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)

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PART 1, A–L
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.
- Cenozoic. An early spelling of Cenozoic.
- Waverllan. 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:

Maine, September 1935.

The following abbreviations are used in citations and in text.


Acad., Academy.

Adv., Advancement.

aggl., agglomerate.

aggl., 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.


Bulls., Bulletins.

Bur., Bureau.

calc., calcareous.

Camb., Cambrian.

Can., Canada.

Carb., Carboniferous.

cgl., conglomerate.

cgls., conglomerates.

chap., chapter.
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

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.
Elem., Elementary.
elev., elevation.
Eng., Engineering, Engineer.
Engrs., Engineers.
Eo., Eocene.
equiv., equivalent.
est., estimated.
Extr., Extract.
fangl., fanglomerate.
fangls., fanglomerates.
fm., formation.
fm's., 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.
Lib., Library.
ls., limestone.
iss., limestones.
loc., locality.
Lyc., Lyceum.
mag., magnesian.
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.
qtzltic, 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.
sec., section.
secs., sections.
Secy, Secretary.

ded., 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., Territoires.
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.
yds, yards.
yrs, years.
Zool., Zoology.
LEXICON—PART 1, A–L

Aarde shale.
Pennsylvanian: Northeastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 9th Ann. Field Conf. Guidebook, pp. 94, 98). [See under Bachelor Creek is. 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 is. intertongues with upper part of Severy sh., which accounts for Aarde sh. containing Nodaway coal. The underlying Bachelor Creek is. also intertongues in Severy sh., he stated.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 39, 105-207). Bachelor Creek is. is basal mem. of Howard is. 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. mem. of Howard is. are classed as belonging to top of Severy sh., because dy by rw. the 2 shales can not be drawn. In northern area Severy sh. extends up to base of Church is. 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 sh., in some places into a schist. Varies from nearly pure greenstone to fairly pure argill. sh. 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. (7).

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. 8, 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 Lichens River 1.8 mi. above mouth of Rocky Creek, thence to Heath Springs, thence below Peavy 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 Mt., thence N. of Culbreath Mine, thence N. of Meeting St. (2 mi.), and thence direct to a point near McCormick, thence to Savannah River, S. of mouth of Little River. Marble, of seeming upper Cherokee equivalence, appears along upper limit of Abbeville-York zone intermittently 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, quartz, 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).
Much altered intrusive hornblende gabbro of dirty greenish gray color; coarse
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).
bedding is caused by thin bands or partings of yellow, buff, pink, or light-gray
fossilliferous sh. The Is. bands are 1/4 to 1/2 inch thick. The shaly material is
present only locally along many bedding planes and similar splotches of sh. occur
less commonly within the Is., and not parallel to the bedding. With increase or
decline in amount of sh., the rock grades into lenticular sh. beds or into rela-
tively massively bedded Is. Thickness 2,700+ ft. Middle Camb. fossils. Grades
into underlying Bushy 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.
signed to Triassic.]

Aberdeen sandstone. (In Pottsville formation.)
Pennsylvanian: Western Kentucky.
deen ss.*—Coarse, massive, cliff-making ss., 40 ft. thick, forming steep cliffs in re-
gion 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 Is. and overlain by buff Is. and marls of Marion fm.
L. C. Wooster, 1905 (The Carboniferous rock system of eastern Kans.). *Abilene
cgl.* consists of Is. and quartz pebbles and is top memb. of Marion beds as here
defined.
top memb. of Marion fm. [See under Marion fm.]

memb.*—Top memb. of Marion fm. Is a peculiar, somewhat variable, conglomerated
Is. At type loc., in vicinity of Abilene, it is a calc. cgl. containing some sand and
sh. 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." Over­
lies Pearl sh. memb.  

Abilene cgl. is Tert. [See fuller statement under fMarion 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 Is. about 2 ft. thick. The interval down to 
top of Herington Is. 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 Is., as it might better be named, have been included in some 
places in this massive bed of secondary Is. 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. 

Thin fossiliferous Is. separated by red and blue clays. Thickness 170 ft. 
Top memb. of Wichita beds. Occurs around Abilene and perhaps southward 
below Calfadan Divide. Thins out and disappears to N., but underlying Lueders 
Is. 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 Is., marls, shales, and gyp., 260 ft. thick 
in Runnels Co., which occur on and near Los Arroyo, 21/4 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 Is. 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. 

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. 


Abitibi River fm. to Middle Dev. 

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

Permian (lower): New Mexico (widespread). 

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 gypsumiferous 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, metabasites, 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) al. 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 rhynolite 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) basalt cgl., 0 to 1,000 ft.; (7) basal brown grit, 30 to 100 ft. Rests, with great uncon., on post-Kewatin 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 Choo, 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.


Abrigo limestone.

Upper Cambrian: Southeastern Arizona.

F. L. Ransome, 1904 (U. S. G. S. P. F. 21). Abrigo Is.—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 Is.; the Is. 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 Balsa qtzite and is apparently conformably overlain by Martin Is. (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 Is., which carries Dev. fossils. It apparently records the consummation of an increasing supply of sandy sediments during later phases of deposition of Abrigo Is. 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 Is. 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 Is., of Bisbee dist. (type area) into (descending): Copper Queen Is. (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.

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.

Acuminac formation.
Devonian: Canada.

Acuminac 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., sec. 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 (¼ 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 18 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 Nyc fm. by H. G. Schenck. Contain sp. of Acita.

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).

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 ss. 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 out. 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 Vamoosa 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 (?).

Adair moraine.

Adamanna shales.
Lower Triassic: Northeastern Arizona.

Adams Branch limestone memb. (of Graford formation).
Pennsylvanian: Central Texas (Colorado River region).
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 Is. 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.


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 Is. 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 ss. 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).


Addington formation.

Permian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 401P, 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 ss. members, which are often broken by white and light-gray sh. and sandy sh. streaks. The ss. are characterized by black red color and slubby appearance on weathering. The weathered slabs are extremely hard and resistant. When freshly broken they resemble fine-grained reddish qtzite. In general the ss. 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 as. There is some evidence these beds are not entirely conformable with underlying Claypool fm. (Penn.). The Addison 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 calcilutite. The transition from the Is. to the shaly Is. 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 sh. No fossils known. Since this broad band of sediment appears to be so distinct through 5 Twp it is proposed to distinguish it by the name Addison shaly Is. 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 Trall argillite and underlies Chewelah argillite and Old Dominion Is.; apparently conformable both above and below.

Adelphian.

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

Adirondack gneiss.


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.]


Adirondack anorthosyte.


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 "syenite" and allied "granites," 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 "syenite" 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 Elisabethtown, 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.

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).

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 ls. as 300 ft., consisting chiefly of shales but including many thin beds of coal, and sa.]

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, 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 Is., and Aspinwall sh. Moore and Condra in their Oct. 1932 revised classification chart for Kans. and Nebr.
defined Admire sh. as underlying Americus Is. and overlying Brownville Is., but they transferred to it, at top, Houchen Creek Is. and Stine sh., which had previously been included in overlying Elmdale sh. They divided Admire sh. into (descending) Oaks sh., Houchen Creek Is., Stine sh., Five Point Is., West Branch sh., Falls City Is., Hawxby sh., Aspinwall Is., and Towle sh. Their Oaks sh. was apparently previously included in Elmdale sh., which overlies Americus Is.

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.

Aetna.
Permain: 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.
Same as Aftonian of other geologists.

Aftonian stage of deglaciation (Pleistocene).
Aftonian stage is name applied to interglacial stage during which the Aftonian soil, gumbotll, 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.


Agassiz Prairie formation.

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


Agassiz Prairie fm., Jurassic, B. C.

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 ss. and cgl. 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.


Agathla shale.

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


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.]

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

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


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. rept.s. to a ls. occurring
at a lower horizon in Marcellus sh. than Stafford Is. 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).
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.

Aguadulce formation.
Pleistocene : Panama.

Agua Fria.
 Probably lower Mesozolc: Sierra Nevada, California.
slates, l.s., cherts, and tuffs, 2,000+ ft. thick. Top fm. of Tuolumne group
(probably lower Mesozolc) on Merced River and southward into Indian Gulch
quad.

Aguas Buenas limestone.
Cretaceous (?) : Puerto Rico.
Islands, vol. 1, p. 64).

Agueguexquite formation.
Miocene : Vera Cruz, Mexico.

Aguja formation.
Upper Cretaceous (Gulf series) : Western Texas (Brewster County).
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, overlap.
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).
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.
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 eolian sands, 8 ft.; Lafayette cobble, 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).


Ainslie sandstone.

Carboniferous (Mississippian): Nova Scotia.


Ainsworth series.

Paleozoic: British Columbia.


Ainsworth formation.

Upper Cretaceous: Southwestern South Dakota and northeastern 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. 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. T10D).* "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).* Ajaic (s.—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-Cambrlan (middle Huronian): Northwestern Michigan (Marquette district).

*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 cgl.s, 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 Slano 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. 129).* 
*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.]


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, Sequoyuh Co.

**Akron dolomite.**

Silurian (Cayugan): Western New York and Ontario.

*Bullhead or Akron Is.—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 Is. (See under Greenfield Is.)


W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 343-344). Cobleskill Is. 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 Is. 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.


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 mammals. 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.]
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."


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 Is. or Tampa Is. 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. Layvson, 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 Is. 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).


Alamosa formation.

Late Pliocene or early Pleistocene: Central southern Colorado (San Luis 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 Milliken, 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 Choctaw-
hatchee fm.
Named for Alaqua Creek, Walton Co.

Alaska Bench limestone.

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

Alaska Bench Is.—Excessively hard, gray, fossiliferous, 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 shs., interbedded with varicolored shs.,
here named Tyler ss. Is overlain by 100 ft. of nonfossiliferous black shs., 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 shs. btw. Tyler ss. and Alaska Bench Is., and 100 ft. of black shs.
above Alaska Bench Is., all of which he included in the Quadrant.]

Alazan shale.

Tertiary: Mexico.

35, p. 731, 1924) and C. Schuchert (Hist. geol. Antillean-Caribbean region, 1935,
p. 189) assigned it to Olig.

Albanian series.

A term proposed by C. [R.] Keyes to replace Albany Is. (Perm.) of north-
central Tex., "until it is made certain the Albany Is. and Vidrio Is. 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.


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
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 there
to Fort Ann, 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.

boulder clay in vicinity of Albany, and both belong to second ice invasion of
glacial period.

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.

clays" was specifically applied to the glacial rock dours 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-Cent. 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. 8, map, pp. 87-187), 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.


Albany formation.

Permian: Northern Texas and southwestern Oklahoma.


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.


Albany porphyritic nordmarkite.

Devonian (?) : New Hampshire.


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.

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.


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. 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).


Alberhill clay.

Eocene: Southern California (Riverside County).


Alberta shale.

Upper Cretaceous: Alberta.


Albertan.


Albert Canyon division.

Pre-Cambrian: British Columbia.

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 Selkirks period, but it “may not include all the strata of Early Selkirks age.” Named for exposures in Albert Canyon, in which Canadian Pacific Railway runs westward out of the Selkirks.

Albion 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 Cambrian 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 Albion shale 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.


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 formal 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 rept.) 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 s.s., cgs., 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 qzite, completely recrystallized by dynamo-metamorphism.

†Albirupean formation.

Upper Cretaceous: Eastern Maryland and Virginia.


B. L. Miller, E. H. Mathews, A. B. Bibbins, and H. P. Little, 1917 (U. S. G. S. Tolchester folio, No. 204, p. 6). The sands of Haritan fm. are in several places indurated by iron oxide or silica. The best examples of such sms. 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.


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.)

Pennsylvania: Northeastern West Virginia and western Maryland.


Md. Geol. Surv. (vol. 11, 1922) applied Albright Is. in Md. to a younger Is., underlying the fire clay beneath “Upper Bakerstown (Maynardler) coal,” and lying a short distance above “Lower Bakerstown (Thomas) coal.”
Albuquerquean 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 Piloto 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. ssh. and cgs., of white to deep green colors.

Albuquerque series.

See under Rio Grande series, Tert.

Alcona moraine.


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 la. memb. of Chugwater fm.—Name here proposed for 8-ft. bed of marine la. lying 335 ft. below top of Chugwater fm. at Alcova. It is hard, resistant, purplish la., 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.—Oily 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.


See Gilmore City la.

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.

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).


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 600 ft. thick, underlying Montevallo shales and ss. and overlying Welsner (Chilhowee) ss. and cpls. 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) Is.]

In several subsequent repts of Ala. Geol. Surv. (E. A. Smith and H. McCalley, Ala. Geol. Surv. 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 Is. was applied to ls. underlying Montevallo sh. and ss. and overlying Welsner ss. or qtzite. Later work by C. Butts led to discovery that the ls. at Aldrich is Conasauga Is., 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 Welsner qtzite that has proved to be the S. extension of Shady dol. of Tenn., and is now called by that name. The name Conasauga Is. has priority over Aldrich Is., 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.


Aldridge conglomerate.

Pre-Cambrian: British Columbia.


Alexandria syenite.


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 Is. (40 ft. thick) and overlying beds containing *Dolomites 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 Cincinnati and the Clinton. The term to have same rank as Cincinnati.

Savage later included in his *Alexandrian series* all beds beneath Bainbridge Is. and above Maquoketa sh. and Thebes fm., both of which he assigned to Ord. (Richmond group). He divided it into (descending) Sexton Creek Is. (=Brassfield Is.), Edgewood Is., Girardeau Is., 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. 184, art. 8, pp. 263-284). *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 sss?] 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.


The name *Alger sh.* was subsequently applied by some Ohio geologists to beds underlying West Union Is. and overlying Brassfield Is., also to beds underlying West Union Is. and overlying Dayton Is.
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 Is.; in Lewis Co. it underlies Ribolt sh. and rests on Dayton Is. Named for Alger, a station on R. R. btw. Fanola 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, 1883 (Canada Geol. Surv. Repts. 1843-68, 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.]

Algoma 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 Algoma lode.

Named for occurrence at Algoma mine, Ontonagon Co.

Algoma flow.

Includes Algoma 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. 122-124). 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.

Algoman revolution.

Same as Algoman revolution.

Algamic period.


†Algonkian period (or system).

A term that was for many years applied to the time (and the rocks) imme-
diately preceding the †Archean 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.

Aliamanu tuff.

Pleistocene (late) : Hawaii (Oahu Island).

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.

Massive white dol. more or less flinty, usually in two ledges, the lower one 8 ft.
and up. 1 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.

dol. is approx. = Day Creek dol. and we recommend "Alibates" be dropped.

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 Hutchinson, 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.

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.

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.

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.

for neither dol. of Camb. succession in Upper Mississippi valley it is with full
concern of fact that for many years the fm. to which it is applied has been
widely known as St. Lawrence is. Latter designation is clearly a misnomer.
[Keyes correlates typical St. Lawrence with Oceata.] Allamakee dol. seems to
have as yet no recognizable representative in Minn. It uncon. underlies Waukon ss., and uncon. overlies Albln 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. 968), lies 100 ft. below Cherry Grove oil sand.

Allegany drift.


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 body between 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.


†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.


Allegrippis sandstone member (of Chemung formation).

Upper Devonian: Central Pennsylvania (Huntingdon County).


C. Butts (U. S. G. S. Hollidayburg-Huntingdon folio, No. 227, in press). Allegrippis ss. memb. of Chemung fm.—Three ss. 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.


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 1913 (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).
Is a part of Conococheague L.
Named for exposures along Lehigh and Jordan Creeks in vicinity of Allentown.

Allison formation.
Upper Cretaceous: Alberta, Canada.

Allison barren member (of Mesaverde formation). (Also Allison member.)
Upper Cretaceous: Northwestern New Mexico (Gallup-Zuni Basin).

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 silt. (Chacra silt 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.

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 synclines 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.
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. Kimmel 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.

Albano 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 ss.s. 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 Renunit fm., with which Morse correlates his Alsobrook fm.]


†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 is., 5 ½ ft. thick, quarried at Alma and locally known as "Alma stone." Same as Cottonwood or Manhattan is.

Replaced by Cottonwood Is.

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 ss., 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.)
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.
Alpena Island.

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


Alpreston quartzite.

Middle Cambrian: Western central Montana (Elkhorn region).


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 ls. come beneath the sh. beds, but as faunas show no great difference in age the 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 Digger 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 Colorado Creek from W. at Fort Peña Colorado. 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. 498–470). Alsen cherty ls. proposed for 20 to 50+ ft. of cherty ls. 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 Fort Ewen, but near Fort Ewen Station the Fort 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 Fort 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 luka fm., from which it is separated by large uncon. Underlies Alleborb 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 (Shafer district, Presidio County).
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, micaeous, sandy sh., 150 to 200 ft. thick, uncon. underlying Maxfield fm. and conformably overliving Brigham granite. 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 percolal nature and represent, for the Georgian embayment, the operation through the agency of the southeastern drainage of Ga. of the same forces and analogous 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.


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. Vestch, 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 Pilo. In 1910 (Ga. Geol. Surv. Bull. 23) S. W. McCallie gave thickness of Altamaha grit as 200 ft., placed it btw. 1Chattahoochee fm. and 1Lafayette, 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 Pilo. 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 central 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 Pilo. Veatch and Stephenson in 1911 [Ga. Geol. Surv. Bull. 26] questioned the name applied to Pilo, 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.]


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.

Altamira shale member. (In Monterey shale.)
Miocene (middle and upper) : Southern California (Paloos Verdes Hills).

Altamont limestone.
Pennsylvania : Southeastern Kansas and northeastern Oklahoma.

In SE. Kans. was for many years treated as lower memb. of Parsons fm. (being the so-called "lower Parsons Is." 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 Is. 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 morainic* 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 *Oklahoma* Is.

Alto formation.
Upper Devonian : Southwestern Illinois.

Alto coal group. (In Pottsville formation.)
Pennsylvaniaian: Central northern Pennsylvania (McKeen County).
C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R). *Alton coal group.*—Chldey sh., sl., and fire clay; usually contains 3 well-marked coal beds—Alton upper, Alton middle, and Alton lower. No Is. or calc. beds. Thickness 20 to 35 ft. In Alton Basin, Lafayette Twp, McKeen Co., It is 30 to 35 ft. thick. The lower coal is at

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.


Named for Altona, W. part of Kingfisher Co.

Altoona limestone.

Pennsylvaniaian: Southeastern Kansas.

E. Haworth and W. H. H. Platt, 1894 (Kans. Univ. Quart., vol. 2, pp. 115-117). Altona 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 underlying lola Is. 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 (Am. Jour. Sci., 5th, vol. 14, p. 217). 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 Interdinger 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, quarte), 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. 46, No. 4, p. 737), changed name to Altuda shaly memb. of Capitan Is., and also treated the Vidrio, Gilliam, and Tessey as members of Capitan Is.

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 tufts and shales containing both plant and vertebrate remains. The mammalian remains collected by Stock appear to indicate upper Plio. age.


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 Is.—Upper memb. consists of 600± ft. of argil, ferrugineous Is., yellow, terra cotta, brown, garnet red; very thin bedded; well exposed in summit of Chief Mtn. Lower memb. consists of 800± ft. of massive Is., grayish blue, heavy bedded, somewhat siliceous, with many flattened concretions, rarely but definitely fossiliferous. Fossils suggest Grayson sh. Underlies Appekunny argilite. 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, 329). 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 Euphona 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
mari memb. of Matson & Clapp and other deposits); Oak Grove sand; and Chipola fm. (including Chipola mari memb. of Matson and Clapp and other deposits). It uncon. underlies Choctawhatchee mari and uncon. overlies Chattahoochee fm. [now replaced by Tampa is.]. 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^2 and coal V in W. and SW. Ind. as consisting of 35 ft. of shales and Is., to which he applied, in parentheses, the term Alum Cave. Derivation of name not stated.

Alvord formation.
Miocene (lower): Southeastern Oregon.

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.

Amarillo sandstone.
Jurassic (?) : Northeastern New Mexico.

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.
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 is., 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).

Ament Bay arkosites.
Pre-Cambrian: Kenora district, Ontario.

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 Madison 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. Croas and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 158). American Flat latite.—Light to dark gray porphyritic rock, notable for glistening bloutte 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, 1900 (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 ss., 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. 58). [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 northeastern Oklahoma.


