juniata dist., there occur, within a thickness of 60 ft., several beds of light blue shaly ls., and near the bottom of the 60 ft., a sandy ls. with lime shales. These calc. layers are sometimes massive, even 6 or 8 ft. thick, and separated by gray shales. In Lost Creek Valley, Juniata Co., a few quarries have been opened in these beds.

Lost Creek shale member (of Admiral formation).

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 422). *Lost Creek bed.*—Red, bluish, or yellowish sandy clay, 25 to 50 ft. thick. Memb. of Albany div. Overlies Coleman Junction bed and underlies Hordes Creek bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 192, 193, and charts). *Lost Creek sh.* of Drake is here defined as basal memb. of Admiral fm. (basal fm. of Wichita group).

Named for Lost Creek, Coleman Co.

Lost Creek granite body.

Age (?): Canada.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 302).

Lost Creek limestone.

Pennsylvanian: Eastern Kentucky (Breathitt County).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 296, 304). *Lost Creek ls.*—A thin ls. that differs markedly from all others in eastern Ky. Where exposed along crest of ridge btw. Lost Creek and Big Branch of North Fork of Ky. River (Buckhorn quad.), just N. of gap through which passes road connecting these 2 streams, the ls. is badly broken, but large blocks of it show it to be at least 3½ ft. thick. Lower two-thirds is fossiliferous dolomitic ls. and upper third a blue shelly ls. Very fossiliferous (fossils listed). Lies 175 ft. above Magoffin beds, nearly 130 ft. above Saltlick beds, and 370 ft. below Flint Ridge flint. For more reasons than one this dolomitic ls. is very appropriately named *Lost Creek ls.*, from stream of that name.

Lost Gulch monzonite.

Early Mesozoic (?): Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Lost Gulch monzonite.*—Adamellite or quartz monzonite. Intrudes Pinal schist. Occupies greater part of Lost Gulch and stretches NE. toward Horrell's ranch, on Pinal Creek, Globe quad.

F. L. Ransome, 1910 (Min. and Sci. Press, vol. 100, pp. 256–257) and 1919 (U. S. G. S. P. P. 115, p. 51) stated that this rock is probably early Mesozoic.

Lost Horse intrusives.

Age (?): British Columbia.

V. Dolmage, 1934 (Canada Dept. Mines, Geol. Surv. Mem. 171, No. 2344, p. 12).

†Lostmans River limestone.

Pleistocene and Pliocene: Southern Florida.

S. Sanford, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 222–225). *Lostmans River ls.*—The nonoolitic fossiliferous lss. which apparently underlie W. coast of southern Fla. and outcrop inland. Varies so greatly in lithology that it is impossible to give a description that contains features common to all localities. At type loc. on Lostmans River the rock is described by Dale as very hard and consisting of large masses of Polyzoa more or less completely changed into crystalline ls. The cavities are filled with crystals of calc-spar. Near Deep Lake the rock is softer and more friable. Rock from head of Hendersons Creek contained much more sand than specimens collected to S. Between Jewfish Creek and Manatee the rock is much less crystalline than on W. coast or toward entrance to White Water Bay. Thickness 30 to 40 ft. Of marine origin. Relations to Palm Beach ls. can not be determined. Miami oolite is believed to be younger than Lostmans River ls.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). "Lostmans River ls." is in part Miami oolite (Pleist.) and in part Caloosahatchee marl (Plio.), and name is abandoned.

Named for exposures on Lostmans River, Monroe Co.

Lost River chert.

Mississippian: Southwestern Indiana (Orange County).

M. N. Elrod, 1899 (Ind. Acad. Sci. Proc. 1898, pp. 258–267). *Lost River chert.*—Constant stratum of chert, occasionally oolitic, 10 to 20 in. thick. Underlies Paoli ls. and overlies Mitchell ls. [as here restricted by Elrod]. [Included in St. Louis group.]

Is a thin bed included in Mitchell ls. of Siebenthal and forming top bed of St. Louis ls. of Cumings (1922).

Named for frequent occurrence on Lost River, especially near Orangeville, Orange Co.

†Lott chalk member (of Taylor marl).

Upper Cretaceous: Northeastern Texas (Falls and Bell Counties).

C. H. Dane and L. W. Stephenson, 1928 (A. A. P. G. Bull., vol. 12, p. 52). In SW. Falls Co. the southward decrease in sand constituent of Taylor marl below horizon of Marlin chalk memb. has progressed to such an extent that none of it shows an appreciable percentage of sand. In addition, there appears at a horizon several hundred ft. below position of Marlin chalk a chalky marl bed which in places can properly be called a chalk. The northernmost outcrops of this bed are in vicinity of Lott [Falls Co.], from which it is proposed to call it *Lott chalk memb. of Taylor marl.* It extends SW. through Falls Co., and good outcrops occur 1 to 3 mi. W-NW. of Rogers, Bell Co., on road to Little River. It is probably not more than 40 ft. thick at any place along its outcrop. Very fossiliferous. Has not yet been traced S. of vicinity of Rogers.

According to L. W. Stephenson (Jour. Pal., vol. 8, No. 3, p. 275, 1934), and Alva C. Ellisor and John Teagle (A. A. P. G. Bull., vol. 18, No. 11, pp. 1506–1536, 1934), the Lott chalk has proved to be the Marlin chalk repeated by faulting, and *Lott* has therefore been abandoned. The Marlin chalk has been found to be the southward continuation of Pecan Gap chalk of NE. Tex., and *Marlin* has been abandoned.

Louann sand.

See 1925 entry under *Meakin sand.*

Loudon shale.

Same as *Loudoun fm.*, the correct spelling.

Loudoun formation.

Lower Cambrian: Virginia, West Virginia, Maryland, and southern Pennsylvania.

A. Keith, 1893 (as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68. The fm. was described, but not named, by Keith in Am. Geol., vol. 10, p. 365, 1892). *Loudon shales.*—Gray and black slaty shales, 400 ft. thick, underlying Weaverton ss.

A. Keith, 1894 (U. S. G. S. Harpers Ferry folio, No. 10). *Loudoun fm.*—Argill. sl., sandy sh., gray ss., quartz cgl., blue ls., and white marble, 0 to 800 ft. thick. Underlies Weaverton ss. and uncon. overlies Catoctin schist (Algonkian). Named for fact all of its varieties are well developed in Loudoun Co., Va.

Louis limestone.

An abbreviated form of St. Louis ls. employed by C. [R.] Keyes.

†Louise formation.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289). *Louise fm.*—Shales, 100 ft. thick, underlying Piran series and overlying Fairview qtzite in Alberta. Of Early Cambric age. [Apparently same as Lake Louise fm.]

Louisian.

C. [R.] Keyes, 1919 (Sci., n. s., vol. 50. p. 74). *Louisian* as a periodic title has 10 years priority over *Mississippian.* [Probably refers to early use of "*St. Louis group,*" which covered the rocks later named *Meramec group.*]

Louisiana limestone. (Of Kinderhook group.)

Mississippian: Eastern Missouri, southwestern Illinois (Jersey and Calhoun Counties), and Iowa.

C. R. Keyes, 1892 (Geol. Soc. Am. Bull., vol. 3, p. 289). *Louisiana ls.*—Ls., 60 ft. thick, usually rather thin-bedded; lower layers usually more or less aren. and highly fossiliferous. Underlies Hannibal sh. and forms basal fm. of Kinderhook group so far as known. Equiv. to Swallow's Lithographic ls.

This continued for many years to be definition of Louisiana ls.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., table opp. p. 282), showed Glen Park ls. as underlying Hannibal sh. and overlying Louisiana ls. in Jersey and Calhoun Counties, SW. Ill., and that elsewhere (Pike Co., Ill., and Pike and other counties in NE. Mo.) the Hannibal is uncon. on Louisiana ls. He also showed Louisiana ls. as underlain by Saverton and Grassy Creek shales, both of which he included in the Kinderhook. In 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245) Moore showed Louisiana ls. as present in NE. Mo. and W. Ill. only, and absent in S. Ill. and SE. Mo., and he continued to treat Saverton and Grassy Creek shales as belonging in Kinderhook group.

Named for exposures at Louisiana, Pike Co., Mo.

Louisville limestone.

Silurian (Niagaran): North-central Kentucky and southern Indiana.

A. F. Foerste, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., pp. 217, 218, 232). *Louisville ls. or Utica lime rock.*—Argill. or dolomitic ls., 40 to 55 ft. thick, usually of light or medium brown color, with some white beds. Top fm. of Niagara group in southern Ind. Overlies Waldron sh. [Foerste gave further details in Denison Univ. Bull., Jour. Sci. Lab., vol. 30, 1935, pp. 166–169, 171–173, 195, and stated that the Louisville can be recognized in Macon, Sumner, and Davidson Counties, northern Tenn., but that "only place [in Tenn.] it can be identified with any degree of certainty is at Bledsoe, Tenn."]

Named for fine exposures E. of Louisville, Ky.

Louisville limestone.

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 23). *Louisville ls.* (memb. of Braddyville fm.) is exposed at base of slope W. of South Bend and in the upper slopes eastward to Louisville. Is main ledge in upper Atwood quarry in Cedar Creek Valley and in N. side of Platte Valley from State fish hatcheries to Meadow. Is main quarry ledge in abandoned Murphy and

Green quarries W. of Meadow. Thickness 10 to 12 ft. Is thin-bedded in upper part, but most of it is massive, hard, and compact. Is blue gray and weathers light. Lies 6 to 10 ft. below South Bend ls. and higher than Meadow ls.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 55, 56). Although "Louisville ls." is preoccupied, it is in use for top part of Howard ls. memb. in Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 27). *Louisville ls.* is preoccupied, hence *Stoner ls.* is proposed for this unit, to include also Kiewitz sh. and so-called Du Bois ls. The "Louisville ls.," Kiewitz sh., Du Bois ls., Severy sh., Topeka ls., and Meadow ls. are parts of Stanton ls. memb.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 134, 252), abandoned Louisville ls. and Kiewitz sh.

†Louisville-Delphi black slate.

Upper Devonian: Indiana and Kentucky.