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 as. 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): (1) sh., 6 in.; (2) ls., 6 ft.; solid buff ls., 21 in. Is overlain by Elmdale fm. and underlaid by sandy shales which are to be named by Adams.


R. C. Moore, 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., brw. 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. Conrad 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, 1938 (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 Iss., 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.
*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 iss. 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.
*Ames sh.*—Dark-green sh. with marine fosslla; 16 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). 
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*).—Course fibrolitic and feldspathic schist exposed in Mount Warner and across Amherst, Mass.
B. K. Emerson, 1917 (U. S. G. S. Bull. 507, pp. 80, 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, 1835.)
Amherstburg dolomite member (of Detroit River dolomite).
Lower Devonian: Southeastern Michigan (Detroit region) and western Ontario.


Amisk group (also series).
Pre-Cambrian: Manitoba.

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 Sugamore 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.]


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, underlining Partridge ss. and overlying Albice qtzite in Littleton and Moosilauke quads. No fossils, but are pre-Sil. (Upper Ord. ?).


M. F. 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 (Ogonta Lake) and Thackerville. The fm. is also well exposed along Ammonoosuc River but with a different metamorphic character. Most of material would be classified as ruff, 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, arkose 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).
Amadon formation.
Pennsylvanian (some Mississippian locally): Wyoming (rather widespread) and Montana.
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. 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 Is. and overlies pre-Leray part of Lowville Is. in Mohawk Valley and beds = Leray Is. memb. of Lowville in Champlain Valley.]
H. P. Cushing, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135-144). Amsterdam Is.—Is Mohawk Is. 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.

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 Clarino fm., of lower Olig. and upper Eo. age.

Anacacho limestone.
Upper Cretaceous (Gulf series): Southwestern Texas.
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. iss. 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. iss. and cherts and also of Penn. iss. (Does not describe the intervening strata of the memb.) Lies 500 to 800 ft. above Crlinerllie memb. and 400 to 600 ft. below Daube Is. memb. Type loc. is on Anadarche Creek, 1/2 mi. S. of NW. cor. of sec 35, T. 5 S., E. 2 E.

Anadarche conglomerate. (In Hoxbar formation.)
Pennsylvania: Central southern Oklahoma (Carter County).

Anadarche limestone. (In Hoxbar formation.)
Pennsylvania: Central southern Oklahoma (Carter County).

Anaktuvuk group.
Lower Cretaceous: Northern Alaska (Anaktuvuk River region).

Analomink red shale.
Upper Devonian (Portage): Northeastern Pennsylvania (Monroe County).
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. 371 shows the 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.
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, 270). 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 interfingerling 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.]

Anastasia formation.
Pleistocene: Florida (east coast as far south as Broward County; west
coast from Ten Thousand Islands as far north as Tampa).
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
cost at Rockledge. Probably contemp., or partly so, with Miami Is. and other
Pleist. fms. along southern coast.
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.

Anawalt sandstone.
Mississippian: Southern West Virginia.
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. 102, pp. 10, 17, etc.). Anchor Is. memb.—
Massive gray Is. with numerous thin chert layers; in places large belts are altered
to dol. Thickness 63 to 400 ft. Many lower Miss. fossils (listed). Underlies
Bullion dol. and overlies Dawn ls.; all members of Monte Cristo ls. well de­
veloped 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-beded ss. and carbonaceous material repre-
senting 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.

Anderson 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). Anderson ls.—In most localities a more or less continuous coral and Stromatopora reef; very fossiliferous. Is middle memb. of Upper Monroe [Detroit River, dol.].


Anderson sandstone. (In Pottsville group.)

Pennsylvanian: Eastern Tennessee.

A. Keith, 1896 (U. S. G. S. Briccenville folio, No. 33). Anderson ss.—Sss., sandy and argill. shales, and coal beds, like preceding fms. [Scott, Wartburg, and Briccenville]. 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 sss. 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).


Anderson clay.


Anderson Bay formation.

Triassic: British Columbia.


Anderson River group.

Age (?): British Columbia.


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 GaMeay 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 body 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.


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.

**Andover shale.** (In Douglas formation.)

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


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 hemmetite. At base the fm. grades into Murphy marble by interbedding and by diminution of amount of ottrelite. Upward it passes into Notely quartzite, 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.


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.

Anguilla formation.
Miocene (lower): West Indies.

Anian 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. 60, 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, s.s., and cgs. 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 Torreon fm. and uncon. overlies McDermott fm.—an andesite 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. Mathes, 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. F. 188, 1932) described by them as post-Durango and pre-Wisconsin interglacial stage.

Animas moraine.

Pleistocene: Southwestern Colorado.


†Animas River beds.

Tertiary? (Eocene?): Southwestern Colorado.

See under Animas fm.

Animikian.

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.


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—Pencoko 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. 430-458). 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 50 ft. thick. A few fossiliferous grayish blue lss. a few ft. thick are also intercalated. Thickness of fm. 1,500 - 1 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 Is. 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 Is., Higham grit, and Timothy ss. of SE. Idaho.

Annabelle shale. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia.


Annapolis formation.


Annona chalk.

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

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 Anonna chalk in Ark. underlies Marlbrook marl restricted (mistaken for the older Brownstown marl in early repts) and overlies Ozain 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), Ozain 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.


Anoka moraine.

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


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. 260, 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 “Norlan.” [For further particulars see Index of Bull. 260.]

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, 389), 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. 186G, 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).


Antelope Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

and some clay. Local deposit. Mem. 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 Wåagen in 1891. For definition see U. S. G. S. Bull. 769, p. 78, 1925.

Anticosti group.
Silurian: Canada and New York.

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. Is. 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.
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 Paoll 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 Paoll, 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.


†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. Terr., identical in character with that of Trinity and Paluxy sands of Brazos section in Tex., except that the lss. which 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 sand 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 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 quartzite 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., quartzites, and jaspilite., and that Negaunee fm. is represented in Menominee dist. only by pebbles in the quartzite 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 quartzite 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 quartzite (correlated with Ajijik quartzite, Siamo sh., 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 quartzite 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).

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.

Anvil ferruginous chert member (of Ironwood formation).
Pre-Cambrian (upper Huronian): Northwestern Michigan (Gogebic district) and northwestern Wisconsin.

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.

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 quartzites, with subordinate shales and cgs. Thickness 800 to 1,000 ft. Underlies Globe Is. and uncon. overlies Finley schist. Divided into (descending): Dripping Spring quartzite, 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 quartzite as mapped in Globe quad. included two quartzites, each 400 ft. thick, separated by 250 ft. of cherty Is. The name Dripping Spring is restricted to the lower quartzite.
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 Aigoukian 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. 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 ls., exhibiting practically same lithological characteristics and fauna as the Capitan and an overlying, well-bedded pisolith 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 ls. The Apache ls. seems to be a barrier reef with accompanying lagoonal deposits.

Apache sandstone.
Upper Cretaceous: Eastern Colorado (Walsenburg district).
C. S. Livingston, 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 Chipola 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 ls. 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 ls. 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 “alex 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.
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 1938) 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).
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, 1897 (Iowa Geol. Surv. vol. 7, pp. 426-463), 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 lls. 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 lls. 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): Lonedale 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 26 ft.; shales and lls., 50 to 100 ft.; Mystic coal, 6 to 36 inches; fine clay.
Lexicon of Geologic Names of United States

1 to 8 ft.; Is., 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. 318, 322). Appekunny argillite—Prevailing gray, black, and greenish; thin-bedded; ripple marked; interbedded with white qtzite; carries flattened concretions resembling fossils. Thickness 2,000± ft. Underlies Altyn Is. 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, 1898 (N. Y. Acad. Sci. Trans., vol. 15, pp. 51-52). Appleton stage.—Ss., and shales underlying Booneville stage and overlying Danville stage. Consists of (descending) : Shales, few ft. to 40 ft.; Croes Plains ss., 50 to 200 ft.; Russellville shales, 500 to 600 ft.; and Washburn ss., 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. Underlies Mio. and overlies Columbia fm. Fresh aspect and comparatively slight erosion indicate its age is much newer 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 Princetonella, underlain by brown shales
carrying Shumardia. Overlain by Maidment fm. and underlain by Brown Mound
fm. Included in Clarenville series. [Derivation of name not stated.]

Apulia shale.
Apulia limestone.
Devonian: Central New York (Onondaga County).
lies 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., Encen­
nal ls., Moscow sh., Apulia and Sherburne shales, and Cazenovia group. [Apulia
sh. not described.]
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, 1.5 mi. SW. of Apulia Station,
Tully Twp. It is hard, heavy-bedded, aren. Is. 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, 2± 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 s.s.s., 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 Otsville, 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.
fm.—More highly aren. and much more calc than overlying Nanjemoy fm. Cons­
sists chiefly of greensands and greensand marls, frequently argill. Thickness 100
ft. Characterized by well-marked fauna representing a clearly defined paleonto­
logical stage. Is divided into t'Spasotansa 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 green­
sand. Is bottom fm. of Pamunkey group.

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

‡Aquia Creek series.
Lower Cretaceous: Northeastern Virginia.
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 Rappa-
hannock 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 "Clabornian" types, and those of Aquia Creek stage are decidedly "Lignite."

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 Lignite stage. Named for Aquia Creek, Va. Separated from overlying Woodstock stage or fauna by 117 ft. of greensand and argill. sands, and from underlying Rappahannock 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 greensish sh. On E. side of Sakonnet River, and across Portsmouth and Middletown (on W. side of Sakonnet River), the upper greensish 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.
The U. S. Geol. Survey classifies Knoxville as Lower Cret.

Aquinnah conglomerate.
Pleistocene: Southeastern Massachusetts (Marthas Vineyard).
and referred to Mio., but it contains the remains of a Pleist. horse. Underlies Duke’s boulder bed at Gay Head Cliffs fold, on Martha’s 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.


W. H. Dall, 1898 (U. S. G. S. 15th Ann. Rept., pt. 2, pp. 330-343). Arago beds.—Name suggested by Diller. Consist of ss. and shales, containing fossils that suggest correlation with Caliboran 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 ss. 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. 86, 1903, Diller gave thickness of Arago fm. in that quad. as 5,000± ft.]


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


R. Arnold and H. Hannibal, 1914 (Sci., n. s., vol. 39, pp. 906-908). Arago or lone fm. Is younger than any Tejon in Tejon or Puget Basins, which includes Oolequa 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.


L. G. Hertlein and C. H. Crickmuy, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 228-242). 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.


Arapahoe formation.

Upper Cretaceous: Eastern Colorado (Denver Basin).


W. Cross, 1903 (Int. Cong. Geol., Compte Rendu, 5th sess., pp. 437-438). Arapahoe beds are a fresh-water deposit whose most prominent memb. is a clg. free from volcanic materials, containing pebbles of sed. rocks recognized as belonging to various horizons from the Laräme down to the red ss. 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. lss., 3,500 to 4,000 ft.; (3) thin-bedded granular lss. and compact blue lss., 250 ft.; (4) heavy-bedded, dull bluish, and cream-colored dolomites, 300 to 400 ft.; (5) thin-bedded siliceous lss., 50 ft.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 624, 642, 661, 606, pl. 27), introduced Honey Creek ls. memb. of Reagan as. 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. 35-57). 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.


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 flabby, 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 mam-malian 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 Is." (also "Upper Archimedes Is.") 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 Is." was applied to Ste. Genevieve Is.; "Third Archimedes Is." was applied to Warsaw Is., also to Warsaw and Keokuk lss., and to Keokuk Is. alone. "Lower Archimedes Is." 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 Is." was in early repts applied to Pitkin Is.

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

Arcturus limestone.
Pennsylvaniaian: Eastern Nevada (Ely region).

Ardmore limestone member (of Cherokee shale).
Pennsylvaniaian: Northwestern and north-central Missouri and southeastern Kansas.
C. H. Gordon, 1893 (Mo. Geol. Surv. Sheet Rept. No. 2 (vol. 9) p. 20). Ardmore Is.—Irregular marly and concretionary fossiliferous lss. in Lower Coal Measures of Bevler 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 lss. beds, and from overlying Bevler coal by 6 to 18 inches of clay. [Later repts give thickness 0 to 10 ft. Is Hydraulic Is. of Swallow.]
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 56). Most important is. in Cherokee sh. is in upper part. Ardmore is. has priority for this bed, but Okla. name Verdigris is. has usage.

Named for Ardmore, Macon Co., Mo.

Ardness formation.
Mississippian: Nova Scotia.

Arecibo formation.
Tertiary: Puerto Rico.

Arenal formation.
Eocene: Mexico.

Arendssville 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). Arendssville fangl. lentil.—Coarse cgl. of rounded cobble and boulders of qtzite, ss., quartz, and some apophyllite 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 Arendssville, whence its name. In Carlisle quad. it passes into Is. cgl. (unnamed). Is top memb. of Gettysburg sh.

Argenta limestone.

Argentine limestone.
Pennsylvanian: Eastern Kansas.
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.

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

†Arickaree shale.
Upper Cretaceous: Northwestern Kansas.
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.


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., 1938, 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 replaces 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 Daemorops 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.


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.

Arisalg series.

Silurian: Nova Scotia.


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 Pinel, 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.


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 slates, 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 Cre. 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. 119–122). 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.
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 Plié.

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. Répt., p. 312). Arkansas ss.—Red ss., 5,000± ft. thick. In Sangre de Cristo Range the ss.s. are interstratified with lss.s. and shales and rest directly on granite. Assigned to Carbf. Is overlain by gray and bluish lss.s. and underlain by gray saccaroidal lss. 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 ss. and shale. Occurs along Arkansas River and in Sangre de Cristo Range. C. E. Siebelithal, 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 puddlingstone 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 ss. 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.


**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 sh., 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 ass. 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, 1905 (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
Arlington lake beds.

Pleistocene and late Tertiary: Central northern Oregon.

E. T. Hodge, 1939 (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, 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 Shutter 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 Shutter.

Arlington traps.

Name applied by N. H. Darton (U. S. G. S. Bull. 67, 1893), to several small sheets of Palisade diabase (intrusive) near Arlington, Hudson Co., N. J.

Arlington moraine.


Arlington Heights moraine.


Armendaris limestone.

Ordovician: New Mexico.


Armenia limestone lens (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 limestone lens of Oswayo fm.—In 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).


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 quadrangle.

C. Butts, 1927 (U. S. G. S. Bessemer-Vanderbilt 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.**

Basil 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).

Pennsylvaniaian: Central southern Oklahoma (Carter County).

Arnoldsburg sandstone. (In Monongahela formation.)
Pennsylvanian: Western West Virginia and eastern Ohio.


Arnoldsburg limestone. (In Monongahela formation.)
Pennsylvanian: Eastern Ohio and northern West Virginia.

Arnoldsburg Is. (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.

E. E. Lamborn, 1930 (Ohio Geol. Surv., 4th ser., Bull. 36, pp. 181, 244-247). In many parts of W. Va. and eastern Ohio the Is. btw. Uniontown coal and Fulton green sh. is divided into 2 well-defined Is. horizons separated from each other by aren. sh. or ss. The lower part of this Is. 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 Is. to that part which lies closely below Uniontown coal and to use Arnoldsburg for the Is. 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 Is. formerly included Arnoldsburg ss. and Arnoldsburg Is. horizons. (Thicknesses of Arnoldsburg Is. given by Lamborn range from 3 to 12 ft. in Jefferson Co., Ohio, but in some sections the name Uniontown Is. is applied to all the Is. 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 Is., 0 to 15; red or green sh. with thin ss. and Is., 44 to 59; Arnoldsburg ss., 25 to 50; sh., 0 to 5; Lower Uniontown coal, 0 to 1; Arnoldsburg Is., yellow, fresh-water, 0 to 5; Fulton green sh., 0 to 5.


Arnott moraine.


Aroostook limestone.
Silurian: Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 185, pp. 21, 44-45). Under name Aroostook Is. 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 Is. and as representing base of Sil. in this region.
Aroostook Falls diabase.

Age (?): Northeastern Maine (Aroostook County).


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).


C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 898), 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, 362–365, and map). Arrastre qzite.—The oldest sedimentary positively identified as such in the region. Qtzites and quartzose schists, chiefly thin bedded, in beds less than 6 inches thick. Differs from Sarasota qzite in that it contains no beds up to 5 and 10 ft. thick of pure qzite, no pure sacycharoidal qzite, no coarse angular grits, pebble cgl., or cross bedding. No fossils found. Grades into Furnace Is. 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 Gallsteo 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 is. and gray sh.; highly fossiliferous; no chert. Thickness 10 to 20 ft. Underlies Yellowpine Is. 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. Grady.

†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. 182, 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).


Most geologists (including U. S. Geol. Survey and Tex. Geol. Survey, Sellers, 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. (Pilo. ?).

Artemisia limestone.

Cretaceous: Cuba.


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.


Arundel formation. (Of Potomac group.)

Lower Cretaceous: Eastern Maryland.

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 158, 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. 38–43). West of Blue Ridge the Martinsburg sh. [Upper and Middle Ord.] was laid down at about same time as Quantico and Arvonia belts of sh.
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

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, 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.


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 laminae 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. Refts 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, 1928) to replace Wisconsin, as applied to the late Pleist. till of Kewatlin 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.


R. D. Irving, 1883 (U. S. G. S. Mon. 6, 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.


A series of diabaile and diabase amygdaloid flows, including cgs., underlying Marble'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 1,230 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.


Asher formation.

Permian: Central and central southern Oklahoma.

G. D. Morgan, 1924 (Bur. Geol. [Okl.] 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 sas. 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 Masards, are several outcrops of ls., calc. shales, and ss., 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-bededged 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 silicious 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 ls., and that Sheridan ss. are of same age as [for 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.
G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 32–33). Ashland mica schist.—Schists, chiefly garnetiferous biotite schist and silicic, more or less graphitic, muscovite schist, the two types intergrading. Contains some quartz. 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.

†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).
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, 1906 (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. Is. [in heading].—Another Is. 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 Is. belt cannot be connected with other Is. 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.
Ashokan beds.
Middle Devonian: Eastern New York (Ulster and Greene Counties).
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.
†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 *Orbiculoites floridanus*, 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). *Aspalaga 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.


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.


Aspen shale.

Upper Cretaceous: Southwestern Wyoming.


Aspermont dolomite.

Permian: Central northern Texas (Stonewall County).


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.


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 Ck.

Asphalt lake bed.

Pliocene: Southern California (northwestern part of Kern County).


Probably named for exposures at or near Asphalt, 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. ssa., 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, 1883 (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 is., and Towle sh., thus discarding Aspinwall sh. and restoring Aspinwall ls.

Assiniboian series.

Assiniboine series.
A term employed by C. [R.] Keyes to cover the post-Dakota Cret. rocks of Iowa.

Astoria shale.

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 Miq.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 259–290). Recently Howe (unpublished thesis Leland Stanford Univ., 1922) investigated Astoria locality and states that the 2 ss. 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.


The U. S. Geol. Survey now classifies Astoria sh., including *Aturia* zone at base, as Mio.

†Astoria sandstone.


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.


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 Home beds (Lower Cret.).

‡Atascadero formation.

Upper Cretaceous: Southern California (San Luis Obispo region).


Replaced by Chico fm.

‡Atchison shale.

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and southeastern Nebraska.


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).


Athens shale. (In Blounf group.)


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 Is. 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. 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 Normanskil 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.


*Atherton bed.*—Chiefly fossiliferous clay [thickness not stated] underlying St. Louis Is. in southern Ind. In northern Ky. overlies Harrodsburg Is., the Salem Is. not being recognized. Carries about same fauna as Salem Is. 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 Is. Derivation of name not stated.]

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Athol shale.

Middle Devonian: Western New York (Eighteen-Mile Creek).


*Athol shales.*—Separated from underlying black Marcellus sh. by 8½ ft. of Stafford Is. 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.


Same as *Atikokan series*, the commonly accepted spelling.

†Atikokan series.

Pre-Cambrian (Keevatlin): Ontario.


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 *Atico Kan* and *Atic Oban* have also been used.

†Atkinson limestone.


Atlantic period.

Atlantic system.

Pre-Cambrian: New Hampshire.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, p. 522), divided his *Eocene 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; Winnipegoose 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. Geok, 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.