J. Collett, 1872 (Ind. Geol. Surv. 3rd and 4th Ann. Repts., pp. 294, 306). *Louisville-Delphi black sl.*—Dev. black sl., 62 ft. thick, overlain by "Waverly" or knob ss. and underlain locally by 0 to 15 ft. of coarse white sandrock, succeeded below by Dev. ls.

Replaced by New Albany sh., established name.

Probably named for occurrence from Louisville, Ky., to Delphi, Carroll Co., Ind.

†Loup Fork beds.

†Loup Fork group.

Miocene, Pliocene, and Pleistocene (?): Nebraska, South Dakota, eastern Colorado, and other western States.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 415–435). *Loup River beds.*—Fine loose sand, with some layers of ls. Thickness 300 to 400 ft. All fresh-water fossils. Assigned to Plio. Extends from Loup Fork of Platte River N. to Niobrara River and S. to unknown distance beyond the Platte. Overlies White River group (Mio.). [No later fm. than Loup Fork mentioned. As here defined includes Ogallala and Arikaree fms., which overlie White River group (Olig.).] All fossils are fresh water.

E. D. Cope, 1880 (U. S. Geol. and Geog. Surv. Terr. Bull. 5, pp. 50–51), and 1884 (U. S. Geol. and Geog. Surv. Terr. Mon. 3, table opp. p. 43). *Loup Fork* divided into *Procamelus* beds above and *Ticholeptus* beds below. Underlies Plio. and overlies White River.

E. D. Cope, 1888 (Am. Geol., vol. 2, pp. 290–292). *Loupfork fm.* (upper Mio.) has wide extent. Overlies Whiteriver beds in Nebr., Wyo., and Colo., and extends into Kans., where it rests on Cretacic. There is a second area, in northern central N. Mex., and one perhaps in southern N. Mex., extending from Rio Grande to near Arizona border; also another tract in Washington Co., Tex., and another in Mexico, on bdy of States of Hidalgo and Vera Cruz. According to King is 2,000 ft. thick in Wyo., but thins gradually to E. and is only 250 ft. thick on White River, according to Hayden. Is same as Niobrara of Marsh.

N. H. Darton, 1899 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 732, 734, 735), divided typical *†Loup Fork beds* of Nebr. into Ogallala fm. (above) and Arikaree fm. (below), by which names these deposits are now generally known.

For history, see H. F. Osborn and W. D. Matthew, U. S. G. S. Bull. 361, 1909.

Loupian.

Name introduced by C. R. Keyes to include Ogallala (Plio. and upper Mio.) and Arikaree (Mio.) fms. (See Iowa Acad. Sci. Proc., vol. 22, 1915, p. 255.)

†Loup River beds.

A name applied by some geologists (F. B. Meek and F. V. Hayden, 1862, 1869, 1872, 1873, etc.; also W. B. Scott, History of land mammals of Western Hemisphere, 1913, p. 127) to deposits called "Loup Fork beds" by other geologists. See under *†Loup Fork beds.*

Lourian series.

A term employed by C. [R.] Keyes to cover rocks of Cordilleran region interpreted as having been formed during later part of pre-Animikie erosion interval. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Lovedale gypsum member (of Blaine formation).

Permian: Northwestern Oklahoma (Harper County).

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 405–432). Name proposed for next to highest gyp. memb. of Blaine fm. in NW. Okla. Consists of approx. 13 ft. of gray to white gyp. A gray dol. bed, which is ordinarily a little thicker and more prominent than the bed underlying the Shimer, underlies the Lovedale. All 3 of these dol. beds are commonly pitted and clinkerlike in appearance. Is separated from underlying Shimer gyp. memb. of Blaine by 7 ft. of red sh. and is also separated from overlying Haskew gyp. memb. by red sh. Named for exposures near Lovedale, T. 26 N., R. 20 W., Harper Co. It has been suggested that this gyp. bed may be correlated with Mangum dol. of S. side of Anadarko Basin. It seems better to give a new name until such a correlation can be proved. If it can later be shown conclusively that Lovedale is correlated with Mangum, then *Lovedale* can be dropped.

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437). So-called Lovedale memb. is probably Mangum memb., as Lovedale seems questionable.

Loveland loess.

Pleistocene (Sangamon): Southwestern Iowa and eastern and southern Nebraska.

B. Shimek, 1909 (Geol. Soc. Am. Bull., vol. 20, p. 405) and 1910 (Sci., n. s., vol. 31, p. 75). *Loveland joint clay.*—Bed of reddish joint clay, which frequently shows stratification and often contains sand and pebbles in lower part. Thickness 0 to 80 or more ft. Rests on Aftonian sands and underlies fossiliferous post-Kansan bluish-gray loess. Evidently bears same relation to Kansan drift as Buchanan gravels, and probably belongs to period of melting of Kansan ice.

The deposit is chiefly loess, according to W. C. Alden and F. Leverett. G. F. Kay considers it of post-Illinoian age, and F. Leverett considers it pre-Illinoian and pre-Iowan.

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, pp. 326, 347–349). *Loveland fm.*—Lower or "valley phase" consists of sand, gravel, and clay filling pre-Loveland valleys, and may be of Illinoian age. This "valley phase" seems to everywhere grade upward into the loess or "upland phase," which grows less and less sandy until it is quite typical loess clay and silt. Volcanic ash or pumicite occurs at base of loess phase quite generally in Nebr. It is generally 5 to 8 ft. thick, but SW. of Eustis, Frontier Co., it is locally at least 50 ft. thick. Entire fm. is quite red. Thickness in eastern Nebr. 6 to 30 ft.; in south-central Nebr. 15 to 40 ft.; to west 100 to 150 ft. Covers about 42,000 sq. mi. of Nebr. Thickness and textural coarseness increase westward. Assigned to Sangamon stage. Rests uncon. on Upland fm. and underlies Sand Hills fm., in part of area, and Peorian loess in part of area.

Named for Loveland, Pottawattamie Co., Iowa.

Loveless sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Tar Springs ss.

Lovelockian series.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 79). *Lovelockian series* covers the early Jurassic section of NW. Nev., typically displayed in Humboldt Range, E. of Lovelock station, Humboldt Co. Includes Oreana shales above and Muttleberry lss, below.

Lovingston granite gneiss.

Pre-Cambrian: Western and northern Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Lovingston granite gneiss.*—Biotite-quartz monzonite, augen gneiss. Assigned to pre-Camb. Intrusive into Lynchburg gneiss. Mapped at and around Lovingston, Nelson Co. Is post-Glenarm.

Low Creek beds.

Eocene: Western Louisiana and eastern Texas.

A. C. Veatch, 1902 (La. Geol. Surv. pt. 6, Rept. for 1902, pp. 127–128, and pl. 37). *Low Creek beds.*—The peculiar beds described from Low's Creek, near Sabinetown [Sabine Co., Tex.], in 1899 and referred provisionally to the Lignitic show a much better development on the Sabine near mouth of Low's Creek, at stations 19 and 20. The beds here furnish a much more complete fauna, especially at the Negreet outcrop, and Harris is inclined to regard the material as having a decided Lower Claiborne aspect. Directly above it is a well marked Lower Claiborne fauna, and the position of these beds at or near the line of parting btw. the Lower Claiborne and Lignitic is fully proved. [Pl. 37 gives thickness of Low Creek beds as 45 ft., and places them as basal bed of Lower Claiborne.]

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 635). *Low Creek beds* of Veatch carry a fauna similar to that of Weches memb., to which they are believed to belong.

Lowe granodiorite.

See *Mount Lowe granodiorite.*

Lowell limestone. (In Allegheny formation.)

Pennsylvanian: Northeastern Ohio (Mahoning County).

J. S. Newberry, 1878 (Ohio Geol. Surv. vol. 3, pp. 797–798). *Lowell ls.,* 12 to 14 ft. thick, in Coal Measures; lying 90 ft. above the ls. next below and more than 150 ft. above coal No. 3. May be either Ferriferous ls. or Freeport ls. Fully exposed near Lowell.

Lowell Mountain formation.

Paleozoic: Northeastern Vermont (Orleans County).

S. B. Keith and G. W. Bain, 1932 (Econ. Geol., vol. 27, No. 2, pp. 173, 175). *Lowell Mtn sl., phyllite, and schist.*—Fine-grained black to dark-brown slates dominate in this group and occur E. of serpentine belt. Bedding obscure; cleavage and jointed structures are characteristic; schist is rare and occurs in a few places only. Assigned to Paleozoic. Seem to correspond to Quebec group on Lake Memphremagog, Quebec. [Lowell Mtn is in Irasburg quad., Orleans Co.]

Lowell Park member (of Platteville limestone).

Middle Ordovician: Northwestern Illinois (Dixon quadrangle).

R. S. Knappen, 1926 (Ill. Geol. Surv. Bull. 49, pp. 54–61, 65). *Lowell Park memb. of Platteville ls.*—Interbedded gray and buff argill. but heavy-bedded lss. and coarse-grained, deep yellow-brown, porous dolomites, the dol. in every way typical of overlying Galena; the chalky earthy lss. are more like the impure parts of the basal or Buff ls. memb. of the Platteville. Is top memb. of Platteville ls. in Dixon quad. Overlain by Galena dol. and underlain by Blue ls. memb. of Platteville ls. Thickness 20–30 ft. Is of same age as Decorah sh. of Iowa. A local term has been used here in place of Decorah, since a ls. instead of a sh. is present in this quad., and also because original definition of Bain, and later of Calvin, who defined Decorah sh., was that the Platteville included all ls. btw. St. Peter and Galena fms. The Black River of N. Y. is correlated with Decorah sh. and with Lowell Park memb. Named for typical development in Lowell Park and along road N. of park.

Lowellville limestone. (In Pottsville formation.)

Pennsylvanian: Northeastern Ohio.

G. F. Lamb, 1910 (Ohio Nat., vol. 10, p. 129). *Lowellville ls.* lies just below horizon of Quakertown coal in Stark and Mahoning Counties.

H. Morningstar, 1922 (Ohio Geol. Surv., 4th ser., Bull. 25, p. 28). Poverty Run ls. of Stout (1918) is same as *Lowellville ls.* of Lamb (1910).

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 97). *Lowellville ls.* is same as Poverty Run ls., and lies in interval btw. Vandusen coal [much higher in section than Quakertown coal] and Lower Mercer clay. Is well developed near Lowellville, Mahoning Co.; in Washington Twp, Coshocton Co.; and in Madison and Hopewell Twps, Muskingum Co.