†Atlanticosaurus 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).

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 Harts-horne 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 Hartsborne ss. and overlies Wapanucka ls.

The fm. (of Penn. age) underlying Atoka fm. in area S. and E. of Ti Valley-Choc-taw 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-Choc-taw 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).
**Atrypa limestone.**
Upper Devonian: Eureka district, Nevada.

**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 Is. 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.

**Attawapiskat limestone.**
Silurian: Ontario.

**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 Rhinesreet sh. includes at top the Hatch sh. of Genesee River section, and is therefore a larger unit than typical Rhinesreet sh. (which lies btw. Cashaqua sh. below and Hatch sh. above). He therefore (1923 citation) named the so-called Rhinesreet of Lake Erie region *Attica sh.*, probably from exposure at Attica, Wyoming Co.]

**Atteleboro sandstone.**
Carboniferous: Southeastern Massachusetts and Rhode Island.

**Attwood series.**
Carboniferous (?): Southern British Columbia and northeastern Washington.

**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, 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 quadriruncatus, 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).


Aubrey group.

Permian and Pennsylvanian: Northern Arizona, southern Utah, and southeastern Nevada.


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 Is. (to replace “Aubrey” Is. 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 ss. 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, 1822 (U. S. G. S. P. P. 171B). The upper 235± ft. of thin-bedded lss. which form top memb. of Redwall Is. 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 Is., Coconino ss., Hermit sh., and Supai fm.

Aubrey limestone.

Permian: Northern Arizona, southern Utah, and southeastern Nevada.


Replaced by Kaibab Is.

Aubrey sandstones.

Permian: Northern Arizona, southern Utah, and southeastern Nevada.


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.


G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 66). *Auburn sh.* Is 20 ft. thick in Nebr. It overlies Wakarusa Is. and underlies Emporia Is. 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.


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 Is. 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. 20, 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.


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 Is.

J. Bridge, March 1937 (personal note). *Auburn chert* is = Decorah or possibly is slightly younger.

Auburn moraine.


†Aucella beds.

A palontologic 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).


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 Is. (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 st. 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.

Aurora sandstone member (of Orangeville shale).
Mississippian: Northeastern Ohio.
C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 123, 208, 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.
†Ausoble granite.

Pré-Cambrian: Northeastern New York (Essex County).
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 "Ausoble granite."

Ausoble sandstone.

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.

Ausoble syenite.

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.
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. 1860G, 1837.)

†AustIn marble.

Lower Cretaceous (Comanche series) : Southeastern Texas.
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.

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.

Aux Sable limestone.
Upper Ordovician (Richmond): Northeastern Illinois.
J. R. C. Evans, 1929 (Chicago Univ., Abstracts of Theses, Sci. ser., vol. 2, pp. 199-200). The Richmond of NE. III. 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 faunaally to lower part of the Wayneville of Ind.; (2) Milledale ls., which contains a few poorly preserved fossils representative of which occur in the Wayneville and lower Liberty of Ind.; (3) Treat ls., practically unfosilliferous; (4) Du Page ls., fossils, poorly preserved, occur in Wayneville and lower Liberty; (5) Rock Run ls., fossils, poorly preserved, occur in Wayneville and lower Liberty; (6) Wilmington ls., highly fossiliferous, and fossils very similar to upper Wayneville 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.
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.)


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 pieces 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. ¼ sec. 8, T. 46 N., R. 8 W. and in NW. ¼ 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 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.


Avalonian formation.


Ayoilt limestone member (of Ochelata formation).

Pennsylvanian: Central northern, northeastern, and northern central Okla­homa.

D. W. Oehrn, 1910 (Okla. State Univ. Research Bull. 4, pp. 31, 37). Avoit ls. Juxtap.—Bluish semicrystalline ls., often thin-beded, from a few ft. to 40 ft. thick. Stratigraphically about 35 ft. above Dewey ls. along 96th meridian S. of Bartles­ville. Included in Copan mem. of Wann fm. in northern area and in Ramona

Avenal sandstone.

Eocene: Southern California (Diablo Range). F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 164–168). Avenal sas.—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 ss., below which occur thin­bedded 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 lso Domergue sas., of upper middle Bo. age. The type loc. of Domergue is N. of Coalinga.

Averill granite.

Age (?) : Northeastern Vermont (Essex County). B. A. Schroeder, 1921 (Vt. State Geol. Rept. 1919–20, pp. 39–42). Averill granite.—Pliik, two-mica granite of medium grain, with subporphyritic texture. Intrudes a muscovite-biotite schist; the contact being well exposed on summit of Averill Mt. 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 Lippia salt shaft, 70 ml. 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 Bridge. It is possibly same as Stevenon’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).
B. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated Avis ss. as basal memb. of Thrifty fm.
F. M. Bullard and E. 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.

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: Southeaster of Nebraska, northeastern Kansas, and northwestern Missouri.

Avon shale and limestone. (In Pottsville formation.)
Pennsylvanian: Central western Illinois (Fulton County).
T. E. Savage, 1927 (Am. Jour. ScL, 5th, vol. 14, pp. 807-818), applied Avon sh. and Is. 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).
A quarry rock in Cockeysville marble is now locally known as “Avondale Is.”

Avondale volcanics.
Pre-Cambrian: Newfoundland.

Avondale series.

Avon River limestone.
Mississippian: Nova Scotia.

Aweres formation.
Pre-Cambrian: Ontario.

Axemann limestone. (In Beekmantown group.)
Lower Ordovician: Central Pennsylvania (Center and Blair Counties).
The Is. at Axemann, Center Co., is Stonehenge Is., which underlies Nittany dol., but the Is. named Axemann crops out 1 mi. E. of Axemann. The Bellofonte, 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.—Blotite-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).


Ayler formation.

Ordovician (Lower): Ottawa Valley, Canada.


†Aztec 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 Is. that caps western Azotea Mesa and overlies Seven Rivers gasiferous 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.

Aztec an 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.


Azuere river series.

Pre-Cambrian(?): British Columbia.


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 Is. have been assigned names as follows, ascending: Bachelor Creek Is., Aarde sh. (containing Nodaway coal), Church Is., Winzeler sh., and Utopia Is. [Derivation of names not stated. On p. 21 Bachelor Creek Is. is described as consisting of 1.35 ft. of blue Is. weathering brown and gray.]

Backbone limestone.
Lower Devonian: Southwestern Illinois (Jackson County).

†Bad limestone.
See 1st entry under Bad River Is.

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., fgs. 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. Ransch stated that Bad Axe Is. is lower Dikecephalus zone. St. Lawrence memb. as used in above definition of Bad Axe Is. 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. 49, 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. Underlies by 3 to 5 ft. of shales which rest uncon. on St. Louis Is.
Named for exposures at Baden, St. Louis Co.

Bader formation. (In Council Grove group.)
Permian: Southeastern Nebraska and northeastern Kansas.
Badger Creek formation.
Cambrian or pre-Cambrian: British Columbia.

Bad Heart sandstone member.
Cretaceous: Alberta.

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).
B. C. Hills, 1900 (U. S. G. S. Walsenburg folio, No. 88). 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).

†Bad River gabbro.
Pre-Cambrian (Keweenawan): Northwestern Wisconsin (Ashland County) and northern peninsula of Michigan.

Bad River dolomite.
Named for occurrence at Bad River, in Penokee Gap section.
C. K. Leith, B. 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.
Bad Vermilion Lake granite.
Pre-Cambrian: Ontario.

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 Labradorian 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 contemporaneous 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.

Bagneil 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.


Bailey Spring limestone.
Pennsylvanian (early) and Mississippian (late): Eastern Nevada (Pioche district).
L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. F. 171, pp. 7, 21, etc.). Bailey Spring limestone.—Gray, medium-bedded Is., some cherty layers; basal beds consist of olive-brown fossiliferous Is. weathering to reddish debris, which passes up into gray-black fossiliferous Is. that weather to mottled red and yellow. These basal beds are probably not very thick. Thickness of Is. 2,276 ft. Overlies Scotty Wash qzite. Is youngest Carfb. Is. 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.
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

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.


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 iss. [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. iss. 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 Brasfield 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.


**Baltoa formation.**

Miocene: Dominican Republic.


**Baker limestone.**

Silurian (early): Western Tennessee.


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).  

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 s. —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.]


Bakoven shale.  
Middle Devonian: Eastern New York (Catskill Mountains).  
The black sh. herefore passing as "Marcellus," below Mount Marlon 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).  
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 sh. 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).  
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 as. Was originally named "Tyrone," but that name is preoccupied. Named for Bald Eagle Mtn at Tyrone, Blair Co.

Oweno (Bald Eagle)
underlies Juniata ss. in central Pa. and rests on Reedsdale sh., the upper part of which is of Eden age.


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.


**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).


**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 marlly 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 l.** 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 Mountain limestone.**

Lower Ordovician (Beekmantown): Eastern New York (Mohawk Valley).

W. W. Mather, 1843 (Geol. N. Y., vol. 1, p. 367). **Bald Mountain l.** is synonym of Black River l.

A. Fitch, 1850 (Historical, topographical, and agricultural survey of county of Washington [N. Y.], pt. 3, pp. 841-853). **Bald Mtn l.**—Blue l., 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 Is. and the stratum beneath it. J. M. Clarke, 1912 (N. Y. State Mus. Bull. 158, p. 21). Bald Mtn Is., of Beekmantown beds; provisionally named because so distinct from Beekmantown beds of Champlain Valley. Underlies “Trenton” Is. Field work by R. Ruedemann.

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 66-99). Bald Mtn Is.—Fine-grained, light bluish gray Is. 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 Is. is older than Normanskili 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 Normanskili 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).

Bald Mountain gneiss.
Pre-Cambrian: Northeastern Oregon.

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 ss., 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 700-1- 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).

Bald Rock conglomerate member (of Lee formation).
Pennsylvanian: Southwestern Virginia (Wise County).

Baldwinsville limestone. (In McLeansboro formation.)
Pennsylvanian: Central eastern Illinois (Edgar County).
See 1894 entry under La Salle Is. memb., where is cited only known use of name. Derivation unknown.

Ballard.
Cretaceous: Jamaica.
Ballard Harmon sandstone.
Mississippian: Southern West Virginia.

† Ballast Point silex bed.
Miocene (lower): Central Florida.
Term used in some early repts of W. H. Dall to designate the very fossiliferous silexaceous 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, 1936 (Geol. Soc. Am. Bull., vol. 46, No. 10, pp. 1556–1581). *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 1,500± 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.
Baltic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 135, 138). 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. (magna.). 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.


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 gneises, also Baltimore gneises, here used to include gneises overlying Cockeysville marble and the hornblende gneises underlying Setters quartz schists, and text says Baltimore gneises embrace a great variety of types. The gneises that overlie 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 gneises, 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 gneises with bands varying from micaceous quartz to biotite and hornblende schists. Includes metamorphosed sediments and igneous masses. [Placed beneath Setters gneite. 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. ScL, 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 quartzite (Chelicks quartz or Setters quartz schist). Apparently of sed. origin.


P. Bascom, 1932 (U. S. G. S. West Chester-Coatesville, Pa., folio, No. 228). 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 Is. (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.


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 1938 (Jour. Geol., vol. 44, No. 4, pp. 434-439). Banbury volcanics.—Massive dark-brown weathered basalt flows and fragmental tuff beds, 380+ ft. thick. Older than Hagerman lake beds and younger than Baft lake beds. There are thick exposures of fm. near Banbury Hot Spring, sec. 38, 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.

Bandera shales.
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 ls. 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 Parson's 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.


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. 286, 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 lss. above named. The ls. which comes next below the Coal Measures is well exposed at many places, as at Bangor, Blount Springs, and Tuscaloosa, 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 lss. The greater part of Shades Valley is based upon these ss. 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 over lain 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 Tuscaloosa 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.)


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, 1928 (Ill. State Acad. Sci. Trans., vol. 19, pp. 257, 261, 282). [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 concoidal.

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.


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 qtzite schists of different character form the lowest layers of the north qtzite range.
Lexicon of Geologic Names of United States

R. D. Irving, 1892 (U. S. G. S. Mon. 19, pl. 1), mapped Baraboo quartzites.
S. Weldman, 1904 (Wis. Geol. Nat. Hist. Surv. Bull. 15). Thickness of Baraboo quartzite is 3,000 to 5,000 ft. Rests on floor of rhyolite, granite, and diorite. Underlies Seeley sl., without evidence of uncon. Is mainly quartzite, but contains small amount of quartz porphyry at base, and in several places is accompanied by red sl., hardend and semi-metamorphosed, making the well-known catlinite of Pipestone and Baraboo Counties.

Baraboo series.

Pre-Cambrian: Central southern Wisconsin (Sauk County).

Barachois slate.
Cambrian: Nova Scotia.
H. Fletcher, 1900 (Canada Geol. Surv., Descriptive note on Sydney coal fields, p. 5).

Barberie andesite.

Barbican formation.
Pleistocene: Jamaica.

Barclay limestone.
Pennsylvanian: Eastern Kansas.
This name fell into disuse years ago. As defined it included several lss. According to R. C. Moore, 1938 (Kans. Geol. Surv. Bull. 22, p. 215), Barclay is. 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.

Named for Bardstown, Nelson Co., Ky.

Bar Harbor series.
Silurian and pre-Cambrian: Southeastern Maine (Mount Desert Island).
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, 1899 (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 ls.); (3) Pilgrim ls. (massively bedded), 140 ft.; (4) Park shales and ls. cgs., several hundred ft.; (5) Meagher ls., 110 ft.; (6) Wolsky 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 ss. 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.


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. [B.] 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.

Barkley quartzites.
C. [E.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 38). Barkley qtzites.—Qtzites, 1,400 ft. thick, composing upper fm. of Panamintan series (Early Camb.) 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 Is., 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 Is. 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 Is. 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 s.l. rocks. Essentially synonymous with "Wappinger Is."

J. D. Dana, 1879 (Am. Jour. Sci., 3d, vol. 17). The Barnegat or Wappinger Valley Is. contains Trenton fossils and is a southward extension of Copake Is.


W. B. Dwight, 1886 (Am. Jour. Sci., 3d, vol. 31, pp. 125–133). The Wappinger Valley (or "Barnegat") Is. at Fishkill and Stissing Mtns. include Is. now known to be Trenton and Calcareous. In outcrops of Poughkeepsie a ledge of rock in Wappinger Valley Is. proved rich in Potsdam fossils. It must be over 300 ft. thick. Is exceedingly variable, but everywhere calc. and more or less arenaceous. (In some places he called it Potsdam). Rests on calc. qtzite of Potsdam group.

W. B. Dwight, 1887 (Vassar Bros. Inst. Trans. Sci. Soc., vol. 4, pt. 2). The Wappinger Valley (or "Barnegat") Is. of Dutchess Co. include Trenton Is. resting conformably on Rochdale group (the rocks which in previous papers I have called Calcareous).

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 Is.s., 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 Is. for supposed Ord. and Camb. Is. underlying Hudson (Manhattan) schist and overlying Poughquag (Lowerre) qtzite. The Is. of this area is now considered to be pre-Camb. and is known by local name Inwood Is.


J. M. Clarke, 1909 (N. Y. State Mus. Bull. 133, pp. 14–17). Wappinger Is.—First called "Barnegate Is." by Mather, but now named for Wappinger Creek, Dutchess Co. Hard, blue, medium banded Is., carrying brachiopods with an occasional trilobite, all of apparent Trenton affinities. (The belt of Is. that runs through town of Fishkill was in this rep. named Fishkill Is. and excluded by Clarke from Wappinger Is.) 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 Is.—Occurs in two well-defined masses in Poughkeepsie quad. the composite Wappinger Creek belt and the Fishkill Is. Is older than Beekmantown ("Calcareous," Rochdale group), but whether Cambrian or Canadian could not be determined. (Gives reason for thinking much of the Is. is older than Trenton and perhaps Camb., or early Ord.)


C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148). Wappinger (Barnegate) Is.—In Poughkeepsie quad. is conglomeratic, arenaceous, siliceous, and dolomitic Is. The western belt is Barnegate Is. of Mather, but now commonly referred to as Wappinger Creek or New Hamburg belt. It includes Trenton, Beekmantown (Calcareous-Rochdale group), Potsdam, and Georgian. The eastern belt of Wappinger Is. is known as Fishkill Is., as it lies chiefly in town of Old Fishkill. It includes Trenton, Beekmantown, and Lower Cambrian (Georgian) fossils. Overlies Poughquag qtzite and underlies Hudson River sl group.

C. A. Harttangel, 1912 (N. Y. State Mus. Hdb. 19, p. 29). Barnegat Is.—Wappinger (Valley) Is. Is the name was from Barnegat, now called Stonoec, Dutchess Co. The Fishkill Is. is in part = Wappinger Is.


E. B. Knopf, 1927 (Am. Jour. ScL, 6th, 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. ("Pough-quag") qtzite.

Has also been called Newburgh ls.

See also under Stockbridge ls.

Barnes conglomerate. (Of Apache group.)

Pre-Cambrian: Central Arizona.


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 fms. 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 fms. which produces bold rounded escarpments. Type loc. of Barneston fms. 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 (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 fms. of Bend group. Overlain by massive beds of Marble Falls ls. The thin ls. 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 Nashaquitis series and before Truro series.


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, 1908 (S. C. Geol. Surv. gognostic map of S. C., advance copy; 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 Freil and by Vaughan). From Johnson’s Landing the line of southerly exposures of this fm. passes near Fairfax and thence probably curves in obscenity of surface sands, towards Scotchmans Bluff; but it has been conclusively discriminated nowhere near St. George’s anticline S. of Orangeburg. The materials consist of siltified 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 wemb. of McBean fm. and of Claiborne group (p. 285).

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 is. and Barnwell fm. as contemp., but stated that they are very different in lithology and present different faunal facies; also that they interbender 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. and is so named. 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, mica, staurolite, a little plagioclase, biotite, much muscovite, usually a little epidote, and a good deal of a second generation of quartz in larger elongated crystals. Feldspars characteristically pollilithic; 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 gneisses are so intimately
intermingled over large areas that it is necessary to map the resulting gneisses 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 wide-spread 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, sse., and cgl. or breccia, with beds of graphite and coal, in Sonora, Mexico. Assigned by him to Triassic, and said to overlie Carbf. Iss. 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.


Barre granite.

Devonian: Northeastern Vermont (Washington County).

C. H. Richardson, 1902 (3d Rept. Vt. State Geol., btw. pp. 81 and 88). Of the eruptives in Washington Is. [Waits River Is. of current literature] the Barre granite plays most important part. The area is about 8 ml. long and 4 ml. 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.


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.


Barree limestone.

Silurian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T., pp. 132-133). Barree Iss.—Thin beds of light-gray bluish gray Iss. 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 iss. group the Barree Upper shales and the shales below that Iss. the Barree Lower shales.

These Iss. 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., p. 133). Barree shales.—Green shales; 60 to 75 ft. thick, with thin, liny, fossiliferous layers. Underlie Barree Iss. and
rest on 10 ft. of ore ss. [Keeler ss. memb.]. Included in Clinton fm. [Form upper part of Clinton fm. as identified in U. S. G. S. Hollidaysburg-Huntington 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 Is. 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 Is. of this reft 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.


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 Is., 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 Is. 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 ss., 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.


Barrington clays.

Pleistocene (Wisconsin stage): Rhode Island (Barrington).

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. 18, pp. 150-182). The Sioux quartzite, New Ulm quartzite, Baraboo quartzite, and Barron County quartzites are of same age, and are pre-Keweenawan and post-Mesabi.


W. O. Hotchkiss et al., 1915 (Wis. Geol. Nat. Hist. Surv. Bull. 44, econ. ser. 19, p. 85 and map). Barron quartzite.—The three main phases are the purplish pink, well-cemented quartzite, the yellowish somewhat less well-cemented quartzite, and the striped or strain-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. quartzite fms., trap rocks, and probably both acid and basic intrusives. Thickness 600 ft. Assigned to Keweenawan. Rests uncon. on Huronian strata.

Barron County quartzite.

See under Barron quartzite.

Barryville member.

Upper Devonian: Southeastern New York and northeastern Pennsylvania (Wayne and Pike Counties).

B. Willard, 1938 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 586-587). Barryville member.—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.] and overlies 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 Brohead 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.


J. C. Merriam, 1916 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, No. 5, pp. 444-448). 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. 188, 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 Dillco 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). *Bartlett 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, qzites and ss.; no lss. Consists of contorted schist, aren. and argill., with frequent bed of qzite, 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. Kelth, 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.


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).


### Barton beds.

**Silurian:** Ontario (Hamilton).

M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. 1913, pp. 170–188). **“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 Is. memb. of the Lockport. [Derivation of name not stated.]

M. Y. Williams, 1919 (Canada Geol. Surv. Memo. 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 Erasmia 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, 1922 (Md. Geol. Surv. vol. 11, pi. 6), applied **Barton ss.** to ss. 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 Weilersburg Is. and fire clay and overlying Barton rider coal in Castlemian Basin.

### Barton limestone. (In Conemaugh formation.)

**Pennsylvanian:** Western Maryland ( Allegany and Garrett Counties).


C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 115), gave thickness of **Barton Is.** in Castlemian 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).

Named for association with Barton coal.

†Barton Creek limestone.
Lower Cretaceous (Comanche series): Central Texas (Travis County).

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 Is. 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 ls.* 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.
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 Hatchetgbee series and overlies Bell’s Landing series (Tuscaboma 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 Hatchetgbee 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.

Marine beds, consisting of (descending): (1) White quartzite, 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 calc. 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.


**Basque formation.**

Jurassic: British Columbia.


**Bass limestone.** (Of Unkar group.)

Precambrian: Northern Arizona (Grand Canyon).


**Bas Sand member (of Bearpaw shale).**

Upper Cretaceous: Alberta.


**Bassendorf shale.**

Oligocene (?): Southwestern Oregon (Coos Bay district).

There is some indication that an angular unconformity may exist between Bassendorf sh. and underlying Coaledo fm.

Microfossils and stratigraphic relations suggest Bassendorf and Keasey shales are late Eocene.

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.


Type loc. of Greenfield dol. is in SW. Ohio.

Bass Mountain diabase.

Mississippian: Northern California (Redding quadrangle).


†Basswood granite.

Pre-Cambrian (Laurentian): Northeastern Minnesota (Vermilion district).


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.


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. 07, pp. 97-98). Bastard ls.—Buffish-gray impure mag. ls. 10 to 25 ft. thick. Overlies Bassardville 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.


Batavia moraine.


Batchawana series.

Pre-Cambrian: Western Ontario.


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 Archimedes [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.)


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 silicaceous nodules, ½ to 1 inch diam., and small crystals of iron pyrites. The material is softly calc. and weather 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 sub-s. sub-memb. of Pony Spring siltstone memb. of Maroon fm.—Arkose, greenish-gray, micaceous sh., 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.


Bathurst formation.

Carboniferous: New Brunswick.


Battery formation.

Pleistocene: Northwestern California (Del Norte County).


Battle quartzite.

Cambrian (?): Central southern Maine (Knox County).


On 1933 geol. map of Maine, by A. Keith, these rocks are included in the Ord. and Camb. block.

Battle Creek moraine.


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.

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 playslike lake, as a series of fine, worked-over flanks, 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, 538-537). 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).


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 3,800 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.


Bayard formation.

Pennsylvanian: Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taft, 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.

Bay de Noc member (of Stonington beds).

Upper Ordovician (Richmond): Northern Michigan (Delta County).


Bayfield group.

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


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 eustonic 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. 168). *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 Plinos and BridgerTimber 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, 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 ogl. 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.

Bayne series. (In Puget group.)

Eocene: Western Washington (Puget Sound region).


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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 Is.**.—On average is of much darker color than Winnfield Is., 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 Is. of Harris and Veatch, 1899, is cap rock Is. of Pine Prairie salt dome.

†Bayou Pierre phase.

Miocene(?) and later(?): Southwestern Mississippi.

L. C. Johnson, 1893 (Scl., 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 Is.** as having "strongest possible resemblance to Grand Rapids Is. in character and in fossils, and both are intimately associated with and underlain by ss."

A. C. Lane, 1900 (Mich. Geol. Surv. vol. 7, pt. 2, btw. pp. 1 and 30). **Maxville or Bayport Is.**.—Sandy yellow Is., cross-bedded white ss., a little dol. Thickness 20 to 60+ 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 Parme ss. I believe Bayport Is. in its sandy phase is Parma ss. [Later repts by Lane and others treat Parma ss. as younger than Bayport Is., and of Pottsville age. **Maxville Is.** is an Ohio fm.]

Named for outcrops at Bayport, Huron Co., where it is quarried.

Bayport chert.

F. Dusia, 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 Is. most prominently exposed near Bayport, Huron Co.," which is type loc. of Bayport Is. 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 Is.

Bayview granodiorite.
Probably Cretaceous or Jurassic: Pend Oreille district, northern Idaho.
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.
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.—Sands and shales, underlying Eastern Head fm. and overlying McGraw bed. Included in Bell Island series. [Derivation of name not stated.]

Beach Mountain paraamphibolite.
Pre-Cambrian: New York (eastern Adirondacks).

Beacon Hill gravel.
Tertiary (Pliocene?): New Jersey.
H. B. Kümmer 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.

Beadie 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).
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 iss. 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 Is. 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 Is. bed, the basal memb. of overlying Clyde fm.

Named for Bead Mtn, Coleman Co.

Beady formation.
Cretaceous (?) : British Columbia.


Beale diorite.
Jurassic (?) : Vancouver Island.

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A).


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, quartzite, marble, crystalline ls., mica schist, amphibolite 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, 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[as.], 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 Reynolds Is. and below Sterling ore, and included Furnaceville sh. in Reynolds Is.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 324, 326), placed Bear Creek sh. below Sterling Station ore and above Reynolds Is., and included Furnaceville ore in the Reynolds. She described Bear Creek sh. in Rochester section as consisting of 18 ft. of purple and olive shales with thin plates of fossiliferous ls.
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.


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).


Bearpaw shale. (Of Montana group.)

Upper Cretaceous: Northern, eastern, and southern Montana and Elk Basin region of central northern Wyoming; also southern Alberta.


T. W. Stanton, 1919 (U. S. G. S. P. P. 120, p. 197), 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).


Bear River formation.

Upper Cretaceous: Southern Wyoming.

F. V. Hayden, 1889 (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. 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.


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 a 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 fms. proper.


T. W. Stanton, 1893 (U. S. G. S. Bull. 106, pp. 16-16, 45-46). Bear River fms. — Brackish-water deposits, 650 to 2,500 ft. thick. Has recently been shown to occupy much lower horizon than Laramie fms., or probably about that of the Dakota.

T. W. Stanton, 1903 (Am. Phil. Soc. Proc., vol. 42, p. 192). Bear River fms. — Conglomeratic ss., cgs., 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 fms. to range from 500 to 5,000± ft., and it is now believed to include considerably more than the equlv. of Dakota ss.

Bear River beds.


Bear River series.

Miocene: Northern California (Humboldt County).


†Bear River formation.

Jurassic or Triassic: Northwestern British Columbia.

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, 290-300). 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.


Beartooth quartzite.

Cretaceous (Upper?): Southwestern New Mexico (Silver City region).

S. Paige, 1916 (U. S. G. S. Silver City folio, No. 199). Beartooth quartzite.—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 126 ft. Lies uncon. on rocks ranging from pre-Camb. to Penn. (Fiero 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 160 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. 106 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.

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.

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.
Named for Beaumont, Jefferson Co.

Beaupre sands and gravels.
Quaternary: Canada.

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. Chely very white and moderately friable, but at places becomes stained and indurated. Underlies St. Lorenz (St. Laurent) ls. and overlies Grand Tower ls. Lithologically closely resembles St. Peter ss. Max. exposed thickness 50 ft.
Beaver division.

Upper Cumbrian or Lower Ordovician: Central Texas.


Named for Beaver Creek, Burnet Co.

†Beaver limestone.

Lower Cambrian: Eastern Tennessee.


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 Is. underlying Rome fm. in vicinity of Rome, Ga., which was “ provisionally correlated with the Beaver Is., which occupies a similar position in the stratigraphy of east Tennessee, and has been there determined as lower Cumbrian.” The name was also used in Ala. Later work, however, proved that the Is. of Beaver Ridge, N. of Knoxville, Tenn., for which the Is. beneath Rome fm. and above *Apison sh.* was named, is Rutledge Is. faulted over, and that so-called “Beaver Is.” 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 Is. 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 Is. of Knoxville folio as a Is. 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.)

Pennsylvaniaian: Eastern Kentucky (Magoffin County).


Beaver “sand.”

A subsurface Is. 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 ashed 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.


Later repts give thicknesses up to 118 ft.

Beaverburk limestone. (In Wichita group.)

Permian: Central northern Texas (Wichita, Baylor, and Archer Counties).


W. E. Hubbard and W. C. Thompson, 1926 (A. A. P. G. Bull., vol. 10, No. 5). Beaverburk Is. or, more properly, dol., is important key horizon and can be traced SW. to S. line of Baylor Co.


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 Is. of Udden, both of which he assigned to higher horizon than Bead Mtn Is. The Bead Mtn Is. 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 is. 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).


Beaverdell quartz monzonite.
Eocene (?) : British Columbia.


Beaver Falls moraine.
A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 42). "Not well defined. Extends S. from Beaver Falls 2 ml., and N. extension is indicated btw. 2 and 3 ml. N.-NW. of Beaver Falls."

Beaverfoot formation.
Upper Ordovician (Richmond) : British Columbia and Alberta.

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, p. 483), 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 sas.) 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 sas. A massive clg. 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 series includes Homewood ss. at top and Sharon Lower ss. at base.


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.


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.


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 Is.], at top.

A. F. Foerste, 1909 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, pp. 1-8). Dayton Is. includes at base fine-grained Is. 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 Beaverton marl is regarded as upper part of Brassfield Is. 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., 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 Is.

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
The occurrence of *Aspidopora parvula* 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.

**Becagaimic formation.**


**Bechler conglomerate.** (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 38, pp. 76-82). *Bechler cgl.*—Gray, reddish, and "salt and pepper" sand with interbedded cgs. Pebbles of cgs. are small, few having diam. of more than 1 inch. Thickness 1,775 ft. Underlies Draney Is. and overlies Peterson Is.; all in Gannett group. Named for Bechler Creek, which enters Stump Creek from N. about ½ mi. N. of mouth of Boulder Creek, T. 8 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 quartzite.

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 quartzite.]

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. Agr. 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., 6th, vol. 27, p. 355) 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. 58). *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 Is. 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.


Was for many years considered top fm. of Helderberg group, but in eastern N. Y. two younger fms. (Port Ewen Is. (restricted) and Alsen Is.) are now included in the Helderberg. (See W. Goldring, 1961, N.Y. State Mus. Hdb. 10, pp. 370, 376-379.)

Becsie formation.

Silurian: Quebec (Anticosti Island).


Becsie River formation.

Silurian: Quebec (Anticosti Island).


Bedford shale.

Devonian or Mississippian: Eastern Ohio, southwestern Pennsylvania, and northeastern Kentucky.


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. 296) 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.


Same as Spergen Is. The quarried rock is still known commercially as *Bedford* Is.

Bedford formation.

Named for Bedford, Lawrence Co., where it is extensively quarried.

Bedford formation.

Ordovician: Canada.


Bedford "augen" gneiss.

Age (?): Southeastern New York (Westchester County).

C. R. Fettke, 1914 (N.Y. Acad. Sci. Annals, vol. 25, p. 256). *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).

H. C. Henick, 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).


**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, 1922 (Wash. Acad. Sc. Jour., vol. 22, pp. 360, 402). *Beebe* Is.—This Is. (only 5 to 20 ft. thick) would in most other regions be called a Beebe fm. 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).

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 f.m., the feldspars make greatest part of rock, giving it a dull whithish 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. Stud. vol. 6, No. 40, pp. 7-20). Beech Creek Is.—Two or more massive to thin-bedded ledges with total thickness of 8 to 24 ft. Is gray, compact to suboölite, and often crystalline f.s., frequently completely oölitic. Is "middle" or "second" Is. 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.

Beecher Island shale member (of Pierre shale).
Upper Cretaceous: Northwestern Kansas (Cheyenne County) and northeastern Colorado (Yuma County).
M. K. Ellas, 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 Is. concretions (the largest 1 ft. thick) are common; irregular-shaped and comparatively small Is. 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.

Beechhill Cove formation.
Silurian: Nova Scotia.
Beech Mountain amphibolite.

Pre-Cambrian: Northern New York (Adirondacks).


Beech River shaly limestone member (of Brownsport formation).

Silurian (Niagaran): Western Tennessee.


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 “Erectal” 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, 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).


J. M. Clarke and C. Schuchert, 1890 (Sci., n. s., vol. 10, pp. 874–875). Beekmantown ls. (nec).—The Calciferous sand rock of Eaton and authors generally. J. 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.


100 ft. of blue Is. in thin beds separated by very thin, tough, slaty layers, which protrude on weathered edges in undulating lines, the Is. often appearing to be a cgl., the small enclosed pebbles being somewhat angular and aren.; No. 3, 120 ft. of sandy Is. 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 Is.; No. 2, 75 ft. of drab and brown mag. Is. containing toward middle several beds of tough ss.; No. 1, 80 ft. of blue Is. 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 Ophiolita 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 Ophiolita 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 Is. 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 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, and D, 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 Is. 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 in Beekmantown is 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 Is. (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 is., 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 Is. 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. 71-83) 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 Is., 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 Is., 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 Is., Nittany dol., and Stonehenge Is. In western Md. and Va. the rocks are not subdivided and are called Beekmantown Is.

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 Ordovician (exclusive of Chazy Is., which is included in Lower Ord. by most writers), while the term Canadian becomes obsolete." Underlies, uncon., Chazy Is.

Includes Theresa fm. at base. "Accepted base of Ordovician is top of Saratoga fm. of N. Y."

Bee Spring sandstone.

Pennsylvanian (Pottsville): Western central Kentucky.


P. N. Moore, 1884 (Ky. Geol. Surv. Western coal field, btw. pp. 8 and 38). The 4th ss. above St. Louis Is. 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 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. 943). Flows and tuffs. Lowest beds are rhyolites of no great thickness; they are overlain by several hundred ft. of hornblende andesites near quartz lattes 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-Potomac age. Assigned to Mio. (?).

Bell limestone. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1930 (Nebr. Geol. Surv., 2d ser., Bull. 8, p. 48). Bell Is. (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. 178). Type loc. of Bell Is. is Bell farm, on Missouri River bluffs, mouth of Kenoshia Creek, S. of Rock Bluff, Nebr.
Bejucal formation.
Eocene: Cuba.

Belcher series.
Pre-Cambrian: Belcher Islands, Canada.
E. S. Moore, 1918 (Jour. Geol., vol. 26, p. 418).

Belcher sandstone. (In Bluestone formation.)
Mississippian: Southeastern West Virginia.
Upper Belcher sh.—Red sh., with lenticular streak of carbonaceous fire clay near middle and with marine fossils; thickness 15 to 50 ft. Rests on Lower Belcher sh., which consists of greenish-gray massive or baggy micaceous sh., 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, pi. 34). Belchertown tonalite.—A granitoid quartz-plagioclase-hornblende rock.

†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. Reseide, Jr.

Belfast bed.
Upper Ordovician (?): Southwestern Ohio (Highland and Adams Counties).
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 Haiyinites 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 (Univ. Tex. Bull. 2182, pp. 161-166). Belknap ls. lentil of Harpersville fm.—Yellow to buff Is., nodular, 2 to 4 ft. thick, locally very fossiliferous. Lies 60 to 80 ft. above Crystal Falls Is. 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 Is., 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 Strophoedonta nacrea beds.]
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 Is. At E. end of quarry only a few ft. of sh. are exposed under the Is.
A. S. Warrbin, 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 Is. of VerWiebe (which they named Killians Is.) and by treating Rockport Is. 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.

Bell shale.

Upper Devonian: Southwestern New Mexico (Sierra County).


Appears to be upper part of Percha sh.

Bellabella formation.

Post-Pleistocene (?): British Columbia.


Bellalr 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.


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 Is.—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, 1922. The fm. consists of two Is. and an intervening sh., all fossiliferous. Average thickness 30 ft. The upper Is. is white or light gray, often characterized by well-developed stylonites; is more massive than lower Is. and from 1 ft. (near Byng) to 15 ft. (near Canadian River) thick. The lower Is. 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.


R. C. Moore, 1929 (A. A. P. G. Bull., vol. 13, p. 888). Belle City Is. lies at horizon of Dewey Is. 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 ss." separate Vamoosa fm. from Belle City Is.

Named for exposures around Belle City, Seminole Co.

Belledune group.


Bellefonte dolomite. (In Beekmantown group.)
Lower Ordovician: Central Pennsylvania (Center and Blair Counties).
**Bellefonte dol.**—At Bellefonte, Center Co., it is 2,145 ft. thick. Upper 400 ft.
consists of mostly argill., highly mag. Is., 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 Is. [Cserm Is.] and underlain by
Axeman [n] Is.

The Bellefonte dol. is top fm. of Beekmantown group in central Pa.

**Belle Fourche shale member** (of Graneros shale).
underlies Greenhorn Is. 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. Con­
tains 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. ScL, 3d. vol. 37, p. 323), 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 Is. 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. Tbreadickness 300 ft. in Callahan Co. and 200 to 250 ft. in
Coleman Co. Includes (descending) following beds described by Drake: **Bead Mtn
Is.** [includes more than Drake’s Bead Mtn Is.], Valera sh., Jagger Bend Is., 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 Is. and overlying Bluff bone bed
of Udden are now included in Belle Plains fm. by Tex. Geol. Survey.
See under Beaverburk Is.

**Bellepoint member** (of Columbus limestone).
Middle Devonian: Central Ohio.
Fossiliferous brown Is. 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.
pp. 298, 365). **Middle Bellepoint Is.—**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 ss., 3 distinct shales, and 1 ls. The ss. 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 ss., 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 (Kansa. Geol. Surv. Bull 15, pp. 12, 19). Belleville fm.—Thin 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 50 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 Ogallala fm. of western Kansa. Few fossils.
A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, p. 355). “Belleville fm.” (Wing) of northern Republic Co., Kansa., is extension of fluviatile Pleist. sand and gravel fms. of Nebr. It is continuous with Pleist. deposits in Nuckolis and Thayer Counties, Nebr. Equis 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. Nickies, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, p. 82). Bellevue or Monticulipora molesta beda.—Lower 15 ft. rather shelly ls.; upper 5 ft. consid-
erably different lithologically and somewhat faunally. Overlain by Corryville or *Chiloporella nicholsoni* beds and underlain by Fairmount or *Dekayia aspera* beds.

Basal mem. 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.


B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 56). *Bellingham cgl.*—A coarse basal cgl. composed of pebbles of granite, quartzite, 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 Chuckanut 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.


**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-beded, 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 “slenitic granite.”

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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. It 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.

**Bellows Pipe limestone.**

Ordovician; Northwestern Massachusetts.


†**Bellows Pipe 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 Is., qtzite, calc. sericite schist and muscovite-biotite schist, constituting **Bellows pipe fm.** [As thus defined includes Greylock schist (muscovite (sericite), chlorite, and quartz schist) and Bellows ls.]

†**Bellows pipe qtzite.**

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 overlaying 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 **Bellows pipe fm.,** above the Berkshire schist; also that it is 500 to 600 ft. thick.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 557), mapped the qtzite of Monument Mtn as Cheshire qtzite, of Lower Camb. age. The qtzite in the Bellows pipe ls. of Mount Greylock is a much younger bed, of Ord. age.

**Bells Landing marl member** (of Tuscahoma sand).

Eocene (lower): Southwestern Alabama.


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 prevailing gray color, with 1-foot marl bed about 10 ft. above base. Underlies Wood's Bluff or Bashi series and uncon. overlies Nanafulla 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 iss., 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).


C. A. Hartnagel, 1912 (N. Y. Geol. Surv. Hdb. 19, p. 89). The plant remains from Bellvale flags indicate Middle Dev. age, and it seems probable the higher beds are as late as Portage.