Lower.

The terms *Upper* and *Lower*, connected with geographic names, have long been and still are employed in a titular sense to designate many lss., clays, and sss. of Appalachian region. A few of these, together with some in other parts of the country, are here listed. Others are mentioned under the geographic names.

†Lower quartzite.

Upper Cambrian: Leadville district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230), 1883 (U. S. G. S. Leadville Atlas), and 1886 (U. S. G. S. Mon. 12), applied the descriptive term "Lower qtzite" to the Camb. qtzite and overlying "transition shales," in contradistinction to the younger (Ord.) "Parting qtzite." It underlies ls. called "White ls." and uncon. overlies pre-Camb. gneisses and schists. Is now known as *Sawatch qtzite*. Some mining companies exclude the "transition shales."

†Lower Archimedes limestone.

Mississippian: Southwestern Illinois and eastern Missouri.

See under †*Archimedes ls.*

†Lower Barren Coal Measures.

†Lower Barren group.

Terms applied in early repts on Appalachian region to Conemaugh fm. (Penn.), also to Conemaugh fm. exclusive of its basal Mahoning ss. memb.

†Lower Bend shale.

Miss., Tex. See 1916 entry under *Bend group*. Replaced by *Barnett sh.*

†Lower Black Band of early N. Y. repts is *Middlesex sh.*

Lower Cambrian series.

Same as *Waucoban series*. (See U. S. G. S. Bull. 769.)

†Lower Cambridge limestone member (of Conemaugh formation).

Replaced by *Brush Creek ls. memb.*

†Lower Carboniferous.

A term applied in early repts to Mississippian series of present nomenclature.

Lower Clarion clay. (In Allegheny formation.)

A clay bed, 8 ft. thick, underlying Lower Clarion coal in western Pa.

†Lower Coal Measures.

†Lower Coal Group.

Terms applied in early repts to Allegheny fm. (Penn.) of current nomenclature of Appalachian region.

Lower Connoquenessing sandstone.

See under *Connoquenessing ss. memb.* The U. S. Geol. Survey does not use *Upper* and *Lower* in a titular sense for parts of Connoquenessing ss. memb.

†Lower Cross Timbers formation.

A name applied in some early repts to *Gulf series* of Tex.

†Lower Cross Timbers sand.

A name applied in some early Tex. repts to *Woodbine sand.*

Lower Devonian series.

The generally accepted definition applies this name to Oriskany and Helderberg groups and their time equivalents.

Lower Freeman-Hampton sand.

A subsurface sand in Cisco group (Penn.) of Archer Co., Tex., which lies a short distance above Bunger ls. memb. of Graham fm. Is made up of two lenses locally about 40 ft. apart, and top lies about 160 ft. below Gose sand.

Lower Freeport clay. (In Allegheny formation.)

A clay bed, 5 ft. thick, underlying Lower Freeport coal in Appalachian region.

Lower Freeport limestone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. xxviii). [See under *Freeport ls. memb.*, F. Platt, 1877.]

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 49). *Butler (Lower Freeport) ls.*—Lies 3 ft. below Lower Freeport coal and 15 ft. above Freeport (Lower Freeport) ss. in Beaver Co. Thickness 2 to 5 ft. Was called Middle Freeport ls. in Repts H_2 and H_3 (Cambria and Somerset Counties). Does not occur at Freeport, but is present at Butler [Butler Co.], in cut near R.R. Station, hence name.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Lower Freeport (Butler) ls.* was called *Butler ls.* in Rept. Q, but Prof. Lesley suggests it be named *Lower Freeport ls.*

The established name for this ls. is *Lower Freeport ls. memb.*

†Lower Freeport sandstone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia, and eastern Ohio.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). *Lower Freeport ss.*, 50 ft. thick, underlies Lower Freeport ls. and overlies Upper Kittanning coal.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q) and 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Lower Freeport ss.* is same as *Freeport ss.* of earlier repts.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 163–164). *Lower Freeport ss.*—Grayish white ss., sometimes double and contains a coal bed. Thickness 30 to 300 ft. Is thickest in W. Va. Underlies Lower Freeport ls. and overlies Upper Kittanning coal.

Freeport ss. memb. of Allegheny fm. is the commonly accepted name of this ss.

†Lower Helderberg group.

See under *Helderberg group.* Various limits have been assigned to this division.

†Lower Homewood sandstone. (In Pottsville formation.)

Same as *Connoquenessing ss. memb.* of Pottsville fm., q. v. See also under *Homewood ss. memb.*. The name "Lower Homewood ss." has also been applied to upper ss. of Connoquenessing ss. memb.

†Lower Kittanning limestone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 303–305). *Ferriferous ls. (Lower Kittanning ls.)*.—Lies lower than Lower Kittanning coal and higher than Clarion coal.

Same as *Vanport ls. memb.*

Lower Kittanning clay. (In Allegheny formation.)

A clay bed, 3 to 8 ft. thick, underlying Lower Kittanning coal in Appalachian region.

†Lower Laramie formation.

A term formerly applied in a titular sense in southern Wyo. (Hanna Basin). Replaced by *Medicine Bow fm.*, of Upper Cret. age.

†Lower Lignitic.

See under †*Lignitic.*

†Lower Little Pittsburgh limestone.

See under †*Little Pittsburgh ls.*

†Lower Magnesian limestone.

A term applied in early repts on Upper Mississippi Valley region to Shakopee dol. and Oneota dol.; later replaced by geographic name *Prairie du Chien group.*

†Lower Mahoning sandstone.

See explanation under †*Upper Mahoning ss.* and *Mahoning ss. memb.*

†Lower Medina.

Name applied in early repts to Queenston sh. of N. Y. and Juniata fm. of Pa.

Lower Mercer limestone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). Rogers' name *Mercer ls.* here changed to *Lower Mercer ls.* [See quotation under *Upper Mercer ls.*]. Underlies Upper Mercer iron shales and lies 0 to 18 ft. above Lower Mercer coal in Lawrence Co., Pa. Named for Mercer, Pa.

Is a bed in Mercer sh. memb. of Pottsville fm.

Lower Mercer iron shales. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Lower Mercer iron shales.*—Sandy shales, 5 to 10 ft. thick. Underlie Lower Mercer coal and overlie Upper Connoquenessing ss.

Lower Mercer fire clay. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_3). *Mercer Lower fire clay,* 3½ ft. thick, underlies Mercer Lower coal and overlies Mercer Lower iron shales.

Lower Narrows rhyolite.

Pre-Cambrian: South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121). *Lower Narrows rhyolite.*—Rhyolite flow and breccia on N. flank of syncline on both sides of Lower Narrows of Baraboo River, secs. 20, 21, 22, and 23, T. 12 N., R. 7 E. Assigned to pre-middle Huronian.

†Lower Niagara limestone.

Name applied in some early N. Y. repts to Gasport ls. memb. of Lockport dol.

Lower Ordovician series.

The commonly accepted definition includes Chazy and Beekmantown groups (the latter group including Tribes Hill ls.) and their time equivalents.

†Lower Pentamerus limestone.

Name applied in early N. Y. repts to Coeymans ls., the names "Second Pentamerus ls." and "Upper Pentamerus ls." being applied to New Scotland ls.

Lower Pittsburgh limestone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and northern West Virginia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, p. 286). *Lower Pittsburg ls.* lies lower than Lower Pittsburg coal and higher than Morgantown ss.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Lower Pittsburg ls.*, 5 ft. thick in Allegheny Co., Pa. Lies 65 ft. below Upper Pittsburg ls. and 70 ft. above Morgantown ss. It is generally in 2 or 3 layers. Is hard, dark gray on fresh fractures but weathers dirty yellow.

See also under †Pittsburgh ls.

†Lower Productive Coal Measures.

A term applied in early repts on Appalachian region to Allegheny fm., of Penn. age.

Lowerre quartzite.

Pre-Cambrian: Southeastern New York.

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). At base of metamorphosed Paleozoic ls. (Inwood ls.) and overlying the Fordham gneiss is a stratum of thinly bedded qtzite. It occurs in southern Westchester Co. near Lowerre station, in Yonkers at the Hastings marble quarry, and about ¼ mi. S. of Sparta on shore of Hudson River. Is well shown N. of Peekskill along E. shore of Annsville Cove and in valley of Peekskill Hollow Creek near Oregon. It does not exceed 16 ft. in thickness at Hastings. From the name of the southern locality it is called *Lowerre qtzite.* Age is probably Camb. and possibly Georgian.

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83). The qtzite overlying Fordham gneiss is here called *Poughquag qtzite,* because considered to be probable strat. equiv. to Poughquag qtzite of Dutchess Co., which carries lower Camb. fossils.

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). *Lowerre qtzite* is pre-Cambric and may belong to Fordham gneiss, with which it is closely connected. In all essential features it is only an upper quartzitic facies of Fordham gneiss. It is 0 to perhaps over 100 ft. thick.

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 47–57). *Lowerre qtzite* tentatively assigned to *Cambro-Ordovicic (?)*.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 22). If *Lowerre qtzite* is Postcambric [Cambrian] it is to be correlated with Poughquag qtzite [Lower Camb.].

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226). *Lowerre qtzite* is of uncertain age, but we are now inclined to believe it is pre-Cambric and belongs to the Grenville. [In chart on p. 140 it is classified as *later Grenville.*]

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799). *Lowerre qtzite* correlates with Setters fm. of SE. Pa. and Md., the basal fm. of Glenarm series. which is classified by U. S. Geol. Survey as Algonkian.

†Lower Shaly limestone.

Name applied in early N. Y. repts to New Scotland ls.

†Lower Silurian.

A term applied in early repts to Ordovician system of present terminology, the Silurian of the present nomenclature being designated "Upper Silurian."

Lower Washington limestone member (of Washington formation).

Permian: Southwestern Pennsylvania and eastern Ohio.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Lower Washington ls.*—Thickness 20 ft. Included in Washington County group [Washington fm.]. Overlies Washington coal, from which it is in some sections separated by 6 ft. of sh. Lies about 89 ft. below Middle Washington ls.

Lower Wurtemburg limestone.

See under *Wurtemburg ls.* and under *Mercer ls.*

Lowery sand.