Bellyan series.


Derivation of name not stated.

Belly River formation.

Upper Cretaceous (of Montana age): Alberta and Saskatchewan, 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.


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 dolomite porphyry dikes and sheets.—Later than Marysville batholith. [Mapped on and around Mount Belmont, 1 ml. 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).

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.


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, Wls.

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. 106-112.

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 Klawa since this paper was written") and Cheyenne ss., or all beds btw. "Dakota" ss. [the quota-
tion 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, 1807 (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).


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. lst Ann. Rept., pl. 3, p. 1xx). 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. sep-
arated 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.

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 lss. [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. Mattes-
on (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 re-
ferred to Miss. In Univ. Tex. Bull. 2182, 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 is. 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 Is., 200 to 700 ft.; and Lower shales. Assigned to Penn., although considered older than usual type of Penn. fms.


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 uncorr. 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 Is., 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 Is., 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 Is. was in 1924 pronounced by G. H. Girty to be of Pottsville age.

B. H. Hollon, 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 Is., and what appears to be upper part of *Barnett sh.*, which he showed (p. 1020) as separated from Marble Falls Is. by a great hiatus, and as separated from what appears to be *Barnett sh.* restricted by another hiatus.
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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. 63), 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 silt, ss., and cgl.s., 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 silt and ss. 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 silt, 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 ls., 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., 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. F. 173, 1932.)

*Ben Lomond formation.*

Oligocene (?): Trinidad.


*Bennett quartzite.*

Pre-Cambrian: Quebec.

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 Elmwood 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.


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).


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** s.s.—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.

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).

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 Brazier age, remains to be determined, but probably some of it is of Brazier (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.

Bent shale. (In Bluestone formation.)
Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).
D. B. Reger, 1928 (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 Is., 0 to 1 foot thick. All belong in Bluestone group (Bluestone fm.). Upper Bent sh. is sometimes red and variegated, and sometimes black and flssile, 20 to 40 ft. thick, and contains marine fossils. Its type loc. is on Bent Mtn (Mercer Co., W. Va., 1.2 ml. SE. of Pride), where it is red and green and 55 ft. thick. The Lower Bent sh. is green, argill., and flssile, 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 ml. NW. of Bailey Station; thickness 6 to 15 ft. [See also under Bent Is.]

Benton limestone. (In Bluestone formation.)
Mississippiian: Southwestern Virginia (Tazewell County).

Benton shale. (In Colorado group.)
Upper Cretaceous: Southeastern Montana, South Dakota, eastern Wyoming, Nebraska, southern Minnesota, eastern Colorado, Kansas, north-eastern 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 ml. 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 ml. 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 Is., 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 Itallia 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, 1985, p. 281, and vol. 64, No. 1, 1985, 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-Connelsville folio, No. 94, p. 10). Benwood la.—Geographic name (to replace inappropriate name “Great ls.”) for the thick ls. which occupies interval btw. Sewickley coal and Unlontown 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.

Benwood la.—Geographic name (to replace Inappropriate name “Great Isi”) for the thick Is. 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 Is. to lower div. of “Great Isi,” and applied Fulton green sh. to the thin sh. (0 to 5 ft.) in places separating it from overlying Unlontown 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.


†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 lat. to ls. said to underlie Lake Valley ls. in N. Mex. Derivation of name not given.


In several subsequent repts Keyes assigned his Berenda ls. to Dev. and correlated it with Martin ls. of Ariz.

Berestford phase.

Pre-Cambrian: Manitoba.


Beresford Lake phase.

Pre-Cambrian: Manitoba.


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 ss. and dark slates, with some dark sh. and occasional cplss., but on N. it is bordered by belt
of cgl. several to 10 ml. wide, which apparently is basal memb. of series. Thickness 2,000 ft. Probably Cret. Conformably overlies Koyukuk series, also Totse series.

W. C. Mendenhall, 1902 (U. S. G. S. P. P. 10, pp. 81-48). Bergman series.—Folded sss., fine cgl., 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 cgl., and cgl. forms base of series. No fossils. Tentatively assigned to Mesozoic.

Named for trading post (Bergman) on Koyukuk River.

Bergman group.

Pliocene: Western California (San Francisco region).


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 Is. 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, 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, opaque 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 Is. 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 Eollin Is., qtzite, Taconic sl., and clay sl., gneiss, and mica schist.

Berland River shales.
Cretaceous: Alberta.

†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 Winnipesogee 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 Mts, in N. part of which is Berlin Twp and village of Berlin.

On 1832 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 (Scl., 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.].

Berlir 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. 148, of same vol., where he called the rock Berlin porphyry.]


C. E. 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."

†Berlir limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvannia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H., pp. 223, 286, 292). Berlin Is.—At Forwardtown, Somerset Co., it consists of an upper Is. 2 ft. thick, which rests on 1 ft. 6 in. of yellow clay underlain by 2 in. of coal, and a lower Is. 1 ft. 6 in. thick; and its top lies 90 ft. below Elk Lick Is. and its base lies 8 ft. 6 in. above Harshberger Is. [A section on p. 292 shows Berlin coal 65 to 70 ft. below Elk Lick Is. and 10 ft. above Berlin Is., which here is 8 ft. thick and occurs 5 ft. above Platt coal.]

Same as Ames Is. memb. of Conemaugh fm.

Berlin group. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania.


Berlir clay.


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).

Carbondale] in Fulton Co. Fills erosion channel in Pottsville fm. [Derivation of name not stated, but probably town of Berndotte, Fulton Co.]
H. R. Wanless, 1931 (Geol. Soc. Am. Bull. vol. 42, p. 804), showed top of Berndotte ss. lying 50± ft. below coal No. 2 and as cutting out beds down to and into coal No. 1.

Berndotte 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.

†Berndollian series.
A time term introduced by C. R. Keyes to cover part of the Perm. deposits of N. Mex.

Berndollio shale
Permian: Central northern New Mexico.
C. R. Keyes, 1903 (Ores and Metals, vol. 12, p. 48), The Perm-Carbt. of N. Mex. consists of series of red shales and sss. called Berndollio 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 Berndollio terrane as 1,000 ft.

†Berndollian series (Keyes).
Same as †Berndollian series.

Bernardston formation.
Devonian: Western and central Massachusetts, southeastern Vermont, and southwestern New Hampshire.
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 iss. containing Upper Dev. corals; at base cgl. of pebbles derived from Leyden argillite, which is locally changed to gneiss. Thickness 1,800 ft. Uncon. overlies Leyden argillite and uncon. underlies Juratrics [Newark group]. [See also B. K. B., 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 courseless 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 cgs. 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 Is. and Otsego memb. of Marcellus in region E. of Schobartie. 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 Uhadilla and Chenango Valleys and other areas.

†Berners formation.

Jurassic, Triassic, and probably Paleozoic: Southeastern Alaska (Berners Bay region).

A. Koopf, 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 porphyritic 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.


Beroun moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.


Bertha limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.


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 Is., 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 sandy, but occasionally a red and variegated or sandy deposit, 50 to 90 ft. thick; underlies Bertha Is. 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 Helderlyr 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 Is.” 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, K. 160-176). Bertie fm.—Name proposed by Chapman in 1864. The Lower Waterlime Eurypterus-bearing mag. Iss. and shales, 50 ft. thick. Underlies Cobleskill Is. (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 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.


See also under Anamosa dol.

Named for Bertram, Linn Co.

Berville moraine.

Berwick gneiss.

Pre-Cambrian(?); Southwestern Maine (Berwick and North Berwick Townships) and southeastern New Hampshire.


On 1933 geom. 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., 6th, 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 Nedick gabbro. Assigned to Dev. (?).

Berwyn conglomerate.

Pennsylvanian: Central southern Oklahoma (Arbuckle Mountains).

J. T. Richards and B. A. Birk, 1925 (A. A. P. G. Bull., vol. 9, No. 6, pp. 983, 987-988). Berwyn cgl.—A series of Is. cgs., arkosic sss., dark shales, and thin Is. Banded pebbles form part of the Is. cgs. at several horizons. The pebbles vary in size from a fraction of an inch to 3 inches in length. Their most common material is Is. derived from the older Is. 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. Sc., 5th, vol. 19, pp. 219, 221, etc.). Berwyn memb. of Skaneateles fm.—Dark, aren. sl. 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 “Marceullus or Lestorhynchus 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 “Lestorhynchus 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 Lestorhynchus 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. Grile, 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 SE1/4 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 †Erle 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. 220). Bethany Falls ls.—Upper 7 inches fine-grained, buff-colored, brittle, shelly, fusoidal 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.


Until 1832 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., 1832 (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 1832 (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., Sinbar ls., Mound City sh., Crittizer ls., Tennison Creek sh., and Schubert Creek ls.; and this definition was repeated by Moore and Condra in their Oct. 1832 chart, and by Moore in his classification of May 1, 1833. N. D. Newell in his May 15, 1835, classification (Kans. Geol.
Surv. Bull. 21) restricted Swope Is. to beds btw. top of Bethany Falls Is. memb. and base of Middle Creek Is. memb. Also in 1932 Moore and Condra greatly restricted both Kansas City group and Ladore sh., and treated Swope Is. as basal fm. of their Bronson group.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 86-88). Bethany Falls Is. (Broadhead 1868, Hinds and Greene, 1915, etc.) is traced from south-central Iowa (Earlham Is. 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 sh., 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 sh. that is believed to be of algal origin, and locally of 13±tt. of gray-white oolitic sh. Total thickness of Bethany Falls Is. 12 to 27 ft.; av. in E. Kans., 18±ft.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1938.
The name Bethany Falls has also been used in a broader sense, to include beds from top of Westervile Is. of Iowa repts to base of Hertha Is., but this usage was long ago discarded.

Bethel sandstone. (Of Chester group.)
Mississippian: Western Kentucky, southeastern Illinois, northeastern Mississippi, and northwestern Alabama.


S. Weller, 1923 (Ky. Geol. Surv., ser. 6, vol. 10). Bethel ss. of Butts is same as his Sample ss.


C. Butts, 1929 (Jour. Geol., vol. 37, p. 46). Bethel ss. underlies Renault fm. and overlies Ohara Is. memb. of Ste. Genevieve Is. 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.


See also under Ste. Genevieve Is.

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 meta-morphosed 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 deacon, the various members of Missiquoi 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 (16th 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.]


Bethel granite.

Devonian: Southeastern Vermont (Windsor County).

See under Knox Mtn granite. Presumably named for Bethel, which is in NW. part of Windsor Co., SEE. Vt.


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 Is., 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, 1894 (Jour. Geol., vol. 4, pp. 44-52). Bethlehem gneiss or proteogene.—Cloritic gneiss. Occurs only on E. slope of Conn. Valley. It does not follow that all of these proteogene areas are of same character. Each one must be studied by itself. They are batholiths. Assigned to Archean.


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.

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, 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.

Betles group.

Betles series.

Silurian: Northern Alaska (Betles River region).
F. C. Schrader, 1909 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 475). Betles series.—Heavy-bedded Is. or marble, usually banded and schistose, but sometimes massive; more or less mica schist is interbedded. Younger than Lake quartz schist. Is principal capping rock over 2,000 sq. mi. of upper waters of Chandlar and Koyukuk Rivers. Excellent exposures on lower part of Betles River, where the mtns which these rocks compose rise 2,000 ft. or more above river.

Now regarded same as Skajit Is.

Beulah shale.

Beulah clays.

Upper Jurassic: Northeastern Wyoming and western South Dakota (Black Hills).
W. P. Jenney, 1899 (U. S. G. S. 10th 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 s.s., 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 ml. N. of Beulah, in Red Water Valley [Crook Co., Wyo.].

Same as Morrison fm., which has priority.

Beulah limestone.

Devonian (?): Eastern Colorado (east side of Front Range).
of shaly, thin-bedded, light-gray to pink, fine-grained, nonfossiliferous Is., uncon.
overlain by Fountain fm. and uncon. underlain by Fremont Is. (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 Is. (Miss.) and uncon. underlain by Manitou Is. (Lower Ord.). In Mis­
souri Gulch section, Manitou Park, Douglas Co., It is 65 ft. thick, underlies 30 ft.
of Madison Is. and uncon. overlies Manitou Is. 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 Is.

Beverly syenite.
Early Carboniferous: Northeastern Massachusetts (Essex County).
(U. S. G. S. Bull. 597 and map); and C. H. Clapp, 1921 (U. S. G. S. Bull. 704,
Named for occurrence at Beverly.

Bevler fire clay.
A fire clay, 1 1/2 to 3 ft. thick, underlying Bevier coal, in Cherokee sh. of
northern Mo. (Macon Co.).

†Bexar.
Upper Cretaceous (Gulf series): Southern Texas.
only, for Navarro fm. in Guadalupe River section of Tex.]
Probably named for Bexar Co.

Bibb dolomite.
Upper Cambrian: Northern central Alabama.
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: Chepul­
tepec Is. (Upper Knox), Copper Ridge chert, †Lower Knox, Bibb dol., Brierfield dol.]
dark, coarsely crystalline, highly siliceous dol., which yields boulders deeply en­
crusted 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).
ties, pp. 301, 436). Bickett sh.—Usually red and argill., but occasionally sandy,
5 to 30 ft. thick. Underlies Reynolds Is. 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
(Anmonoosuc River region, Franconia quadrangle).
C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78). Bickford granite
(Carb.f).—Fine-grained, even-textured. Forms small bodies in Kinsman granodio­
rite.
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).


Named for Bicknell's ravine, Mount Jura, near Taylorsville.

† Bicknell tuff.


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. 251-258), 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 Conc, Cornfields 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 Conc 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 Conc.

Biddeford granite.

Post-Carboniferous (?) : Southwestern Maine.


On 1933 geol. map of Maine, by A. Keith, this rock is included in block labeled “mainly Carbf.”

Blehl 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 Is. memb. of Mauch Chunk fm.; also to basal part of Greenbrier Is. The name has also been applied to Renwood Is. memb. of Monongahela fm. and to Loyalhanna Is. In eastern Ky. it has been applied to 800 ft. or more of oolitic and granular oil-bearing iss. of Chester and St. Louis ages. In Ohio it has been applied to Maxville Is., also to rocks extending probably from top of Delaware Is. to Brassfield Is. (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.

Big Basin sandstone. (In Cimarron group.)
Permian: Central southern Kansas and northwestern Oklahoma (Harper County).
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.]
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.

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 Is. 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 Is. 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. 608). 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 cgs. 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 ineza zona, 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. Nauer, 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 Nauer, 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 Is. of Tenn.


H. A. Buchler, 1922 (Mo. Bur. Geol. and Mines geol. map of Mo.), used Buffalo as a group term to include Joachim Is., St. Peter ss., and Everton Is.


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 Is. of Tenn.

E. O. Ulrich, 1927 (Okl. 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 Everett by U. S. Geol. Survey.)


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 Is.—Generally nearly uniform, semi-conglomerate or granular crystalline, laminated, phosphatic Is., of gray or bluish color; upper part often shaly or arenaceous; lower part frequently having beds of shale 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.


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.)

Middle Cambrian: Western Kentucky.

C. J. Norwood, 1878 (Ky. Geol. Surv., n. a., 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. Equivalent to “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.

U. S. Nat. Mus. Proc., vol. 78, art. 21, p. 73; also, U. S. Geol. Surv. Prof. Pap. 603, p. 11. Big Cottonwood fm.—Shales, sats., and qtzls., 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 contemporaneous with marine Colorado fm. or Niobrara. Represents a river delta or filled valley of a stream which originally descended from E. to W.

Big Cottonwood formation.

Upper Cretaceous: Southwestern Minnesota.


Big Creek shale. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–318), 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 Declper calcareous sands.
Upper Cretaceous (Gulf series): Southern Arkansas (Clark County).

Named for exposures in bluffs of Big Declper Creek, 6 mi. S. of Arkadelphia, Clark Co.

†Big De Gray horizon.
Upper Cretaceous (Gulf series): Southwestern Arkansas (Clark County).

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 quartzite ss.; above which are 300 ft. of shales and thin quartzite ss. 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 Halymentites major, 5 ft.
2. concealed, probably sh. or sandy sh., 45 ft.
3. ss., quartzite, in thin beds alternating with sh., 41 ft.
4. ss., coarse, somewhat massive; bone fragments, 107 ft.]

Bigelow formation. (In Council Grove group.)
Permian: Southeastern Nebraska and northeastern Kansas.

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 con-
cretionary masses. Contains no paper shales and sands, such as occur in Indio fm., and no thick, cross-bedded, and commonly quartzitic 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. 610-620). 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 amendment 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.
Midlle Ordovician: Southwestern Arkansas and southeastern Oklahoma.
A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557; also Sates 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.] Strlngtown 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. ml., 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).
C. F. Bowen, 1918 (U. S. G. S. Bull. 688D, 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 considerable area, and which is well exposed at Bigheart, forming main ledge in bluffs W. of road btw. Bigheart and Quapaw. 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 Is.

Is now treated as basal memb. of Nelagoney fm.
Named for exposures W. of Barnsdall (formerly called Bigheart), Osage Co.

Big Hill beds.
Upper Ordovician (Richmond): Northern Michigan (Delta County).
argill. Is., 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 Hinkln'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 Is.—On E. side of Bighorn Mtns, Wyo., consists of 250-300 ft. of Is., in greater part hard and massive. Top memb. Is thin-bedded impure Is. 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 Is. containing numerous corals, including Halyaitea ctenulata. Lower memb. Is hard, massive, impure Is., 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] Is. (lower Miss.) and overlies Deadwood fm. (Upper Camb.).

See Leigh memb. of Bighorn dol.


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 (Scl., 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. 905), the Big Injun sand of SE. Ohio and northern W. Va. is Black Hand cgl.
Big Lake lime.

Big Lake Big lime.
A subsurface Perm. Is. 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 (Heiderberg) : 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 Is. memb. of Keyser Is. from lower Is. 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 Is., with which it intertongues to N. Is 61 ft. thick at Big Mtn, about 1 1/2 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.

Big Snowy group.
Mississippian: Central Montana.
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 Is. 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 Is. 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.

Big Spruce Knob sandstone.
Mississippian: Southern West Virginia.

Big Spruce Knob shale.
Mississippian: Southern West Virginia.

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.
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 Stone 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 Stone 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 % inch thick; at Apison, 16 mi. away, it is 2 ft. 10¼ 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 98 ft. 5 in. thick. Is overlain, with sharp contact, by the gray Glen-dale sh.


Big Thompson schist.
Pre-Cambrian: Central northern Colorado (Larimer County).

M. B. Fuller, 1924 (Jour. Geol., vol. 32, pp. 51-83). Big Thompson schist.—A series of metamorphosed a.s.s., shales, and iss, 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, bathylths, 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 Lovcland 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.)
Pennsylvania: 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).


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. 390, 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).

argill. Is., 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, are 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 str.,” 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.


Is now divided into Toklo fm. above and Woodbine sand below. See under Toklo 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 qzite.—Chiefly fine-grained qzites and sas., more or less silicified. Mostly white and fre-
quently vitreous. In lower portions of the qtzite, especially below the Jordan Is., a slight banding is seen in many places, also cross bedding. In upper part of fm., particularly above Highland Boy Is., are many layers of ripple-marked argill, and slightly calc. ss.s. In places very thin layers of fine-grained quartz egl. 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 Is. 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 800 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 ls.s. occur in lower part of Bingham qtzite, and the Highland Boy, Yampa, and other Iss. 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 Is. 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 Is. 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, 1888 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 140-145, 224). Birch Creek series.—Chedy 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 Forty-nine 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).

4± ft. Laterally it grades into limy ss. Is overlain and underl. by thick ss. Lies 70–115 ft. below Bighorn ss. in T. 24 N., R. 10 E. Named f. 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. 688S, p. 239, pl. 38). Above the 55 to 70 ft. of sh. which overlies Clem Creek ss. is thinner series of ss. which is substantially = Okesa and Torpedo ss. of twps to N. At base, or at some places 12 to 15 ft. above base, of this series of ss. 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 ls.

Is a bed at or near base of Torpedo ss. memb. of Ochelata fm.

Birch Lake sandstone.

Upper Cretaceous: Alberta and Saskatchewan.


Birch Lake series.

Pre-Cambrian: Ontario.


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 non-crystalline rock 4± ft. thick. On fresh surface is commonly lead-gray to black and weathered 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 Stonebraker 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).


Bird Mountain grit.

Upper Ordovician (?) : Southwestern Vermont (Rutland County).


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 micaeous Qtzite. Is petrographically different from Rensselaer grit. Probably belongs in upper part of Ord. and later than Calcareous. 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 ls. 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 1890 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).


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 Goodspings northward a coagogenous 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 Goodspings section, and the names he proposed to apply to the fms., to W. S. Gluck, who in 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 329-339) described the *Bird Springs* fm. in east-central part of Spring Mtn. Range. Goodspings quad.]

C. H. Longwell and C. O. Dunbar, 1936 (Geol. Soc. Am. Proc. 1935, pp. 89, 375). Fusulinans 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.


Now divided into several named fms. and discarded. (See Ill. chart.) Named for Birdsville, Livingston Co., Ky.
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Birmingham shale member (of Conemaugh formation).
Pennsylvanian: Western Pennsylvania and northern West Virginia.


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 200 ft 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 is.

Preoccupied by Birmingham sh. memb. of Conemaugh fm., and replaced by Attalla chert cgl. memb. of Chickamauga Is.

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. Dibble, 1902 (Am. Inst. Min. Engrs. Trans., vol. 31, pp. 698-715). 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. 58). Bisbee group.—Same unit as Dibble's Bisbee beds, but in Bisbee quad. is here divided into 4 fms. (descending), Clutura 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.
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, 160). Bishop Mtn cgl.—Composed of bowlders and pebbles of ss., qtzite, and crystalline schists, but ss.s. 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.]


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 iss., overlying Duchesne iss., and composing a middle fm. of Flaming Gorge series in Utah. [Assigned to late Jurassic, but Keyes also states that it may correspond to Uinta 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 ss. 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 Heiderbergian, but is so far unstudied. Lies uncon. on Pools Brook ls., and at Manlius is uncon. overlain by basal quartz sands of the Onondaga
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(rewoked 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 fm., as I saw it in field with A. E. Brainard, 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 Iss., 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. Aullin, H. G. Officer, and C. N. Gould, 1926 (A. A. F. 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, 1931 (Univ. Tex. Bull. 3035). 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.


At present Triassic (?) is age classification of U. S. Geol Survey.

†Bitter Creek group.

Eocene: Southwestern Wyoming (Sweetwater County), northeastern Utah, and northwestern Colorado.

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 grayish slabby sss. and shales, probably of Cret. age.

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.]

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.

Bitter Creek peridotite.
Cretaceous (?): Southern British Columbia.

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.

Biwabik iron-formation.
Pre-Cambrian (middle Huronian): Northeastern Minnesota (Mesabi district).
**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.


**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 Is., 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.
- **Tennessee**
- **Georgia**
- **Alabama** Chattanooga sh., Dev. or Carbf. (Formerly classified as Dev.)
- **Illinois**
- **Missouri**
- **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 Is. 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 Is., 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. (In Midway group.)
†Black Bluff series.

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 Nabeola 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. O. 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 Cachetopa 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.


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. (Pls.)]


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, 18, 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. Overlie 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 (unconformably 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 Dikelogalopus minnesotaensis 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) Lodl 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.

Replaced by Mendota dol. memb., the earlier name, and now considered a synonym.

Blackface Mountain shale.
Devonian: Alberta.
Blackfoot formation.
Pre-Cambrian (Belt series): Central western Montana (Mission Range).
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 1928 (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 ss., 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).


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. Harresse, 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 landslide 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, 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.


Blackhorse shales.

Upper Cretaceous: Central northern South Dakota and southwestern North Dakota.


Blackjack basalt.

Miocene: Southeastern Oregon.

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 22 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 Is.—Massive, thick-bedded Is. 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 Is. 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 betw. 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).

Black Mingo formation. (Broad sense.)
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
Black Mountain basalt flow.

Tertiary or Quaternary: Southern California (western El Paso Range, eastern Kern County).


Black Mountain volcanics.

Probably Upper Triassic or Jurassic: Southern California (San Diego County).


Black Mountain granite.

Age (?): Southeastern Vermont (Windham County).

C. H. Richardson, 1931 (18th Rept. VT State Geol., pp. 340-357, 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.


See Eddy Hill grit of Ruedemann, which replaces it.

Black Point basalt.

Pleistocene (late): Hawaii (Oahu Island).


†Black Prairie series.

Upper Cretaceous (Gulf series): Texas and Arkansas.


Black River group.


E. Emmons, 1842 (geol. map of N. Y.). Birdseye, Trenton, and Chazy Is. 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 Calcareous sandrock and underlies Trenton Is. Includes Chazy and Birdseye Is.

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), 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 Is. 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: Pamela 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).
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.]

B. 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 Jurassic 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 sh.

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, Wy.

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 Is.—Thick-bedded, massive, relatively pure, gray Is., with some sandy Is. members near top of ridge and minor amounts of calc. sh. in some parts of fm. The Is. is 800+ ft. thick and is overlain by 150+ ft of calc. sh., sandy sh., ss., and qzite, with the sh. near base and the qzite near top where the fm. merges with Brigham qzite. Some of ls. beds contain small rounded concretions and other irregular forms that may be traces of fossils. Underlies Brigham qzite 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 Is.—Lss., 0 to 200± ft. thick, uncon. underlying Everton Is. and uncon. overlying Smithville Is. 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 Is. and slightly dolomitic Is. yielding a small residue have been found above Powell fm., but overlying Black Rock Is. 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. Is. or dol. that weathers drab or whitish, with minor amounts of ss. and blue gray Is. Thickness in Sharp and Lawrence Counties, Ark., 260± 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.


**Blackburg 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 qzite, cgl. and schist [Kings Mtn qzite] 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.


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 ½ 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 Cambian: Northeastern Utah and southeastern Idaho.


Blacksnake sandstone member (of Hance formation).

Pennsylvanian: Southeastern Kentucky (Cumberland Gap district).


**Blacksnake (Cawood) ss.** on pl. 16; **Blacksnake (f) ss.** on p. 80. All of definition.

†Blackstone series.

Pre-Cambrian: Northeastern Rhode Island.


**Blackstone series.**—A series of lss., chloritic and hornblendic schists, slates, and qzites, 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 quartzites, Ashton schists, and Smithfield lias. Uncon- 
overlain by lowermost Camb. (Olenellus) horizon. Named for typical develop-
ment 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 quartzite.

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* is.—Quite pure gray is, 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 
In Washington and Greene Counties, Pa., the *Blacksville* la. 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.
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 prevalingly quartzite; 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 quartzite, 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).
tail Deer Creek beds*, the beds on Blacktail Deer Creek, which are probably White 
River Olig. 
Mont., doubtfully included in upper Olig. White River group. They are more 
probably lower Mio.

Blackwaterian 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. Over-
lies 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.
Named for exposures on N. side of Blackwater River, 1/2 mi. SW. of Davis and 1/2 mi. below Blackwater Falls, Tucker Co.

Blackwell sand.

†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 limy. 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. (Pecos) and rests uncon. on Cape Fear 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): Shinem gyp.; Atoka dol.; red sh. (Jenkins clay of Cragin); Medicine Lodge gyp.; Magazine 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. Misor, 1926 (geol. map of Okla.), modified the definition of Blaine gyp. so as to include beds above Shinem gyp. and below Ferguson gyp., and designated Acme dol. for 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. 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 or Okla. is included in part or entirely. Childress dol. and gyp. is top memh. of Blaine in Tex. and Quanah gyp. lies near base.
J. L. Mair, 1934 (A. A. P. G. Bull., vol. 18, No. 10, p. 1390), gave detailed section of Blaine fm. at type loc. in Salt Creek Canyon, Blaine Co., Okla., showing it as underlying Dog Creek shale, overlying Flowerpot shales, and including Lovedale gyp. at top, Shinem gyp. in middle, and Medicine Lodge gyp. 2 ft. above base.
Named for exposures in Blaine Co., Okla. Type loc. is in Salt Creek (Henquinet’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 ss., and interbedded sh. and shaly ss. with little or no bituminous matter; massive ss. 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 Mesa-verde. 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 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 ss., sh., and, a little above middle, a bed of cgl., and another bed of cgl. at base. It discon. overlies Kootenay fm. and underlies Crowenest volcanics. The upper part of fm. contains a Cenomania 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 Kootenay 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 ss. overlain by nearly 1,000 ft. of nonfossiliferous cgl. 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. Crittmay, 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. Purdu (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. 620, 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. Purdu as upper part of Crystal Mt. 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 crystalvitrine tuffs and cgs., 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.


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 Fayayette beds, which it closely resembles in some lithologic features.


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 s.s., cgs., 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 375 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.*
Blandford limestone.
Pre-Cambrian: Western Massachusetts.
E. Hitchcock, 1833 (Rept. Geol., Min., Bot., and Zool. of Mass., p. 305). Blandford la.—Coarsely granular, white, crystalline ls. exposed in NW. part of town of Blandford. [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 sq.) 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 quartzite and contain numerous quartz veins; other thin layers closely resemble chert. Overlies Polk Creek sh. Underlies, probably uncon., Missouri Mtn sq.

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 la.—Top bed (0 to 32 ft. thick) of Clifton Is. 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, 1933 (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.—Breciated 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 (?).


*Block* Is. memb. of *Cherryvale* sh. overlies Fontana sh. memb. of *Cherryvale* and underlies Wen sh. memb. of *Cherryvale*.


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

Block Is. shale.


Blood Reserve sandstone.

Cretaceous: Alberta.


Bloody Run zone.

Upper Devonian: North-central Iowa (Floyd County).


Bloomfield sandstone. (In Cayuga group.)

Silurian: Central Pennsylvania (Perry County).

E. W. Claypole, 1855 (2d Pa. Geol. Surv. Rept. F, 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.)


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. ("possibly 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.)

Pennsylvania: Southeastern Ohio (Muskingum County).


Bloomington limestone member.

Upper Cambrian: Eastern Tennessee.

C. R. L. Oder, 1934 (Jour. Geol., vol. 42, No. 5, pp. 478–479, 492, 496). *Bloomington* Is. memb.—Upper mem. of *Cumberland-Copper Ridge* fm. in eastern Tenn. Overlies Morristown dol. (lower memb. of *Cumberland-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.
Bloomington fm.—Bluish gray, more or less thin-bedded ls. 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.

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. G4, 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 Bloomington. 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 sh. and shales with some red sh. Overlies Clinton series.
C. Butts, 1918 (Am. Jour. ScL, 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., underlyiB Wills Creek fm. and overlying McKenzie fm., and on pp. 651 to 660 they extended the name into SE. N. Y. as far as Otsego, 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) inter-fingeriBg 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.

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.

Blossberg.

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. Phlla., vol. 8, p. 234) applied name Blossburg to these red-beds (“Cattaraugus” of the folio) [U.S.G.S. Elkland-Tioga, No. 23], 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 as. 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.

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. 1078-1009, 1924.)

Blount group.

Lower Ordovician (Chazy): Alabama, eastern Tennessee, western Virginia, and West Virginia.
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).
J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 7, 8). Blowout Mtn ss. of Wruether is same as San Angelo beds of Lcrch (named in 1891), and San Angelo will replace Blowout Mtn as name of this fm. It connects with San Angelo beds.

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).
Blue Ball fire clay.  (In Allegheny formation.)  
Pennsylvanian: Central Pennsylvania (Clearfield County).

Bluebell dolomite.

Ordovician (Upper to Lower): Central northern Utah (Tintic district).
G. F. Loughlin, 1910 (U. S. G. S. P. F. 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 Is. and overlies Ophoponga Is. 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.

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 (?) :
  1. dark-gray sl. 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. 15 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 sl. and sh., 150 ft.;  
    d) calc. sl. with Niagaran fossils, 6-10 ft.;  
    e) sh. 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).
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.


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. 60). Blue Canyon fm.—Black and fissile clay slates and dark-gray fine-grained quartzitic sst.; only one occurrence of oeg. 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 Carb. 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).


†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.


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.


Named for the Blue cut, a deep railway cut a few mi. S.-SW. of Belvidere, Kiowa Co.

Blue Earth sltstone.

Lower Ordovician: Southeastern Minnesota (Lesueur County).

a thin bed of white to greenish (sometimes red) laminated argillite—the Blue Earth sltstone—, which seems to spread beyond limits of underlying Kasota ss. and to then rest, apparently conformably, on Jordan ss. The sltstone 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 sltstone bed and Oneota dol. Relations of Blue Earth sltstone bed to overlying and underlying fms. are unknown. Because of historical significance of term “Blue Earth,” this sltstone is here called Blue Earth sltstone 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 sltstone 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.

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 argillite 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.
dark-gray hydraulie Is.; thickness 90 ft. Underlain by 30 ft. of siliceous Is. and overlain by 25 ft. of granular Is. correlated with Capitol Is. of Tenn. All included in Trenton group.

Named for part of State where the blue grass grows, as these Is. furnish the soil for that grass.

Blue Hill granite porphyry.
Devonian or Carboniferous: Eastern Massachusetts (eastern Norfolk County).

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 etc., 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 contempor. 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, 700 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 Paradoxies 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.
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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. Gregor 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. Othorn in unpublished ms., 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., 1925 (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 (Castlemann Basin).
C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 114). Bluelick Is., 2 ft thick, underlies fire clay beneath Lonconning 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.

Blue Mountain formation.
Ordovician: Ontario.

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 Is.—Dark-gray to nearly black heavy-bedded Is., 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 Is., and contains larger percentage of very dark, extremely carbonaceous rock and less coarse granular Is. than the Rogers Spring. Thickness 900 ft. Neither top nor bottom accurately located. Underlies Calville Is. 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. Condrns and J. E. Upp, 1931 (Neb. Geol. Surv. Bull. 6, 3d ser., p. 22). Blue Rapida sh. is new name for basal part of Speiser sh. as originally defined. It includes the beds btw. Crouse Is. below and Funston Is. 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 1/4 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.
Orдовician: Northeastern West Virginia and adjacent parts of Virginia and Maryland.

†Blue Ridge sandstone.
Silurian and Ordovician: Northeastern West Virginia and adjacent parts of Virginia and Maryland.

Blue Ridge conglomerates.
See under South Mountain ss.

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 Monoplura; (2) massive foraminiferal ls., 40 to 100 ft. thick; (3) alternating beds of ss. and siliceous shell breccia 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.

Bluff bone bed. (In Wichita group.)

Permian: Central northern Texas (Wichita County).

J. A. Udden and D. M. Phillips, 1912 (Univ. Tex. Bull. 248, 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 martyr 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 SW¼ part of Wichita Co. [Fossils listed.]


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. S. P. P. 183, p. 21). At Bluff the lower part of Morrison fm. is composed of thin red and gray ss. 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. 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).


F. E. 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. ss. 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. 8501, 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 is. lentU, 23± ft.; (3) sh., 15 to 20 ft.; (4) White Ranch Is. (new), 2 to 3½ ft.; and (5) Lower Bluff Creek sh., 35 to 45 ft. The latter rests on Home Creek Is.

Named for Bluff Creek, McCulloch Co.

Bluff Dale sand. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Central northern Texas.


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).


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.


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. (Uncinatus zone) red Is. and shales in lower two-thirds, overlain by gray massive Is.; very similar lithologically to Dixon fm. Middle 25 to 42 ft. white, yellow, blue, and grayish shales and Is. holding abundance of brachiopods and called Dicyonella zone. Uppermost 15 ft. massive nodular cherty Is. or hard sh., called Conchidium zone, because brachiopods of genus Conchidium are most characteristic fossil. Is middle fm. of Brownsport group. Overlies Beach 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 granulite. 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 50 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 1/2 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.
A part of either Packsaddle schist or Valley Spring gneiss of present nomenclature.
Named for Bodeville, Mason Co.

Bogachiel formation.

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 sl.; 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.

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.

Pennsylvanian (Allegheny): Central southern and eastern Oklahoma and western Arkansas.

Pennsylvanian (Allegheny): Central southern and eastern Oklahoma and western Arkansas.

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.

Bogie Island formation.

Pleistocene: Jamaica.

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 cgs. 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.

Pre-Cambrian (Keweenawan): Northern Michigan.

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.

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.
derlain by Huronian series.


†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.


Named for exposures in Bohicket Creek, near Rockville, Charleston Co.

Bohio limestone.

Eocene (upper): Panama.


Bohio conglomerate.

Oligocene (?): Panama Canal Zone.


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 Is.—Thin-bedded, crystalline and noncrystalline Is., 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. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470-474). Top fm. of Hunton group is here named Frisco Is., 0 to 20 ft. thick. It rests on Bois d'Arc Is. [restricted], 0 to 90 ft. thick, which contains abundant fauna that indicates Becraft age. Fauna of Frisco Is. is Oriskany. The Frisco is best exposed in bed and bank of Bois d'Arc Creek and in vicinity of Cool Creek, 7 mi. S. of Frisco.


Named for exposures along Bois d'Arc Creek, Pontotoc Co.

Boise granite.

Jurassic or Cretaceous: Southwestern Idaho (Boise Mountains).

L. C. Russell, 1902 (U. S. G. S. Bull. 190, 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 Mts. 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, 1923 (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.

Poissevain sandstone.

Tertiary: Winnipeg region, Canada.


Bokchito formation.

Lower Cretaceous (Comanche series): Southeastern and central southern Oklahoma.


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, 1902 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., p. 59). 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, 1901 (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 (Gassaway) Mag. Is. forms. 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 unit 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 Is.); (2) Bolin ss. memb. (persistent, consisting of 10 ft. of gray and reddish sand, 8 to 15 ft. of Is. and chert, and 10 ft. of gray and reddish sand); (3) cherty mag. Is. 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 asa.; (2) Bolin Creek ss. memb., 0 to 50 ft. cross bedded and ripple marked; (3) dol. and asa.

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 ls. 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 Is.]
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. ss. of Franciscan group, with radiolarian chert lenses of undet. horizons, but in other parts of region the rocks btw. Sausalito chert and Calera Is. are mapped as upper part of CahiI ss.]
†Bolinas Creek sandstone member (of Roubidoux formation).
See under Bolin ss. memb.
Bolivar sandstone. (In Allegheny formation.)
Pennsylvanian: Western Pennsylvania.
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 Is. 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 Is. 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 Is., is known as “Bolivar fire clay.”
G. H. Ashley, 1908 (Topog. and Geol. Surveys Pa.). Bolivar fire clay lies short distance below Upper Freeport Is.
Bolivar sandstone.
Lower Ordovician (Beekmantown): Southwestern Missouri.
E. M. Shepard, 1907 (?). 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 Is. [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. Ramsone, 1904 (U. S. G. S. P. 21, pp. 28–30). Bolsa quartzite.—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) clst. at base, ½ to 1 ft. thick. Thickness 430 ft. Rests uncon. on pre-Camb. schists and is conformably overlain by Abrigo Is. In 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 Dragon 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 prevalently 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 Quabbin 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 Carbonic micaceous qtzite made gneisoid by abundant injection of granite btw. its laminae. Named for town of Bolton, which it extends through. Includes Millbury Is. and other Is.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 86–87, 219). "Bolton" gneiss.—A complex of mica gneiss, chiefly biotite, 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 pre-occupied 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.

Bolza quartzite.
Cambrian: Mexico (Sonora).
N. L. Tailaferro, 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).
_Bomoseen grit._—Olive green grit, nearly a pale brick red, in places associated with a bed of quartz 12 to 55 ft. thick. Underlies Metawee sl. in Washington Co., N. Y.; in Rensselaer Co. it underlies Diamond Rock quartzite 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. 52, p. 2). 
_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 Vanderhe 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.
_Bonair or Lower Coal Measures._—Alternating shales and ss., 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 Mountaintop is.
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.

Bonanza latite.
Tertiary: Southern Colorado (Bonanza district, Saguache County).
_Bonanza latite._—Usually gray, grayish black when fresh, sometimes brown, fine-grained, with phenocrysts of feldspar and often blotite. Is country rock of most of Bonanza dist.
W. S. Burbank, 1932 (U. S. G. S. P. P. 163). 
_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.

Bonanza King formation.
Middle Cambrian: Southeastern California (San Bernardino County).