A subsurface sand, of Ord. age, in NE. Okla. See under *Kinter sand.*

Low Gap limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia (Summers County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 344). *Low Gap ls.*—Yellow and impure calc. stratum, usually shaly or sandy; marine fossils, 1 to 5 ft. thick. Lies 0 to 3 ft. below Low Gap ss. and overlies Low Gap sh.; all members of Hinton group [fm.]. Type loc. same as Low Gap ss.

Low Gap sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 343). *Low Gap ss.*—Greenish gray micaceous, sometimes shaly, sometimes massive; 5 to 30 ft. thick. Underlies Lower Tallery sh. and lies 0 to 3 ft. above Low Gap ls. All members of Hinton group [fm.]. Type loc. is on Wolf Creek Mtn, Summers Co., in public road slightly E. of and above Low Gap School. Also observed in Mercer and Monroe Counties, W. Va., and in Tazewell Co., Va.

Low Gap shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 345). *Low Gap sh.*—Red and variegated, 5 to 40 ft. thick. Underlies Low Gap ls. and overlies Avis ss., all members of Hinton group [fm.]. Type loc. same as Low Gap ss. Also observed in Mercer Co.

Lowhee member (of Richfield formation).

Pre-Cambrian: British Columbia (Cariboo district).

G. Hanson, 1935 (Canada Dept. Mines Geol. Surv. Bur., Econ. Geol. Mem. 181, p. 4).

Lowrie sandstone bed. (In Wellington formation.)

Permian: Central northern Oklahoma (Logan and Lincoln Counties).

J. M. Patterson, 1933 (A. A. P. G. Bull., vol. 17, No. 3, pp. 243, 251, etc.). A few mi. N. of Guthrie vertical bluffs are present on E. side of Cimarron River, in central part of T. 17 N., R. 2 W. It is here proposed that the 45-foot massive ss. bed associated with the red shales of these bluffs be named *Lowrie ss. bed,* from railroad station of Lowrie, in sec. 16. Thickness 20 to 45 ft. Is in upper part of Iconium memb. of Wellington fm., and in texture, color, and composition like rest of ss. beds in that memb. Lies higher than Evansville ss. bed. Good exposure is in bluffs E. of Lowrie.

Lowville limestone. (Of Black River group.)

Middle Ordovician: New York, Ontario, Pennsylvania, Maryland, western Virginia, Tennessee (Nashville dome).

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Lowville ls.,* instead of *Birdseye ls.* of common use. Well exposed at Lowville, Lewis Co., N. Y. Underlies Black River ls. and overlies Chazy ls. Basal fm. of Mohawkian group.

In subsequent repts up to 1910 the Lowville was treated as a fm. distinct from and underlying the *Black River ls.;* but in 1910 (N. Y. State Mus. Bull. 145) R. Ruedemann treated it as basal fm. of *Black River* *group* and divided it into (descending): (1) *Leray ls. memb.*, 10 ft., more cherty than underlying ls.; (2) *Lowville ls., s. str.*, 22 to 55 ft. of dove and blue-dove ls., both thick- and thin-bedded, and conglomeratic at base. Uncon. overlain by Watertown ls. and uncon. underlain by Pamelia ls. of Chazy group. [In subsequent repts the thickness of Lowville was stated as 0 to 85 ft.]

H. P. Cushing, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135–144). *Leray fm.* (black cherty lss. of Watertown region) is classed provisionally as uppermost memb. of Lowville. In Watertown region it uncon. overlies *typical Lowville ls.*, but Ulrich says there is gradation elsewhere, and that the chert beds can not be separated from the Lowville. At Lowville there are 5½ ft. of cherty ls. with *Columnaria halli* and *Stromatocerium rugosum*, not seen at Watertown, and to S. this *Stromatocerium* bed is sole representative of the [Lowville?] fm. In Champlain Valley massive black ls. seems to bridge interval btw. Lowville and Leray in Watertown region. *Typical Lowville ls.* consists of thin-bedded dove lss. containing little or no chert, and is Lowville ls. as originally defined by Clarke and Schuchert in 1899, or the fm. previously called *Birdseye*. Overlain uncon. by Watertown ls. and underlain by Chazy group.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), included Leray in Lowville.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 37), stated that "the upper cherty layers of the Lowville have been designated the Leray ls.;" but the accompanying chart placed Leray ls. above Lowville ls.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 1), included Leray in Lowville, but in 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51) he excluded it, as he did in 1934 (Geol. Soc. Am. Spec. Paper No. 1). A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, chart opp. p. 58) included Leray in Lowville, but E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, p. 34, and Bull. 31, p. 16) excluded Leray from Lowville.

G. M. Kay, 1929 (Jour. Geol., vol. 37, No. 7, pp. 664–671; and A. A. P. G. Bull., vol. 13, No. 9, p. 1214), divided Black River group of N. Y. and Ont. into Chaumont fm. (above), *new*, and Lowville ls. (below); and included in his Chaumont, in descending order, Watertown ls., Glenburnie (new, 0 to 2 ft.), and Leray ls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), excluded Leray from Lowville in table on p. 268, but on p. 282 stated: Uppermost layers (15 to 20 ft. max.) of Lowville ls. are cherty, and separated from typical Lowville by uncon., and this portion has received name *Leray ls.*

E. O. Ulrich and R. Ruedemann, 1933 (16th Int. Geol. Cong. Guidebook 4, p. 126), used *Leray ls.* for beds btw. Watertown ls. (above) and *Lower Lowville ls.* (below).

G. M. Kay, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 227–228), divided Black River group at *type section* into Chaumont fm. (including Watertown and Leray) and Lowville.

The U. S. Geol. Survey at present treats Leray ls. as top memb. of Lowville ls.

In central Pa. the Lowville ls. is overlain by Rodman ls., a local name for post-Lowville part of Black River group. In western Va. and southern Pa. the Chambersburg ls. composes the post-Lowville part of Black River group and overlies Lowville ls. In Nashville dome, Tenn., the Lowville is divisible into 2 members, to the lower of which (consisting of massive, compact, white or light-blue cherty ls.) the name *Carters ls.* is now restricted, while the upper memb. (consisting of thin-bedded dove-colored ls. layers and yellowish gray sh.) is correlated by E. O. Ulrich and R. S. Bassler with Tyrone ls. of Miller, in central Ky.

Lowville granite.

Pleistocene: Northwestern New York (Lowville quadrangle).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 74, 78–79, 83, 104, and map of Lowville quad.). *Lowville type* (also *Lowville granite*).—Coarse to medium-grained equi-granular granite over wide areas, often high in quartz. Relations to Hermon and Alexandria types of granite undet. A band about 4 mi. wide strikes NE.–SW. across central part of Lowville area. Intrudes Grenville series.

Loxley ground moraine.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).

W. A. Ver Wiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 163). *Loxley ground moraine* is located near settlement called Loxley, in T. 22 N., R. 4 W.

Loyal Creek.

Upper Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, p. 400). *Loyal Creek* introduced for middle Utica or zone of *Dicranograptus nicholsoni* in Mohawk Valley.

Loyalhanna limestone (in Pennsylvania).

Loyalhanna limestone member (of Greenbrier limestone, in Maryland and West Virginia).

Mississippian: Western and central Pennsylvania, western Maryland, and northern West Virginia.

C. Butts, 1904 (U. S. G. S. Kittanning folio, No. 115, p. 5). Coarse calc. ss., strongly cross bedded, surface pitted by differential erosion. Thickness at least 40 ft. Universally known in region as "Siliceous ls.," but generally it is a rather calc. ss. In deference to general usage it is here named *Loyalhanna ls.*, because well developed along the gorge in which Loyalhanna Creek flows across Chestnut Ridge, Westmoreland Co., Pa. Underlain by Burgoon ss. Top of Loyalhanna is here taken as top of Pocono fm., as in western Pa. folios already published.

C. Butts, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 249–257). In SW. Pa. the fossils reveal a great hiatus btw. Loyalhanna ls. and Burgoon ss. memb. of Pocono fm. The Loyalhanna is therefore here separated from Pocono and treated as a distinct fm. btw. the Pocono below and the Mauch Chunk above. It is a nonfossiliferous transgressing fm., equiv. in lithology and strat. position to Ste. Genevieve ls. In western Md. it is very properly treated as a memb. of Greenbrier ls., which there replaces lower part of Mauch Chunk sh.

Loysburg formation.

Lower Ordovician: Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 404, 410). *Loysburg fm.*—Dark and impure dolomitic ls. overlying Beekmantown ls. and underlying first intraformational zone. Only 115 ft. exposed at Bellefonte, so that base cannot be located. Appears to be not so thick at Loysburg, Bedford Co. Lowest fm. of Stones River group. Collie does not appear to have recognized the existence of this formation. Butts also does not mention the lowest div. of the Stones River group, probably because it is poorly exposed at Roaring Spring. Differs from superjacent Carlim in lithology, in paucity of fossils, and in total absence of reef-building organisms, which are so characteristic of the Carlim.

Lucas dolomite.

Lower Devonian: Ohio, southeastern Michigan, and western Ontario.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, pp. 521, 540). *Lucas ls.*—To include all rocks btw. top of Sylvania ss. and base of Columbus ls. of Ohio or Dundee ls. of Mich. Is top memb. of Monroe fm.

C. R. Stauffer, 1908 (Ohio Nat., vol. 8, pp. 271–276, and Geol. Soc. Am. Bull., vol. 19, pp. 544–545, footnote). *Lucas ls.* overlies Sylvania ss. and underlies Columbus ls. Consists of (descending): (1) 63 ft. of compact drab dolomitic ls., showing banded structure, in quite massive layers but weathers into much thinner layers, and contains several fossiliferous layers near middle; (2) 36 ft. of compact drab dolomitic ls. with some drab-gray to brown sandy layers.

A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, pp. 553–556), named the "Upper Monroe" of Mich., Ohio, and western Ont. the ***Detroit River series***, and divided it into (descending): ***Lucas dol.***, 200+

ft.; Amherstburg dol., 20 ft.; Anderdon ls., 40 to 50 ft.; and Flat Rock dol., 40 to 150+ ft. This was a restriction of Lucas as originally defined.

W. H. Sherzer and A. W. Grabau, 1910 (Mich. Geol. Surv. Pub. 2, geol. ser. 1, p. 51). In Lucas Co., Ohio, the *Lucas dol.* rests on Sylvania ss. in all quarries, showing that Anderdon and Amherstburg have been cut out by overlap of the dol. on Sylvania ss.

C. R. Stauffer, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 72). Amherstburg dol. certainly occurs at West Liberty, Ohio, and probably at Fremont; and Anderdon ls. outcrops in quarries at Castalia, Ohio.

J. E. Carman, 1927 (Jour. Geol., vol. 35, pp. 481–506). Flat Rock and Anderdon members have not been recognized in Ohio. They are known to be absent in Lucas Co.

In Cleveland, Ohio, region, the Lucas dol. is treated as a distinct fm. In Mich. it is treated as a memb. of Detroit River dol.

Named for Lucas Co., Ohio, which Lucas dol. crosses from N. to S.

Lucas limestone.

Middle Devonian: Central eastern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, p. 149) and 1913 (Iowa Acad. Sci. Proc., vol. 20, pp. 205, 206). *Lucas terrane.*—White fine-grained ls., 20 ft. thick; *Straparollus* abundant at base. Forms topmost part of Cedar Valley ls. Underlain by Coralville ls. Included in Senecan. Named for a locality [not stated] in Johnson Co.

Lucero beds.

Cretaceous: Cuba.

E. L. De Golyer, 1918 (A. A. P. G. Bull., vol. 2, p. 142).

Lucien shale member.

Permian: Central northern Oklahoma.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786–799). *Lucien sh. memb.*—Lower 250 ft. of Garber ss., consisting largely of red, more or less fissile or laminated clay shales, with several ledges of red ss., one of which generally occurs at base of the memb. Underlies Hayward ss. memb. of Garber ss., and rests on Wellington fm. Named for exposures at Lucien, Noble Co.

Luck-Sure series.

Age (?): Southeastern Arizona (Tombstone district).

W. P. Blake, 1902 (Tombstone and its mines). *Manganiferous or Luck-Sure series.*—Series of thickly bedded massive lss., in which occur ore deposits characterized by large amounts of manganese ore. Chiefly developed in mineral claims formerly known as Lucky Cuss, Luck Sure, Wedge, Sunset, Knoxville (Stonewall), Anchor, and Grand Dipper. Underlies, uncon. (?), the Contention and Toughnut series [Mesozoic]. [Appears to be younger than his Emerald series, "which includes the heavy qtzites of Ajax Mtn."]

Lucky Cuss limestone.

Ordovician (?): Southeastern Arizona (Tombstone district).

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Lucky Cuss ls.*—Thickness 400 ft. Is full of crinoids. Underlies Herschel qtzite [Mesozoic] and overlies Emerald ls. [Upper Camb.].

Lucky S argillite.

Upper Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 896, 902). *Lucky S fm.*—Micaceous qtzite, with one or more fine cgls. of chert and qtzite pebbles derived from much older deposits, grading up into micaceous dark-gray siltite and black argillite. Thickness 600 ft. Very meager marine fauna in upper beds; no identifiable fossils. Of mid Upper Jurassic age. Named for Lucky S mine. Type loc., Forman Ravine, W. end of Forman Ridge. Underlies Trail tuff and cgl. and overlies Cooks Canyon aggl.

Ludlow sandstone.

Middle Devonian: Central Pennsylvania (Perry County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 1236–1237). [See under *Perry fm.*]

Ludlow lignitic member (of Lance formation).

Upper Cretaceous: Southwestern North Dakota, northwestern and northern South Dakota, and northeastern Montana.

E. R. Lloyd and C. J. Hares, 1915 (Jour. Geol., vol. 23, pp. 523–547). [See 1915 entry under *Cannonball marine memb.* The following additional details regarding the Ludlow memb. are also given in rept cited above.] *Ludlow lignitic memb. of Lance fm.* occupies large area in Harding Co., S. Dak., and has been mapped northward into Bowman and Billings Counties, N. Dak., and eastward in Perkins Co., S. Dak., where it merges with Cannonball marine memb. In vicinity of Ludlow, S. Dak., its type loc., it consists of 350 ft. of loosely consolidated buff and cream-colored calc. ss. and sh. with interbedded lignite. It contains most of lignite of S. Dak., and the presence of this lignite is one of chief criteria for considering it a distinct memb. of Lance fm. In S. Dak. its lithologic character is very like Fort Union fm. and its fossil flora so far as determined is identical with that of Fort Union; its flora is like that of lower part of Lance, but its lithology is quite different. In N. Dak. its flora has same affinities as in S. Dak., but its lithology resembles lower part of Lance except for presence of numerous lignite beds. It is this variation in color and lithology that renders its separation from overlying Fort Union so difficult. All of the *Triceratops* collected in Little Missouri country came from below the T Cross lignite bed [in lower part of the Ludlow] and the oysters from above it. Calvert, however, states that in Mont. ceratopsian bones were found just above the lowest persistent lignite bed, but there is certainly nothing in character of overlying strata to suggest that similar bones do not occur therein up through a strat. distance of perhaps 500 ft. (U. S. G. S. Bull. 471, p. 197, 1912.) The T Cross lignite bed was mapped to Mont. State line, and it is undoubtedly the same lignite as the "persistent lignite" referred to above.

See also D. E. Winchester, C. J. Hares, E. R. Lloyd, and E. M. Parks, 1916 (U. S. G. S. Bull. 627, pp. 15–26), and T. W. Stanton, 1920 (U. S. G. S. P. P. 128A).

The U. S. Geol. Survey now classifies Cannonball marine memb. of Lance fm. and the demonstrably equiv. part of the Ludlow memb. as Upper Cret.

†Ludlow conglomerate member.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). [See 1933 entry under *Knapp fm.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 61), replaced this preoccupied name with *Wetmore cgl.*

Ludlowville shale. (In Hamilton group.)

Middle Devonian: Western and central New York.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., p. 298). *Ludlowville shales.*—Bluish or olive sh. with different fossils from those of underlying olive sh. [later named *Skaneateles sh.*]. Underlies Encrinal ls. Named for occurrence at Ludlowville [Tompkins Co.].

Ludlowville sh. continued to be used, for many years, for beds said to overlie Skaneateles sh. and to underlie Tichenor ls., a name introduced to replace Encrinal ls. of Hall. But further studies revealed 2 encrinal lss.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 222–224). *Ludlowville fm.* in western N. Y. is composed in lower part of dark soft sh. having a "Leiorhynchus or Marcellus facies," and in upper part of soft, lighter gray shales abounding in typical Hamilton fossils. Traced eastward the beds become more aren. and "Leiorhynchus facies" of lower part is eventually lost. In western and central N. Y. the Ludlowville is divisible into several members, but in eastern central part of State the uniformity of lithology and faunas prevent any subdivision. The name Ludlowville was used first by Hall in 1839 for the sequence on Cayuga Lake btw. base of Centerfield memb. and a certain bed designated by him "Encrinal ls." The type section was not happily chosen, as only about 50 ft. of the Ludlowville is exposed there, the overlying fms. (Moscow sh. and Tully ls.) being found within the village. It is clear from above that Hall's type section is utterly inadequate, but as the name has been entrenched in the literature for 90 years writer suggests that it be retained, but that the section for reference be that sequence on Paines Creek at Aurora beginning with the Centerfield at Moonshine Falls and terminating with Portland Point beds (erroneously referred to Tichenor by N. Y. State Surv. bulletins) at Black Rock. [See also under *Centerfield ls.* and 1930 entry under *Moscow sh.*] Is here divided into (descending) Deep River memb., Tichenor memb., Wanakah memb., Ledyard memb., and Centerfield memb. In Chenango Valley the typical Centerfield fauna is absent, and base of Ludlowville is drawn at base of *Spirifer divaricatus* zone, the latter species also occurring in Centerfield ls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), defined *Ludlowville sh.* as underlying Menteth ls. memb. of Moscow sh., overlying Skaneateles sh., and as including Tichenor ls. in upper part and Centerfield ls. at base. This is present definition of U. S. Geol. Survey.

†Ludlowville group.

Middle Devonian: New York.

J. Hall, 1842 (Am. Jour. Sci., 1st, vol. 42, pp. 57–62). The great group of fossiliferous shales so well developed along Cayuga and Seneca Lakes, and known as Marcellus, Skaneateles, Ludlowville, and Moscow shales, I shall for the sake of brevity speak of under the name of *Ludlowville group*. [This broad use of Ludlowville did not gain currency, for Vanuxem the same year (Geol. N. Y., pt. 3) adopted *Hamilton group* to include all beds btw. Tully ls. above and Marcellus sh. below, or (descending) Moscow sh., encrinal ls., Ludlowville or Olive sh., and Skaneateles sh.; and Hall himself in 1843 and later publications ceased to use this broad definition of Ludlowville.]

Lueders limestone. (Of Wichita group.)

Permian: Central northern and central Texas.

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, p. 94 and chart opp. p. 96). *Lueders ls.*—Top memb. of Wichita div. Has been identified by writer from a point S. of Harrold, on Fort Worth and Denver City R. R. in Wilbarger Co., past Seymour, across NW. Throckmorton and SE. Haskell Co. to Ballinger, Runnels Co. Persists to within few mi. of Red River. Thickness *20 ft.* in section from Abilene to Sweetwater. Around Abilene and perhaps southward beneath Callahan Divide, Lueders ls. is overlain by Abilene fm., which there forms top memb. of Wichita. Named for small town on Clear Fork of Brazos River, in eastern Jones Co.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 41–42). *Lueders fm.*—Over top of Paintrock fm. is a series of rocks with a larger proportion of sh. and marly impure lss., which weather easily, except in upper part, which is formed by Ballinger lss. The shales below these lss. are frequently marly and very fossiliferous; in fact they are coarse fossil cgls. made up mainly of Myalinas and other pelecypods with many gastropods and Bryozoa. The lss. at Ballinger are quite fossiliferous, and the beds are relatively thick and massive, and mostly buff. The Lueders fm. is here regarded as beginning with No. 142 and extending to top of No. 158 of general section. As thus defined it has *thickness of 194 ft.* It is uncertain how Lueders fm. as here used will check with section at Lueders, but according to Wrather they are in general equiv. The Lueders fm. as a whole naturally breaks into an upper and a lower part with rather distinct characteristics, and further study may necessitate its subdivision.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). *Paint Rock beds of Drake* are basal part of Lueders fm. as defined in this rept.