Bonaparte marble.
Mississippian: Southeastern Iowa.
C. H. Gordon, 1895 (Iowa Geol. Surv. vol. 4, p. 211). A few ft. of Is. appears at Des Moines River level on S. side, about half way btw. Bentonport and Bonaparte (Van Buren Co.), which may represent uppermost part of Upper Burlington Is. 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.


C. H. Kindley, 1896 (Eastern Geol., No. 1, April 1896, p. 5). **Bonaventure fm.** consists mainly of red sss. and Is. cgl. West of Mal Bate (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. (f) is used; on maps, Penn., without a query.]

Bonavista formation.

Lower Cambrian: Newfoundland.


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.).


†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. 60-1-). 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. 902, 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. This 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., 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 Is., 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 contemporaneous 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).

**LEXICON OF GEOLOGIC NAMES OF UNITED STATES**

**A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). Bonita s.s.—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 Ingleseide 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, 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, 67-68). 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.

**Bonnetterre dolomite.**

Upper Cambrian: Southeastern Missouri.


E. O. Ulrich and H. F. Bain, 1905 (U. S. G. S. Bull. 267, pp. 21-26). Bonnetterre ls.—As a rule consists of more or less heavily bedded, granular, and highly mag. iss., 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 Bonnetterre has suffered least from widespread erosion that took place prior to deposition of Elvins fm., it grades upward from the massive ls. 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, 1906 (Mo. Bur. Geol. and Mines vol. 9, pt. 1). Bonnetterre 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 Bonnetterre 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.


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.


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. 833), 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.
K. H. Sellards (September 1931, News Letter from Bur. Econ. Geol. Univ. Tex.). In Wise Co. the Palo Pinto Is. has been found to be divided into 2 thin Is., separated by sh. The Is. are named Boone Creek and Willow Point.


E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103). Boone Creek Is. in Palo Pinto fm., is named for Boone Creek, Jack Co.

Booneville stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.


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. Jg. Geol., vol. 61, No. 4, p. 310). Bopesta fm.—Wholly different from underlying Kinlick 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 Kinlick fm. [Derivation of name not stated.]

Boquilla slate.

Pre-Cretaceous: Mexico.


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 Is.

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.

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) Is. and overlies Rockford (Kinderhook) Is. 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 throughout entire outcrop area. Writer's studies reveal that Borden group consists of five geol. fms., each recognizable throughout 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, Floyd 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. between areas not widely separated. Perhaps outstanding case is Carwood fm., which displays 7 distinct facies over the 125 ml. 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. 08, 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 Floyd’s Knob Is. The group is here divided into (descending) Edwardsville fm., Floyd’s Knob Is., Carwood fm., Locust Point fm. (replaces St. Joseph, preoccupied), and New Providence fm. (redefined to include Kenwood ss.). The Edwardsville and Floyd’s 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 Is. and overlies Rockford Is. (where present) or New Albany sh. [See further under the several fms. On pp. 310–311 he suggests reddefining top of Borden group, as explained under Harrodsburg Is.]

†Border conglomerate. (In Newark group.)

Upper Triassic: Eastern Virginia.


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 cgls. extend 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 cgls. 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. Stoe (U. S. G. S. folio 225, 1929) finds Bordercgls. the youngest Triassic fm. in Fairfield-Getsbysburg area. Kummel (U. S. G. S. folio 191, 1914) finds that in Barltian area not only the Brunswick, but the Stockton and Lockatong as well, pass along the strike into Border cgls. Thus, though the cgls. 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).

Bosche formation,
Cambrian: Alberta (Jasper Park).

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 northward 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.

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 Fred­
ericksburg. These three beds are (descending) Paluxy sand, Glen Rose (Alternat­
ing) 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.).
Slurian: Northeastern Pennsylvania (Monroe, Carbon, and Schuylkill
Counties) and northern New Jersey.

serville ls.—The main quarry lime through Monroe Co., Pa. Almost nonfossi­liferous.
Upper 65 ± ft. mostly bluish black layers with this 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 Pocono Island
sh.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G.), 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.

†Boston group.
Pennsylvanian and Mississippian: Northwestern Arkansas and northeast­
ern Oklahoma.

group.—[Name proposed, in table only, for ecuv. of Genevieve group of H. S.
Williams.] Approx. equiv. of H. S. Williams' "Chester," "St. Louis," and "War­
saw." Includes (descending) Kessler ls., Coal-bearing sh., Pentremital ls., Wash­


†Boston conglomerate.
Pre-Cambrian (Keweenaw): Northern Michigan.
See †Albany and Boston cpl. and Allouez cpl.

Boston Bar group.
Carboniferous or Triassic: British Columbia.

Boston Basin series.

See Boston Bay group.

Boston Bay group.

Carboniferous or Devonian: Eastern Massachusetts (Boston Basin).


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 Qtmt. 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. ScL, 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, plakish 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 lsa. cgl. with associated lsa. and ssn. known as Bostwick memb. It disappears northward from Ardmore. Above Bostwick memb. occur 3 or more very fossiliferous lsa., 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 lsa. 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.

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.


†Bosworthian series.

C. [R.] Keres, 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 Camb. 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.


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).


Boule limestone.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 294–296, 300). Boule dolomitico 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 (Gaspe Peninsula).


Boundary argillites.

Paleozoic (?): Northeastern Washington (Stevens County).

C. B. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 80, map). Boundary argillite.—Chiefly argillites, with lls. 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.


Boundary Peak granite.

Age (?): Central eastern California (Inyo Range).

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. F. Vickery and Mr. S. W. Harris. This is from lower Bouquet Cañon, 30 mi. N. of Los Angeles and 5 mi. N.E. 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 kaolinite), etc., in a carbonate cement, almost without fine clastic grains.

Bourbon series.


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 bellerophonitids 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.

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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 Is. separating Bourbon fm. from overlying Ladore sh. is here called Sniabar Is. memb. of Hertha Is.]

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 Is. 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 Is. 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+ ft. in most places; in Kansas City region appears to be 150-1 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.


Bowden formation.

Miocene: Jamaica.


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).


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).

Bowler Green limestone member (of Edgewood limestone).
Silurian (early): Northeastern Missouri and southwestern Illinois.
Later repts by T. E. Savage and other geologists classify this Is. as top memb. of Edgewood Is., of pre-Niagara Sil. age, and state that it is uncon. on Nolx oolite and uncon. below Sexton Creek Is. Named for exposures near Bowling Green, Pike Co., Mo.

Bowling Green stone.
Trade term for a building stone (white Is.) quarried from Gasper oolite (of Chester group) near Bowling Green, Warren Co., Ky.

Bowman limestone.
Middle Cambrian: Central northern Utah (Oquirrh Mountains region).

Bow River group.
Lower Cambrian and pre-Cambrian: Alberta and British Columbia.

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 Is. to Is. 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 Is. to the Is. 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.
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 Is. in Weston sh. (Penn.) of Butler Co., Kans.
Boyer till.

Boyle limestone.
Middle Devonian: Central Kentucky.


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-Vanderbilt 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 ch. —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.

Boyno beds.
Cretaceous: Manitoba.

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 tMississippi 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). Boyzeman lake beds.—The cgs., ss., 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 Archs. schists and all sed. strata up to and including Livingston fm. (of Cret. and Eocene age.).

The whole series of Tertiary 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 Miocene, but in some parts of region strata of Oligocene (White Bluff) age have been identified.

**Brad formation (restricted).** (In Canyon group.)

**Pennsylvania:** Central and central northern Texas.


F. H. Seifards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 112), defined *Brad fm.* of Colorado River Valley as consisting of Ranger Is. memb. (above) and Placid sh. memb. (below), and transferred to underlying Graf ford fm. the Clear Creek Is. and older members originally included in Brad fm. He stated that in Wise Co. the Adams Branch Is. is absent and that the shales and ss. from Devil Den Is. up to Ranger Is. have been named *Vernier* beds.


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 Is. capping the escarpment W. of Graford (here called Merriman Is. memb. of Graford fm., but previously misidentified as the older Adams Branch Is.) up to top of Ranger Is. Type loc. is the outcrop N. of Brad, Palo Pinto Co. The Brad of Palo Pinto Co. is divided into 2 members, Ranger Is. (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 Is.-bearing part being included in Graford fm.

**†Braddyville Limestone.** (In Shawnee formation.)

**Pennsylvania:** Southwestern Iowa and northwestern Missouri.


Named for exposures at Braddyville, Page Co., Iowa.

**†Bradford schist.**

**Ordovician:** Northeastern Vermont (Orange County).


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 quartzite and a foliated mica schist. Overlies black sl. of Ord. age. The Washington Is. is intimately interstratal 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 quartzite, staurolitic, actinolitic, amphibolitic, othellite, 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 Montpeller to Barnard. (U. S. Geol. Survey has adopted Vershire schist as substitute for Bradford schist (preoccupied). Washington Is. (preoccupied) is replaced by Waits River Is.)

C. H. Richardson, 1924 (14th Rept. Vt. State Geol.). Bradford schists, in Bradford Twp, overlie Waits River Is. and are therefore younger than the phyllites here named Randolph phyllite.

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-Olenn 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.


G. H. Girty, 1912 (U. S. Geol. Surv. Bull. 71, pp. 421). In NW. Pa. I have discriminated a group of rocks btw. Berea ("Corry") sh. and top of typical Chemung under name "Bradfordian." In Ohio I am tentatively assigning to this group Bedford sh., Cleveland sh., and Chagrin 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 sh, 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 sh. 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. Chadwick, Oct. 1933 (Pan-Am. Geol., vol. 90, p. 177). 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 Cenewangan 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 Cenewango series is appropriate. The original "Cenewango 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 Cenewango to top of the Knapp. [On p. 338 he stated:] Cenewango 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 Cenewango, 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, Cenewango, 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.

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, Algokian. 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.

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, 304). 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, 308). 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.

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 quartzites; no ls. Similar to Mariposa slates. Tentatively assigned to Jurassic.

According to J. S. Diller (U. S. G. S. Redding folio, No. 158, 1906) the Bragdon fm. is 2,900 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, Weaver-ville quad.

Brainard shale. (In Maquoketa group.)
Upper Ordovician: Northeastern Iowa, northwestern Illinois and western Wisconsin.
Brainard shale.—Blue and bluish gray shales, with some intimately associated is beds at top and bottom. Thickness 120± ft. Forms top fm. of Maquoketa stage [group]. Overlies Fort Atkinson is. of Maquoketa stage and is succeeded by Hopkinton is. 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 Brainard tunnel, on Lefthand Creek about a mt. E. of Ward, and another dike occurs farther N. in Tuscarora Gulch.

Braintree slate.

Middle Cambrian: Eastern Massachusetts (Boston Basin region).

N. S. Shaler, 1871 (Boston Soc. Nat. Hist. Proc., vol. 13, pp. 173-175). Braintree slates.—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.]


L. LaForge, 1909 (Scl., 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. ScL, 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 lamina; 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. ScL, 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 (?): Southeaster Pennsylvania.


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 ploio better.


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.


F. A. Burt, 1931 (17th Rept. Vt. State Geol., pp. 7-27). Tertiary clays extend from Colchester to Bennington; include Brandon lignite.

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.
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, 500). 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. Elkon-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 Pliel. or late Tert. age. The late Brandywine consists of about 1 ft. of sand and gravel lying at altitudes of 290 to 500 ft., and is thought to be a terrestrial deposit of Pliel. streams.

F. Bascom, 1924 (U. S. G. S. P. P. 132H, pp. 117-119). The early Brandywine gravels are found in Elkon-Wilmington dist. at altitude of 280 ft., capping Egg Hill and other outstanding hills on W. border of Elkon 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 Pliel. age. The high-level gravels (380 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. 508-513), 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.

Branford granite.
A facies of Branford granite gneiss. See under Light House granite.

Brannon cherty member (of Flanagan limestone).
Middle Ordovician: North-central Kentucky.

Adopted by U. S. Geol. Survey as Brannon, cherty memb. of Flanagan Is. 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 Is. 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 Is.—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 Is. 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 Is. have been mapped across SE. corner of Palo Pinto Co. [This name appears to replace the preoccupied name Brannon Is., 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.
more numerous thinner bedded layers; toward top thin layers of clay are often interbedded. Called Clinton Is. in earlier repts. Overlies Ord. and underlies Indian Fields fm., basal fm. of Sil. in Ky.


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 ottelite schist, at base of which is a variable thickness of banded al. with little or no ottelite. 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 ottelite-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 ottelite. Eastward toward Nantahala River the ottelite diminishes, and disappears in neighborhood of Nantahala. All schists and slates of the fm. contain ottilite. Eastward toward Nantahala River and black. 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 al. into seams of light-gray silt. Thickness estimated at 1,200 to 1,500 ft. Underlies Valleytown fm. and overlies Tusquulate quartzite.

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 phylites that flank Cavendish schist and Reading greis on E. of Reading, Cavendish, Baltimore, and Chester. Its home is in Springfield, Rockingham, Putney, Brattleboro, Guilford, and Vernon, and southward into Mass. It is youngest fm. in SE. Vt. Assigned to Ord. Named because Brattleboro Twp is practically all covered with a fine-grained graphic phyllite schist. Brattleboro phyllite and the older Randolph phyllite are interstratified with Waite River Is.


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, flabby, 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).

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. 10, 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.


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.
Brazer limestone.
Named for exposures in Brazer Canyon, Rich Co., NE. Utah.

Brazil formation.
Pennsylvanian: Southwestern Indiana.
M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84). Brazil fm.—Alternating shales and thin ss., 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, 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 Kana., since it contains similar fauna.
Preoccupied. Included in Brazil fm.
Named for Brazil, Clay Co.

Brazil Branch breccia.
Cretaceous: Central northern Arkansas (Perry County).
†Brazos series.
Late Permian and Triassic: Texas, Oklahoma, southern Kansas, and eastern New Mexico.
cgl., and great beds of gyp. [Also called “Red Beds” and “Permian-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.


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 Mlnus ss. 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.


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., 1930 (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).


Breathitt formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

M. R. Campbell, 1898 (U. S. G. S. London folio, No. 47). Breathitt fm.—Sandy sb. 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 Whitley 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 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).


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 ss., 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.

Brentwood limestone member (of Bloyd shale).
Pennsylvanian: Northwestern Arkansas.
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 Is., 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 Is. is 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. Misler.)]

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.
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 Bretonian 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

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. Lias 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.

Breuer phyllite member (of Talladega slate).
Pre-Cambrian or Paleozoic: Northern central and eastern Alabama.
C. Butts (U.S.G.S. Montevallo-Columbiana folio, No. 226, in press), treated Breuer 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. 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. Höffmeister, 1952 (16th Int. Geol. Cong. Guidebook 4, chart opp. p. 6, pp. 106, 107, 108). In the Clinton of Rochester region, above Maplewod sh. occurs about 3 ft. of interbedded ls. and sh., typically exposed in Genesee Gorge near Brewer Dock, and locally known as Brewer Dock ls. and shales. Characteristic fossil (chiefly in ls. layers) is a minute gastropod of genus Cyclora. The brachiopod Hyattidina congeata 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. 327-388). 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).
Interbedded dark-colored ss. 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).
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 Briarfield dol.

Bricceville shale. (In Pottsville group.)
Pennsylvanian: Eastern Tennessee.
A. Keith, 1896 (U. S. G. S. Loudon folio, No. 25, p. 4). *Bricceville 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 Bricceville was in 1925 named Jellico fm. by L. C. Glenn, and Wartburg ss. was restricted to a ss. near middle of Bricceville 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. below 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.**

Pennsylvania: 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).


**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. Extents on Hartland sh. memb. of Greenhorn ls. and is overlain by Fairport chalky sh. memb. of Car limestone.

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, 1877 (Carnegie Inst Wash. Pub. 348). 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 Clarinos 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).

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).


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. 3222, 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, 1899 (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 ss., mostly indurated, sometimes forming compact beds, but usually weathering into those castellated and dollmellike 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.


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 Vermillion 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.


Bridge River series.

Pennsylvanian or Permian (?) : British Columbia.


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.


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.


uncon. 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 Cohansay 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. Sc., 5th, vol. 19, pp. 133, 219, etc.). Bridgewater memb. of Marcellus fm.—The sh. overlying Chittenango memb. of Marcellus fm. and underlying Solville memb. of Marcellus in Chenango and Unadilla Valleys. Lower part is soft, fissile, slightly aren. sh. especially characterized by Leiorhynchus limitare, Conularia, and Stylotina b-auricula. The succeeding zone is coarser non-laminated sh. containing Leiorhynchus laure asociated 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 1½ 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 Solville memb., are exposed in Seabridge Farm 2½ mi. W. of Bridgewater. Markham and Fork Mtns at Unadilla Forks are almost completely composed of Bridgewater sh., the Solville 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).


Markham and Fork Mtns at Unadilla Forks are almost completely composed of Bridgewater sh., the Solville being also top of these elevations. Thickness 200 to 360 ± ft.

†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 shore of Coosawhatchie River near Gifford Station. Underlies 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.

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 allica and weathered 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 lls. [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 unit. Type loc. is W. front of Wasatch Range NE. of Brigham, Box Elder Co., Utah.

**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 is. 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 is., locally known as “Snuffy Is.” 57 ft., including 25 ft. of soft sh.; (3) soft, green, micaceous sandy sh. and thin ss. 160 ft. Middle fm. of Tonto group. Conformably underlies Muav Is. 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 [687] ft. of shaly beds containing near base a few beds of mottled ls. similar to the mottled ls. 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 ss.; (2) Bright Diamond Is.; (3) Bright Diamond qtzite; (4) reddish and greenish shales and ss. 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 Is.

**Brighton melaphyr.** (In Boston Bay group.)
Carboniferous or Devonian: Eastern Massachusetts.
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.
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.
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 Carbt.

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 st.*—Pre­valingly 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 nonperslstent 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., Clerbo fm., and *Briones st.* The latter fm. is locally known as *Astrothrix brevianus* 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. 76, 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 schist. The typical granite gneiss is light gray, with gneismoid 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.
Bristol limestone. (In Washington formation.)

Permian: Northern West Virginia.


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 ss.s 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: Northern Alaska.


Bristol Pass limestone.

Mississippian (lower): Eastern Nevada (Pioche district).


Bristow shale and sandstone. (In Chester group.)

Mississippian: Southwestern Indiana and western central Kentucky.


C. A. Malott, 1925 (Ind. Acad. Sci. Proc., vol. 34, pp. 110-132). *Bristow ss.*—Thin to massive ss.s. fine-grained and hard, often quartzitic, 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.s. Named for exposures at and near village of Bristow, Perry Co., Ind. Also identified at Buffalo Wallow, 3½ 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. Path, 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 ss. 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.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 331) and 1924 (Revisa económica, San Salvador, año 11, No. 4, p. 175), assigned Brito beds of Costa Rica to Eo.

**Brittania formation.**

Carboniferous (?): British Columbia.


**Britton clay.**

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

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 230, 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.


**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, 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 1/2 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.

Broadway moraine.

Brock shale.
Upper Triassic: Northern California (Redding quadrangle).
J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). Brock sh. conformably overlies Hoselkus Is. in Brock Mtn, whence the name, and has a thickness of about 400 ft. In lower 300 ft. or more adjoining the Is. the shales are dark, somewhat calc., and frequently contain Halobia. Above these come sandy shales, gray and reddish in color, and characterized locally by Pseudomavette subcircularis. Is overlain, probably uncon., by Modin fm. [Brock sh. is approx. = Swearinger sh.]

Brock series.
Pre-Cambrian: Quebec.
H. C. Cooke, 1919 (Jour. Geol., vol. 27, p. 283).

Brockenback Hill formation.
Lower Cretaceous: Southwestern British Columbia (Harrison Lake region).

Brockville granite.
Pre-Cambrian: Ontario.

Broken Arrow formation.
Pennsylvania: Northeastern Oklahoma (Tulsa County) and central Oklahoma (Creek County).

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 Is., 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 dis-
tributary. 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.


C. E. Decker, Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498-1505). Bromide fm.—Chiefly lss., some sh., some sa., 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, 88). The Simpson is here raised to a group, divided into 5 fms. (ascending) : Joins, Oil Creek, McClish, 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.