Lueders limestone member (of Lueders formation).

See 1930 entry under *Lake Kemp ls.*

†Lufkin beds. (In Claiborne group.)

Eocene: Eastern Texas.

W. Kennedy, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 45, 58). *Lufkin or Angelina County beds.*—Chiefly dark-blue gypseous clays (gray, white, and blue), sands (sometimes laminated and cross-bedded), sandy clays, and lignites, 100 or more ft. thick. Basal fm. of Mio. Underlies Fayette sands and sss. and uncon. overlies Eocene Cook's Mtn beds.

Same as Yegua fm. (Eo.), the better established name.
Named for Lufkin, Angelina Co.

Lufkin rhyolite.

Tertiary: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. 19, pp. 7–21). *Lufkin rhyolite*, Tert., 500 ft. thick. Type loc., Lufkin Mtn, near Lake Valley [Sierra Co.].

Lufkin member (of Cook Mountain formation).

Eocene: Eastern Texas.

B. C. Renick, 1928 (A. A. P. G. Bull., vol. 12, pp. 521, 534). *Lufkin memb.*—Top memb. of Cook Mtn fm. Underlies Yegua fm. and overlies Nacogdoches memb. of Cook Mtn fm. Consists of 300 to 400 ft. of marine chocolate-brown clay, containing some fossiliferous beds, some glauconitic beds, and thin beds of sand. Upper 5 to 15 ft. generally contains macrofossils, making this memb. easily recognizable as distinct from overlying Yegua fm. Weathers reddish brown. The term Lufkin was introduced by G. M. Knebel and Miss Alva Ellisor. [The compiler has been unable to find where Mr. Knebel and Miss Ellisor published this name, and Renick does not give the reference.]

Lugert granite.

Pre-Cambrian: Southwestern Oklahoma (Kiowa and Greer Counties).

C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). Intrusive red granite, younger and finer-grained than Reformatory granite and older than Quanah granite. Occurs in vicinity of Lugert, Kiowa Co. Appears to be younger than Cold Springs granite.

M. G. Hoffman, 1930 (Okla. Geol. Surv. Bull. 52, pp. 33–45). *Lugert granophyre.*—Salmon-pink medium-grained granophyre, speckled with little dark-gray to black spots of ferromagnesian minerals. Was called Lugert granite by Taylor, 1915. Intrudes Meers qtzite, the basic rocks, and the Saddle Mtn, Davidson, and Carlton granophyres in Wichita Mtns, SW. Okla.

Luisian stage.

Tertiary: California.

See under *Zemorrian stage*, R. M. Kleinpell, 1934.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224). *Luisian stage* includes lower Monterey fm., Claremont sh., "*Valvulineria californica* zone," etc.

Lukachukai sandstone.

Triassic (?): Northwestern New Mexico and northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 337). *Lukachukai ss.*—Application for lower ss. section of Doloresian series, as outcropping in Lukachukai Valley, at N. end of Chuska Mtns [NW. N. Mex.]. Thickness 200 ft. Younger than Holbrook sss.

Lukashukai.

See *Lukachukai*.

Luke clay. (In Allegheny formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Luke clay* (*Middle Kittanning clay*).—Underlies Middle Kittanning (Luke) coal and overlies Ellerslie ss.; all included in Allegheny fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 47, 343, pl. 6). *Luke clay* (*Middle Kittanning clay*).—Impure clay, lenticular. Overlies Lower Kittanning rider coal. Exposed in cut on B. & O. R. R. opposite Luke [Allegany Co.].

Luke Hill formation.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 185, 1931) to B_4 (160 ft. of dark bluish-gray thin-bedded lss.) of Logan's section of Philipsburg series of Quebec. McGerrigle mapped his Luke Hill fm. in St. Albans quad., NW. Vt. (See 1931 entry under *Philipsburg series.*)

Luke Hill limestone.

Name applied by T. H. Clark (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6–7, 1934) to a ls. in Quebec.

Lulbegrud clay.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 50). *Lulbegrud clay.*—Clay, 10 to 13 ft. thick; forms basal memb. of Alger fm. (of Niagaran age). Overlain by Waco ls. (of Alger fm.) and underlain by Indian Fields fm. (also of Niagaran age).

In 1931 (Ky. Geol. Surv. ser. 6, vol. 36, pp. 172, 173) Foerste assigned this clay to Clinton epoch.

Named for Lulbegrud Creek, Clark and Powell Counties.

Lunasan series.

Lunasian series.

A term introduced by C. [R.] Keyes for a part of the middle Carbf. (Penn.) of N. Mex.—"the main ls. sequence in Manzano Mtns." (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 3, 8.)

Lundy.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Lundy glacial epoch.

A name applied by E. Blackwelder (Geol. Soc. am. Bull., vol. 41, pp. 91–92, 1930) to time during which the next to youngest drift was laid down on slopes of Sierra Nevada, Calif. He later (G. S. A. Bull., vol. 42, pp. 865–922, 1931) replaced this name with *Tahoe glacial stage*, which he correlated with Iowan stage

Lundy Mountain type.

Pre-Cambrian: Eastern Alabama.

W. F. Prouty, 1923 (Ala. Geol. Surv. County Rept. No. 1, pp. 18, 19). In crossing Ashland series [Ashland mica schist] from NW to SE., going from border near Clairmont Springs through Ashland, one finds from W. border past Sardis Church and nearly to Idaho, soils of grayish to pink color. In a number of exposures through here the [Ashland] mica schist has large compound flakes of green mica together with many bluish-gray scales of aluminous material. This type of mica schist has been called *Lundy Mountain type* by Dr. E. A. Smith in his field notes of 1896.

Lunenburg schist.

Upper Cambrian: Northeastern Vermont (Essex County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., pp. 79–82). *Lunenburg schist.*—Highly metamorphic green, greasy, chlorite schist. [Pre-Camb. on pp. 79–80; probably Camb., p. 80; on p. 82 is following:] Prof. Hitchcock suggested, in "Geol. sections crossing N. H. and Vt.," term *Montalban* as=White Mtn series in N. H., whose age is upper Laurentian. In this rept I have included these with Lunenburg schist as pre-Camb., awaiting further field investigation.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288). *Lunenburg group,* uppermost Upper Camb. of eastern Vt., consists of sericite qtzite, sericite schist, and chlorite schist.

Apparently named for village or Twp of Lunenburg, Whitefield quad., Essex Co.

Luning formation.

Upper Triassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Muller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Luning fm.*—Chiefly ls. and dol., but where in contact with or close to Excelsior fm., as in Pilot Mtns, there are one or more members of siliceous slates with cgls. whose pebbles are almost wholly chert. In Gabbs Valley the fm. is chiefly dark ls. and dol. with subordinate sl.; in places there are interbedded lava flows, altered andesite, and quartz latite. Some of siliceous slates may be, at least in part, of tuffaceous origin. Fossils are Upper Triassic. Thickness 10,000 ft. Conformably underlies Gabbs fm., and uncon. overlies Excelsior fm. (Middle Triassic). Named for little settlement of Luning, in Soda Springs Valley, the best exposures being in mtns bordering this valley. Type loc. is on N. slope of Pilot Mtns, about 12 mi. SE. of Luning.

Lupton sand.

Lower Cretaceous: Central northern Montana (Cat Creek oil field).

F. Reeves, March 1921 (U. S. G. S. Press Bull. on Cat Creek anticline, Twps 13, 14, 15, Rs. 28, 29, 30, 31 E., Fergus and Garfield Counties). About 200 ft. below top of Kootenai fm. is a multiple-bedded ss., 30 to 60 ft. thick, which has yielded small quantities of oil in Franz Corp. discovery well, sec. 21, T. 15 N., R. 30 E., and in Decker-Collins well, sec. 13, T. 15 N., R. 29 E. It also yields strong artesian flow of fresh water. Is usually called second Kootenai sand, but it will be here referred to as *Lupton sand*, after the geologist who located the discovery well—a name suggested by O. W. Freeman in Eng. and Min. Jour. April 17, 1920.

Is now sometimes called Second Cat Creek sand.

Luquillo formation.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 279).

Luscar formation.

Lower Cretaceous: Alberta.

B. R. MacKay, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. B, p. 12) and 1930 (Canadian Min. and Met. Bull. 222, p. 1312).

Lusk.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 39, No. 4, 1923, p. 320) to 140 ft. of Miss. lss. shown as occupying interval btw. Hardinsburg and Cypress sss. of Ill. This is position of Golconda fm. (Brokaw, 1916). Derivation of name not stated, but probably named for the small village very near Golconda, Pope Co., SE. Ill.

Luta limestone. (In Sumner group.)

Permian: Central and southern Kansas and northern Oklahoma.

J. W. Beede, 1909 (Jour. Geol., vol. 17, pp. 710–729, and Kans. Acad. Sci. Trans., vol. 22, p. 251). *Luta ls.*—More or less cellular, soft gray ls., 10 to 30 ft. thick, with siliceous and other geodes scattered through it and with layers of more or less banded chert concretions. Basal memb. of Marion stage. Overlain by Enterprise shales and underlain by Winfield ls.

"Marion fm." has been abandoned by both Kans. Geol. Survey and U. S. Geol. Survey, and Luta ls. has for many years been treated as basal fm. of Sumner group. In Sept. 1936, however, R. C. Moore (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12) transferred Luta ls. to Chase group and treated it as top memb. of Winfield ls., thus redefining Sumner group, Winfield ls., and Chase group. These redefinitions have not yet been considered by U. S. Geol. Survey for its publications.

See also under *Cresswell ls.*

Named for Luta Brook, a tributary of Antelope Creek, just N. of Marion, Marion Co., Kans.

Luthers Mills coquinite.

Upper Devonian: Northeastern Pennsylvania (Bradford County).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 580, 583, 589, 592). *Luthers Mills coquinite.*—Name here applied to type "Burlington ls" of Sherwood, 1878. Coquinites at Lemon, Lime Hill, Le Raysville, Rome, and Burlington assumed to be the same. Useful key bed to upper part of New Milford fm., or lowest recognized Canadaway. Lies near top of New Milford. [On p. 583 is a section showing Luthers Mills coquinite, 40 ft. thick, separated from overlying Damascus red sh. by a concealed interval of 25 ft.] Williams and Kindle (U. S. G. S. Bull. 244, 1905) gave name *Franklindale ls.* to a memb. which they found near Franklindale and at Towanda Narrows, which was to supplant Sherwood's preoccupied term "Burlington ls.," which at its type loc. is actually a mass of broken shells, a shell breccia, cemented by red mud. For this type of deposit writer has proposed the name coquinite. It is 40 ft. thick in central Bradford Co., near Burlington. The Franklindale ls., according to Williams and Kindle and also the writer's observations, is more nearly a true ls. or group of thin lss., and it is older than the "Burlington," being probably late Chemung. Therefore, for type "Burlington" the name *Luthers Mills coquinite* is proposed, from a crossroads E. of Burlington, Bradford Co., near which place the beds are well exposed along the highway. They lie higher than most of Mansfield iron ores.

Luyano marls.

Cretaceous: Cuba.

E. L. De Golyer, 1918 (A. A. P. G. Bull., vol. 2, p. 141).

Lyell formation.

Upper Cambrian: Alberta and British Columbia.

C. D. Walcott, 1920 (Smithsonian Misc. Coll., vol. 72, No. 1, p. 15). *Lyell fm.*, Camb., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll., vol. 67, No. 8, Mar. 5, 1923, pp. 460–461, when he assigned it to Upper Camb. and stated that it underlies Mons fm., overlies Sullivan fm., and is 1,270 to 1,700+ ft. thick.]

†Lykens series.

Pennsylvanian: Eastern Pennsylvania.

D. White, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, p. 755). Pottsville fm. has been locally called "Lykens series" by Second Geol. Survey (Ann. Rept. 1886, pt. III; Summ. Final Rept. 1895, vol. III, pt. 1; Atlas southern anthracite field, pls. I–VI). Contains the Lykens coals.

Lykins formation.

Triassic (?) and probably Permian: Eastern Colorado.

N. M. Fenneman, 1905 (U. S. G. S. Bull. 265). *Lykins fm.*—A series of sss. and sandy shales, with a little ls. Is clearly distinguished from underlying Lyons ss. and Fountain fm. by its softness and its showy colors, the most striking of which is a rich brick red that characterizes its sandy shales and shaly sands. At places the color is more brownish, but it is always deep and rich. At Fourmile Canyon, where the fm. is somewhat more than 800 ft. thick, the lowest 230 ft. are largely if not wholly sss. of a clear red color, a little darker than brick. These are overlain by the "crinkled" ss., here 35 ft. thick. Above this for 467 ft. there are no exposures, but soil is very red and exposures not far distant indicate that most of this thickness is red aren. shales. Above these obscured beds are 100 ft. of the familiar red ss. Any horizon of this fm. may be slightly calc., but this is not general. The "crinkled" ss. is present wherever the Lykins is found. The Lykins is the "Upper Wyoming" of Eldridge at localities farther S It is named for Lykins Gulch [about 9 mi. N. of Boulder], the scenery along which owes its strange and beautiful character to this fm.

In places is overlain uncon. by Upper Jurassic Morrison fm. and in other places by the older Entrada ss., also Upper Jurassic.

Lyman formation.

Silurian (Niagaran) and older (?): Northwestern New Hampshire (Ammonoosuc River region).

C. H. Hitchcock, 1874 (Am. Jour. Sci., 3d, vol. 7, pp. 468–476). *Lyman group*.—Chiefly drab soapy qtzite, weathering nearly white; parts of it conglomeratic; also includes a cgl. 200 ft. thick. Thickness, 2,330 ft. Underlies clay sl. and an auriferous cgl. that will be distinguished from Lyman group in my forthcoming rept. Overlies Lisbon group. Included in Huronian.

C. H. Hitchcock, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 461–482), called the Lyman of Ammonoosuc dist. *Lyman schist*, and stated that it consisted chiefly of argillitic schists, also that the Lyman, Lisbon, and Swiftwater "may be Ord."

C. H. Hitchcock, 1905 (Geol. of Littleton, N. H., p. 31, Univ. Press, Cambridge). *Lyman schists* do not represent a strat. terrane; it is a petrographical designation. At present it is not known what the original rocks were, but one of them must have been the aren. div. of sands and cgls. and another an argillite. Underlies auriferous cgl. and overlies Lisbon group, both of which are Lower Sil. [Ord.] or Camb.

F. H. Lahee, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 231–250). *Lyman schists*.—Highly metamorphosed fine-grained sss. and mudstones with few beds of fine cgl.; drab or greenish gray. Are pre-Sil.

F. H. Lahee, 1916 (Jour. Geol., vol. 24, pp. 366–381). "Lyman schists" was applied by Hitchcock to a group of schists many of which are characteristically whitish on weathered surfaces. Hitherto *Lyman series* has been regarded as a group of metamorphosed sed. rocks. Field evidence, megascopic examination of hand specimens, and microscopic examination of thin sections indicate that Lyman series contains interbedded members that appear to be of volcanic origin. These metamorphosed volcanic rocks include, among others, species related to quartz keratophyres and keratophyres and probably also tuffs and aggls. of similar composition. Structural relations and age obscure. Not younger than Dev. and may be older. [Appears to include Lyman and Lisbon fms.]

C. P. Ross, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 267–302). *Lyman fm.*—Interbedded gray, white, and buff schists and gray phyllites, parts of which are distinctly calc. Contains cgls., and sandy schists (not so coarse as those in underlying Lisbon and Swift Water fms.) are interbedded with fine-grained more or less calc. gray phyllites. Corresponds to Lyman group of Hitchcock, although there are minor differences in map boundaries. Scanty fossils, but appears fairly certain to be= nearby rocks of Niagaran age. As here defined may contain rocks of 2 ages, the older being=Lyman series of Lahee.

M. Billings in 1934 (see 1934 entry under *Swift Water fm.*) dropped Lisbon, Lyman, and Swift Water from the nomenclature of Littleton and Moosilauke quads.

Named for exposures over wide area around village of Lyman, Grafton Co.

Lyman series.

See 1916 entry under *Lyman fm.*

Lyman erosion surface.

Pleistocene: Northeastern Utah (Uinta Mountains).

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). Lies 50 to 75 ft. above Tipperary surface. Named for fact that Lyman, Wyo., is built upon its northern edge.

Lyme granite gneiss.

Late Carboniferous or post-Carboniferous (?): Southeastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 148, 152, and map). *Lyme granite gneiss*.—Massive, medium-grained, generally light red shading to gray. Essentially pink orthoclase, quartz, and albite, with a small though somewhat variable amount of biotite and occasional crystals of hornblende. Considerable pegmatite, in veins and in spots, is associated with the rock. Covers portions of towns of Lyme, Old Lyme, and East Lyme. Intrudes Mamacoke gneiss. Is intruded by Westerly granite.

Lynch dolomite.

Upper and Middle (?) Cambrian: Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Lynch dol.*—Thick-bedded light-gray dol. with some dark-gray dol. spangled with short white rods in lower part and with a few ls. beds, especially in lower half. Thickness 825 to 1,000 ft. Uncon. underlies Dev. dol. (Jefferson?). Grades into underlying Bowman ls., the bdy being arbitrarily drawn at base of lowest dol. bed. Named for exposures on Lynch Ridge, N. of Ophir.

Lynchburg gneiss.

Pre-Cambrian: Northeastern Virginia.

A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 844, 845). *Lynchburg gneiss* [also called *Lynchburg mica gneiss*].—Fine-grained biotite-quartz gneiss and schist, in part garnetiferous. Typically exposed at Lynchburg. Is intruded and injected by Precamb. hornblende gneiss, gabbro, and quartz monzonite. Widely exposed from Madison Co. southward, and is oldest known rock of the anticlinorium. May be= Carolina gneiss. Some previous workers have included this Precamb. gneiss in Loudoun fm. [Lower Camb.], but it can readily be separated from the Loudoun because of its greater degree of metamorphism and the igneous intrusions of Precamb. age which it contains.

Lynch Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, p. 375). *Lynch Creek bed.*—At base usually 50 to 75 ft. of bluish sandy clay, graduating upward into shaly to massive ss. and downward into sh. In places the ss. is 75 to 100 ft. thick. Basal memb. of Strawn div. Uncon. overlies Bend div. and underlies Burnt Branch bed.

Named for Lynch Creek, W. and NW. of Nix, Lampasas Co.

Lyndon limestone.

Middle Cambrian: Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. Met. Engrs. Trans., No. 1647, p. 5) and 1932 (U. S. G. S. P. P. 171). *Lyndon ls.*—Consists of 200 ft. of light-gray to white more crystalline ls. (than below), usually thick bedded but showing distinct partings, underlain by 200 ft. of fine-grained dark-gray, rather heavy-bedded ls. Conformably underlies Middle Camb. Chisholm sh. and conformably overlies Lower Camb. Pioche sh. So closely resembles the younger Highland Peak ls. that where intervening Chisholm sh. is absent it is difficult to separate the lss. Typically exposed in Lyndon Gulch, and is present in Highland and Ely Ranges. Fossils not abundant, but fm. is here assigned somewhat arbitrarily to Middle Camb., along with the fossiliferous Chisholm sh.

Lyndon gypsum bed.

Silurian (Cayugan): Central New York (Syracuse region).

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 81). The full succession of *Bertie* (*Tonoloway*) *group* in central N. Y. is: Chrysler "waterlimes" ("Rondout" of this region); Akron dol.; Williamsville waterlime (cement bed); Scajaquada shaly beds; Falkirk dol.; and Oatka shaly waterlimes. Below this lies Camillus fm. The Falkirk corresponds in position with the Fiddler's Green. The massive bed taken for latter by Hopkins at mouth of Chrysler's Glen is lithologically indistinguishable from the Falkirk. *If* the covered space above it is actually occupied by *Lyndon gyp.*, then these two beds may belong to Bertie group and search should be made for the Oatka beneath them. The alternative is an uncon. Lyndon has been in use by us informally a long time, but I think not till now officially introduced. It is from the old quarries at Lyndon, a locality made typical by T. C. Hopkins' bull. on Syracuse quad.

Lynn volcanic complex.

Devonian or Carboniferous: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.). *Lynn volcanics*.—Quartz keratophytes, trachytes, dacites, and andesites, with dikes of similar rocks and one bostonite dike.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 200). In Essex Co. the earliest volcanic rocks rest in places on a coarse aggl. of Dedham granodiorite and are called *Lynn volcanics* by Clapp. They form the older and more felsitic part of the complex of volcanic rocks to which LaForge has given the name Mattapan volcanic complex.

C. H. Clapp, 1921 (U. S. G. S. Bull. 704, pp. 30–31, 34, 51, 58–71). *Lynn volcanics* is term applied to the so-called felsites, formerly called petrosilex, which occur N. of Boston Basin. They are chiefly effusive rocks but include some closely related dike rocks that apparently served as feeders for the lavas. The effusive types are chiefly felsic, largely quartz keratophyre, but include trachyte, dacite, and andesite. Extend westward from Lynn to Middlesex Co. Rest on eroded surface of Dedham granodiorite.

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Lynn volcanic complex*.—Nearly all of volcanic origin but partly effusive and partly sedimentary. Believed to be contemp. with Mattapan volcanic complex, but tentatively treated as a distinct fm. Also believed to be of same age as Newbury volcanic complex, which has been determined to be probably Lower Dev. The norite of Nahant, which Clapp included in the Lynn, is here excluded.

Lynnfield serpentine.

Cambrian or pre-Cambrian: Northeastern Massachusetts (Essex County).

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.).

Named for occurrence at Lynnfield, Essex Co.

Lynx formation.

Cambrian (Upper): British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 334, 337).

Lyon Mountain granite.

Pre-Cambrian: Northern New York (Clinton County).

W. J. Miller, 1919 (Jour. Geol., vol. 27, p. 29; also see Econ. Geol., vol. 14, p. 512). *Lyon Mountain granite*.—Fine- to medium-grained rock usually pink; varies from true granite through granitic syenite to quartz syenite or even quartz diorite. Well exposed in and near village of Lyon Mountain [Clinton Co.]. Is perhaps most conspicuous memb. of Cushing's Saranac fm. There is considerable field evidence to show that Lyon Mountain granite grades into and is only a facies of the coarse-grained rock which writer proposes to name *Hawkeye granite*. Both of these granites are believed to have developed from a single body of intruding magma. Lyon Mountain granite contains great profusion of silexite and pegmatite masses, while Hawkeye granite contains relatively few. The Hawkeye contains many aplite dikes, but none was observed in typical Lyon Mountain granite.

Lyons sandstone.

Permian: Central northern Colorado (Boulder and neighboring regions).

N. M. Fenneman, 1905 (U. S. G. S. Bull. 265). The rocks of Boulder region hitherto called "Wyoming" embrace 3 fms. (descending) Lykins fm., Lyons ss., and Fountain fm. The Lykins fm. is "Upper Wyoming" of previous repts. The "Lower Wyoming" here clearly embraces two lithological units. The lower and major part consists chiefly of rather coarse, arkose sss. and cgls. of reddish color, while the upper and lesser part is a finer-grained quartzose ss. of white, "creamy", or light-reddish color. The coarse sss. were called Fountain fm. by Cross in Pikes Peak folio. The top of Fountain fm. is not exposed in Pikes Peak quad., but Darton (Geol. Soc. Am. Bull., vol. 15, p. 22) has found the character of the Fountain as described by Cross to continue [upward] to a white ss. corresponding with "creamy ss." of Eldridge occurring in Garden of the Gods, to which name *Lyons ss.* is here given. The Fountain is characterized by very thick beds throughout and cross-bedding may be found at any horizon. The Lyons ss. consists of purely quartzose ss. It is best developed at Lyons (a few mi. N. of Boulder dist. as mapped), where it is quarried in large amounts. The siliceous cement of this ss. has sufficient iron to produce shades of pink, but the popular name "creamy sss." conveys a wrong impression as to their color. While they have a fairly uniform shade they are locally almost white, and at some places red. These sands are characterized by cross-bedding of unusual dimensions, perfection, and dip, which is at a lower angle than that of the true bedding. This cross-bedded stratum reaches max. thickness of 297 ft. at Fourmile Canyon and is absent just S. of Boulder Creek. It grades into underlying Fountain of "Red Beds," and is conformably overlain by Lykins fm.

R. M. Butters, 1913 (Colo. Geol. Surv. Bull. 5, pp. 68, 75, etc.), applied *Ingleside fm.* to 100 to 125 ft. of beds underlying Lyons ss. and overlying Fountain fm. from N. line of State to a little N. of Lyons. [See under *Ingleside fm.*]

W. T. Lee, 1927 (U. S. G. S. P. P. 149). *Lyons ss. redefined.*—A hard ledge-making ss., 100 ft. thick, characterized by conspicuous cross-bedding, occurs at Lyons, Colo., from which it takes its name. It differs in general appearance from all neighboring rocks. It is of light-red or pink color, consists almost wholly of coarse sand, contains a few small pebbles in some places near the base, and is separated by an inconspicuous erosional uncon. from the older rocks. The most conspicuous peculiarity of the ss. is its cross-bedding. As originally defined by Fenneman some of the red sed. rocks here referred to Ingleside fm. were included in Lyons ss., for the Lyons was said to rest on the Fountain. However, the original description applies chiefly to the cross-bedded upper part (popularly called "Creamy" ss. because of its light color), which is the Lyons of present paper. The inclusion in the Lyons of sss. here referred to Ingleside fm. and the miscorrelation of these older sss. with beds in upper part of the Fountain farther S. have led to confusion, which is dispelled by following the fms. at outcrop to points where both Lyons ss. as here redefined and the underlying Ingleside fm. wedge out toward S. The Lyons ss. as here redefined is traceable by its strat. position and physical peculiarity southward beyond Eldorado, where it thins out. It was not found near Golden nor at Morrison. It is practically continuous northward to Boxelder Canyon, where it seems to thin out. No fossils except tracks of a reptile which C. W. Gilmore regards as Perm. The fossiliferous beds in basal part of overlying Lykins fm. are regarded as probably Perm. Hence Lyons ss. is here classified as Perm. [See also under *Ingleside fm.*]

Lyons limestone.

Pennsylvanian (?): Central Oklahoma.

A. I. Levorsen, 1928 (Okla. Geol. Surv. Bull. 40BB, pp. 17, 43). *Cromwell sand* is basal sand of the Penn. It varies in thickness from 0 to 100 ft. and extends as far W. as E. side of R. 6 E. A thin ls., which thickens to 125 ft. farther E., there known as *Lyons ls.*, is found capping it in several places in Cromwell field. The Lyons ls. is correlated by some geologists with Morrow and Wapanucka lss. of the outcrop, but according to Okla. Geol. Surv. Bull. 40Q, 1928, p. 180, it is of Miss. age.

Lyons sand.

Lyons-Quinn sand.

A subsurface limy sand, of early Penn. or late Miss. age, in Lyons-Quinn pool of Okmulgee and Okfuskee Counties, Okla., the outcrop of which has been named, by R. V. Hollingsworth, *Union Valley ss. memb. of Wapanucka fm.*, and said to compose middle memb. of Wapanucka (early Penn., Pottsville).

Lyons moraine.

Pleistocene (Wisconsin stage): Central Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Lyons, Ionia Co.

†Lysite formation.

Eocene (lower): Northern Wyoming (Bighorn Basin).

W. J. Sinclair and W. Granger, 1911 (Am. Mus. Nat. Hist. Bull., vol. 30, pp. 104, etc.). *Lysite fm.*—Lower fm. of Wind River group in Wind River Basin; well exposed on Lysite Creek. Consists of (descending): (1) Yellowish and gray sandy shales covered with heavy mantle of pebbles from older rocks of mtns, 50 ft.; (2) alternating buff sss. (1 to 5 ft. thick) and red and blue-gray shales, 200 ft.; (3)

gray and dark brick-red sandy shales (red predominating) and gray sss., 100 ft.; (4) dull-colored, deeply disintegrated clays with feldspathic ss. and much gyp., thickness undet. [Sinclair and Granger in 1912 (Am. Mus. Nat. Hist. Bull., vol. 31, pp. 60–62) gave thickness of their Lysite fm. as 600± ft.]

This is a geographic name applied to a paleontologic zone in lower part of Wind River fm., or *Wind River A* (*Heptodon-Coryphodon-Eohippus* zone), according to H. F. Osborn (U. S. G. S. Mon. 55, 1929). Geographic names are not applied to paleontologic zones by U. S. Geol. Survey.

Lytle sandstone member (of Purgatoire formation).

Lower Cretaceous (Comanche series): Eastern Colorado (Colorado Springs region).

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). *Lytle ss. memb. of Purgatoire fm.*—Consists of 145 ft. (average thickness) of ss. with intercalated beds of grit and sh. Contains pebbly beds at several horizons. Base is generally marked by 15 ft. or less of coarse massive ss., prevailingly siliceous, white, yellowish-brown, or blackish grains. Near Colorado City the base of Lytle memb. consists of 100 ft. of fine-grained white or cream-colored ss. Basal memb. of Purgatoire fm. Underlies Glencairn sh. memb. Named for Lytle.

Lytle limestone.

Permian: Central northern Texas.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 9, pp. 948, 949). *Lytle ls.*—A thin ls., of local extent, lying 30 ft. above Rainy ls. and 125± ft. below Standpipe ls.; all members of Clear Fork fm.

Probably named for Lytle Creek, Taylor Co.

†Lytton formation.

Eocene: Central Texas.

R. T. Hill and T. W. Vaughan, 1902 (U. S. G. S. Austin folio, No. 76, p. 6). *Lytton fm.*—Laminated clay, clay and sand, and ss., the latter often cross-bedded. Thickness 300 ft. in Austin quad. Fossils correspond to those of Midway fm. of Eocene. Overlies, probably uncon., Webberville [Navarro] fm. and underlies Uvalde fm.

Same as Midway fm.

Named for Lytton Springs, Caldwell Co.

Lytton Springs sand.

Local name for a subsurface unit consisting of porous, soft green altered basic igneous rock called serpentine, which produces oil at Lytton Springs, Tex. Probably somewhat older than Thrall sand. Extends from base of Austin chalk well up into overlying Taylor marl.

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