Bromley shale. (In Cynthiana formation.)

Middle Ordovician (Trenton) : Southwestern Ohio and northern Kentucky.

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 1/2 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 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.


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 Is. (above) to base of sh. and channel ss. underlying Hertha Is. 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 Is. in lower part of Missouri series which until recently has been designated Hertha (here renamed Salabah Is., as explained under Hertha Is.), Bethany Falls, and Winterset. This group of Is. 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 Is. of Moore rested on what he called Ladore sh. and treated as top Is. 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, 1932 (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 Is. to base of Salabah Is.


R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 41, 43, 70). Bronson group as here used is as defined by Adams. It conformably overlies Bourbon fm. and underlies Fontana sh., basal Is. of Kansas City group as here restricted. Is. chiefly Is. includes beds from base of Hertha Is. up to top of Dennis Is., 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. Willmarth, 1896.)
†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. 380, 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, 508). *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, 1916 (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, Hartford 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 sa. 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.


Brooklyn moraine.


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, Breckinridge 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.


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.


Brougher dacite.

Tertiary (upper Miocene?): Central Nevada (Tonopah district).


J. A. Burgess, 1899 (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 Oddle rhyolite.

Broughton series.

Pre-Cambrian: Quebec.


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.)
Pennsylvania: Central Texas (Colorado River region).
Named for Brown Creek, Mills Co.

Brownian series.

A term introduced by C. [R.] Keys to include Browns Park fm. (late Mio. or early Plio.) and Uinta fm. (Eo.) of Utah.

Brown Mead formation.
Lower Ordovician: Newfoundland.

Browns Mountain group.
Ordovician: Nova Scotia.

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.—Ss., gravel, las., concretionary and stratified flints, 0 to 1,800 ft. thick. In some places clgs. having a great development are found at base. Uncon. underlies Bishop Mtn. clg. [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.
W. H. Bradley, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 11, p. 318) and 1936 (U.S.G.S.P. 185, 1) demonstrated that Bishop clg. is older than Browns Park fm., and J. D. Sears accepts Bradley's evidence.
The few fossUs 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. 666-683, 681-708). **Brownsport bed (of Niagara age).**—Richly fossiliferous white iss. 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 Niagara and include it in the Brownsport. A. F. Foerste stated (Denison Univ. Bull., Jour. ScL Lab. vol. 30, 1935, pp. 197-198) Decatur fauna is Niagaran.]

Now subdivided into (descending) Loelville shaly iss. memb., Bob crystal-line 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.


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. Terr., 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 Toklo 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.


**Brownstown sandstone.** (In Kanawha formation.)

Pennsylvanian: West Virginia.


**Brownstown Hills sandstone member.**

Mississippian: Southern Indiana.

P. B. Stockdale, 1981 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 78., 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 Goos 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 Ritter 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.

†Brownstown 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). Brownstown ss.—Hard, massive, gray ss., 0 to 35 ft. thick. Lies 5 to 20 ft. below Waynesburg coal and overlies Little Wayneburg coal. Finely exposed along bed and bluffs of Ten Mile Creek at and below Brownstown, 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 Brownstown 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.

Brownsville 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.

Brownsville limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, and eastern Kansas.


R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), restricted Admire sh. to beds above Brownsville 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.


See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Brownwood division.

Pennsylvanian: Central Texas.


C. H. Gordon, 1911 (Jour. Geol., vol. 19, p. 117). Brownwood div. now includes Brownwood and Milburn of Tarr, and is = Canyon div.

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 sh.-Chieffly 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, 81; 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.


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.


Bruce series.

Pre-Cambrian (early Huronian): Western Ontario.


C. K. Lelth, R. J. Lund, and A. Lelth, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Bruce limestone.

Pre-Cambrian (early Huronian): Western Ontario.


C. K. Lelth, R. J. Lund, and A. Lelth, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Bruce conglomerate.

Pre-Cambrian (early Huronian): Western Ontario.


C. K. Lelth, R. J. Lund, and A. Lelth, 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, 1908 (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 differ-
ences 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.


E. 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. Contains 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 Chasie group.)

Permian: Eastern Kansas and southeastern Nebraska.


Brunswick shale. (In Newark group.)


H. B. Klümmei, 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 sh. 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).


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. 38, 301). *Brush fm.*—Shales and s.s.s., 100 ft. thick, uncon. beneath Dakota s.s., and overlying Junction l.v. A middle l.v. 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 l.*—Frequently seen along Brush Creek, Cranberry Twp, Butler Co., Pa., for which it is named. In places it is a black calc. l.v. 4 to 5 ft. thick; again it is a very compact l.v. 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 s.s., 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 l.* is same as Philson l. of Somerset Co. [which has priority].

J. P. Lesley, 1879 (2d Pa. GeoL Surv. Rept. Q.), *Brush Creek (Summit) l.* underlies Brush Creek fire clay.

According to modern repts of U. S. GeoL Surv. and Pa. GeoL Surv. the Brush Creek l. lies higher in Conemaugh fm. than Brush Creek coal. In Ohio this bed is a fossiliferous calc. marine l.v. 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 s.*—Lies 12 ft. below Brush Creek l. and above Brush Creek coal.

**Brush Creek clay.** (In Conemaugh formation.)

**Brush Creek fire clay.** (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania.

J. P. Lesley, 1870 (2d Pa. GeoL Surv. Rept. Q.), *Brush Creek fire clay l.* underlies Brush Creek coal and overlies Brush Creek (Summit) l.

According to U. S. G. S. folios of SW. Pa. and recent repts of Pa. GeoL Survey, the Brush Creek l. 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.


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 l. and resting on Brush Creek coal in Upper Youghiogheny Valley, Md.

**Brush Creek fire clay shale.** (In Conemaugh formation.)

Pennsylvania: Northern West Virginia.

Brush Creek red bed. (In Conemaugh formation.)
Pennsylvaniaian: 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 Is. and underlies lower bench of Buffalo ss.

Brushy Basin shale member (of Morrison formation).
Upper Jurassic: Southeastern Utah (San Juan County).

Brushy Creek sandstone. (In McLeansboro formation.)
Pennsylvaniaian: Southeastern Illinois (Saline County).
G. H. Cady, 1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 256-288). 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).
B. 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 Is. and uncon. underly 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 “Huntun” fm. On p. 27 the Brushy Creek section is described, but neither Brushy Creek Chert nor Brushy Creek cherty Is. 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 Is. 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.)
Pennsylvaniaian: Southeastern Tennessee.
J. M. Safford and J. B. Killibrew, 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 8,000 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. Warburg folio (No. 40), named (descending) Anderson ss., Scott sh., Warburg ss., and Briccville sh. Named for Brushy Mtn, Morgan Co.

Bruzer limestone.
Mississippian: Utah.

Bryant limestone.
Middle Ordovician: Central eastern Missouri.
C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 61). Bryant Is.—Compact, light-blue or gray, rather thin-bedded Is., with numerous sh partings; somewhat fossiliferous, and presents marked contrast to underlying and overlying dolomitic Is. Thickness 125 to 150 ft. Underlies McCune Is. and overlies Folley Is. 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.


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. Ailing, 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 quartzite. [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, 289–308). 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.


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, 1908 (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, 12-18, 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 unconf. 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 fms. the beds thus designated have heretofore always been included.

Buchanan gravel.
Pleistocene: Eastern and central Iowa.


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.


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.

Devenian or Carboniferous: Northwestern Pennsylvania.


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).


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.
K. C. Heald in unpublished ms. Consists of lss., shales, and ss. 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 ls. 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 s.s. It lies 200±
ft. lower than Dobbs Valley ss.

Buckeye shale. (In Sumner group.)
Permian: Northeastern Kansas.
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.
J. Gilhuly, 1932 (U.S.G.S.I.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 is., including these beds, is locally
called “Buckhorn” ls.

Buckingham gneiss.
Pre-Cambrian: Quebec.

Buck Lodge diabase.
Upper Triassic: Central northern Maryland.
shown as a dike lying E. of Sugarloaf Mtn, Md.)

Buck Mountain moraine.
Pleistocene (Wisconsin stage): Northeastern New York (Essex County).

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 96 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. Reward and Buck Point ss. is occupied principally by ss.; in a few places the entire interval is sand. [See 2d entry under Reward 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 ss. 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.


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 *Pseudophycus 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 calcisiltites 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.
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, 629). 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 40 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 Harden sh. memb. and overlying Henley sh. memb. (5½ to 22½ ft. thick). [This is present approved definition.]
Named for Buena Vista, Scioto Co., Ohio.

†Buena Vista shale.
Lower and Middle Cambrian: Central western Virginia.
Name is preoccupied and fm. is now considered same as Watauga sh., and is called by that name.

Buena sandstone.
Cretaceous or Tertiary: Mexico.

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 Is. and is separated from underlying Brush Creek Is. 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 ss. 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.


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 SU.

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.


Buffalo glacial stage.
Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 328-328). 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.


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 Red Oak granite in vicinity of Buffalo Lithia Springs, Mecklenburg Co., Va. Is light gray, coarse-grained, and differs from main granite masses of Virginia dist. very little except in texture.


†Buffalo cement bed.
Silurian: Western New York.

G. H. Chadwick, 1917 (see 19th 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).


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] Is. 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.


†Buffalo Creek sandstone member (of Conemaugh formation).

Buffalo Creek shale.
See 1913 entry under Buffalo sh. (Upper Ord. and Sil.).

Buffalo Creek Limestone. (In Kanawha formation.)
Pennsylvanian: Southwestern West Virginia.


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).

Buffalo Peaks andesite.
Tertiary: Central Colorado (Park and Chaffee Counties).
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).
Buffalo Run Is., 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.

Buffalo Wallow formation. (In Chester group.)
Mississippian: Western central Kentucky (Breckinridge County) and southern Indiana.
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 cirque-like excavation in the characteristic shales of the fm. on highway 2 mi. W. of Cloverport.

Buff Bay beds.
Pleistocene or Pliocene: Jamaica.

Buffkin formation.
Pennsylvanian: Indiana.
See 1985 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 Silicieux 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 Grosier; and to this stratum and the C. Silicieux 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 Calbone 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.

Bull creek sandstone. (In Strawn formation.)

Pennsylvanian: Central Texas (Colorado River region).


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 Is.—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 Is. 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 sst., 80 to 125 ft. thick, overlain by Wild Horse Is.

 maxWidth:1800 maxHeight:1800

Bull Face slate.

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.

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.


Bullion dolomite member (of Monte Cristo limestone).
Mississippian (lower): Southeastern Nevada (Goodsprings region).

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.


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 Is. 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). <i>Bull Mt. series (Upper Laramie).</i>—A succession of light-colored clays, soft, white, argill. ss., and heavy benches (30 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 Mt. 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). <i>[Bull Pond Is. is shown on this geol. cross section from Monticello, Sullivan Co., to Croton River near Bulls Bridge, Westchester Co., N. Y.]</i>

Bull Run shales. (In Newark group.)

Upper Triassic: Northeastern Virginia.


J. K. Roberts, 1928 (Va. Geol. Surv. Bull. 29, pp. 24-25, 38-43). Manassas ss. is for most part intercalated with <i>Bull Run shales.</i> 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.


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.]


Bully Hill volcanics.

Age (?): Northern California (Redding quadrangle).


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 quadr. 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 “Balak-
lala 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.

†Buncombe group.
Cambrian (?) and pre-Cambrian: Western North Carolina (Blue Ridge Province).
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, feldsparic, micaceous, and hornblendiic, 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 maf. rocks, olivolites, serpentines, soapstones, talcose and chloritie slates, with tremolite, asbestos, and actinolite rocks, generally associated with hornblendie, sl., and syenite, and usually containing veins of chrome 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. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 221-223), used <i>Bunger</i> ls. in McCulloch Co., Colorado River Valley, and stated: The ls. called <i>Bunger</i> in Colorado River Valley occupies same strat. position as typical <i>Bunger</i> 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 <i>Bunger</i> of Colorado River area is continuous with the <i>Bunger</i> 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).


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).


Bunker slate.

Lower Cambrian: Quebec.


Burbank member (of Cuyahoga formation).

Mississippian: North-central Ohio (Wayne County).


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 Is. 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 Moreto.

A. W. Grabau, 1906 (N. Y. State Mus. Bull. 92, p. 302). Fragments of Burden cgl. are found scattered over Mount Bercraft, 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 Bercraft 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, 1930 (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 Pilo, 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. Tablequah 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 fm. Its age is inferred from its strat. position. A study of St. Peter or “Saccharoldal” 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 ss.s 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 indeflnlteness 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 Is.—A single Is. 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 Is. in lower part of Tyner nor in Burgen ss.)

Burgess shale.

Middle Cambrian: British Columbia.


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 Is. in Russellville dist. (Franklin Co. and W. part of Lawrence Co.). Overlain and underlai by blue fossiliferous Is. of Bangor Is. 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 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 ss. and shales, with interbedded purple quartzitic ss. and white quartzite. Shallow-water features throughout. Thickness 1,700 ± ft. Underlies Revett quartzite and overlies Prichard sh. 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).

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 Louisina and eastern Texas.
A. C. Vestch, 1902 (La. Geol. Surv. pt. 6, Rept. for 1902, p. 138, pl. 37). Fossils collected near Burkeville (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 ss. If this be the correct interpretation of his meaning we would suggest the name Burkeville beds for this stage.

See also under Cold Spring horizon.
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.


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± ml. 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.


thick) to the higher Keokuk or lower Archimedes l.s. Includes Owen's Encrinital group of Hannibal, Mo., which is identical with Encrinital Is. of Burlington. Characterised by great numbers of crinoids.

A. H. Worthen, 1882 (Econ. Geol. Ill., vol. 1, pp. 79, 80). Burlington l.s. at Burlington, Iowa [type loc.], consists of (1) an upper member of light-gray or nearly white l.s. with some brown layers and abundant chert; and (2) a lower memb. of brown mag. l.s. locally aren., with abundant chert.

C. R. Keyes, 1885 (Iowa Geol. Surv. vol. 3). Upper Burlington l.s. is distinguished from Lower Burlington l.s. 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 l.s.

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 Pennsylvanian (Bradford County).

A. Sherwood, 1878 (2d Pa. Geol. Surv. Rept. G, p. 37). Burlington l.s., the thickest stratum of l.s. 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 Is. lentil of Chemung fm. by H. S. Williams and E. M. Kindle in 1905 (U. S. G. S. Bull. 244).


†Burlington limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 110, 120-121, 125). Hard, compact l.s. separated into two parts by 8 to 10 ft. of sh. Here called Burlington or Oread l.s., ultimate choice of name being left to future. Overlies Le Roy shales. Separated from overlying Strawn l.s. by 75 to 100 ft. of sh.

Same as Oread l.s., 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 l.s.; (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 ss., the sh. containing some l.s. 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.

hard brittle Is. May represent Birdseye Is. of N. Y. Underlies Carboniferous 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. 1v, 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 s.s. 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 hornblende 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 hornblende lattes 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).


B. 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 lss. beds in upper part of the Hendricks the Fiborn Is. These beds are buff to grayish buff, dense grained to lithographic lss. 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 lss. 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).

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.

Burnt River schist.
Pre-Carboniferous (?): Northeastern Oregon (Baker quadrangle).
J. Gilly, 1937 (U. S. G. S. Bull. 879). Burnt River schist.—Various greenstone schists, quartz schist, conglomeratic schist, and some interbedded lss., al., and qtz. Thickness, 5,000+ ft. Tentatively assigned to pre-Carb. (?). 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, Twp. 11 and 12 S., R. 41 E.

Burntside granite gneiss.
Pre-Cambrian (Huronian): Northeastern Minnesota (Vermilion district).

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.


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 is memb. of Grenola fm.—The newly established Grenola fm. is divided into following members (descending): Neva Is., Salem Point sh., Burr Is., Legion sh., and Salyards Is. 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 Boca, 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 motting, and weathers platy or shattered. Type loc., the bluffs and ravines W. of South Fork of Little Nemaha River, in sec. 20, at point ¾ mi. W. of N. - S. road, 2 ½ mi. NW. of Burr, Otoe Co., Nebr.

G. E. Condra, 1935. (See under Boca 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:


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, asa., 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 qtzite.—Main body of Mid Camb. qtzites which immediately overlie Chlordan series of 1ss. near Silver City. Thickness 500 ft. [On p. 4 it is shown as underlying his Chlordan 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, 24 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. ¼ sec. 21, T. 71 N., R. 43 W., Fremont Co., Iowa, about 6 mi. S. of Pacific Junction, Iowa, and about 3 ½ 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 Osawekle 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
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. Kansas Geol. Soc., p. 48), differentiated 36 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.


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 fm., the shales becoming increasingly abundant upward. Mud cracks and fusco markings present in many of beds. Thickness 450± ft. Top arbitrarily placed at base of lowest sh. 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.

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.


Probably named for village of Busseron, Knox Co.

**Butano sandstone.**

Oligocene? (may be Eocene): Southern California (Santa Cruz Mountains).


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 gns 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.
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 Panamintian series (Early Cambria) in Utah. [Derivation of name not stated.]

Buttabatchie 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 Buttabatchie 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).


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 lm., 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 phylrite 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.

button beds.
Miocene: Southern California (Kern County).

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. Is. 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.
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 139). †Buxton fm. includes beds from top of †Piqua (Stanton) Is. to base of †Painterhood (Oread) Is.

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, 658, 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 Alvinsville 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 Shaw’s School (Buchanan Station) and about 1½ mi. W.-NW. of Byham School, there is a Is. similar to West Mead Is. (lower Meadville Is. of early repts). It is proposed that this “middle Meadville Is.” be called Byham Is. Resembles West Mead Is. lithologically and faunally, both being characterized by iron-ball concretions, fish bones, and a Springothyrid fauna interspersed with inarticulate brachiopods. In area around Byham School it is 3 to 12 ft. thick and much used in past for lime.
Lexicon of Geologic Names of United States

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 both 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 stage, (3) Byram stage, and (4) Vicksburg stage. [The strat. position of Byram as here given is now known to be incorrect. See below.]


Thickness 13 to 70 ft. Top fm. of Vicksburg group. Conformably overlies Marianna Is. (of Vicksburg group), and underlies Catahoula as. 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 Is. have since been separated as a distinct fm. (Glendon Is.), so that the fm. upon which Byram marl rests is Glendon Is., instead of Marianna Is. The Red Bluff clay has now been determined to correspond in time to lower part of Marianna Is. The Byram as defined by Cooke included in upper part the beds in Miss. that were later named (by Blanpied) Chickasawhay marl [mem.], and Bucatunna clay [mem.], 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 bronze 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 Wolf, the "Oxford type" of Nason, and gneissoid granite of Breakneck Mtn., on the Hudson. Appears to cut Pochuck gneiss and Franklin Is. 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. 790, correla-
tion chart, 1929) as post-Glenarm. Intrudes Franklin Is. 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 Is., 110 to 140 ft. thick. Rests on Mayville Is. and underlies Lower Cornl beds. Fossils rare. Named for Byram 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.


Caballos novaculite.

Devonian (?) (Oriskany?): Southwestern Texas (Brewster County).


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, varicolored 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.

Cabanos conglomerate.

Ordovician (?): Quebec.


Cabanos River limestone.

Silurian (Niagaran): Quebec.


Cabezon fanglomerate.

Quaternary: Southern California (San Bernardino Mountains).

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).


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

Cabin Creek sandstone.

Name applied by C. Cronceis (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).


Cabo Rojo stage.

Quaternary: Puerto Rico.


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 ss. 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.


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
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. xlv-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. Tallaferro, 1933 (Jour. Geol., vol. 41, No. 1, p. 26).

Cacapon sandstone member (pronounced Câ'pö'n). (In Clinton formation.)

Silurian: Northern West Virginia and western Virginia.

Is a ss. in lower part of Clinton fm.

†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 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.

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).

Named for Cactus Flat, San Bernardino Co.

Caddell clay.
Eocene (upper): Eastern Texas.
E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 25, p. 462). Caddell clay.—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-drag clays with gyp. and sulphur. Included in Jackson beds. Separated from underlying Racine clay by clays and sands, and separated from underlying Frio clays by clays and sands that are believed to be the Wellborn. [E. T. Dumble, 1922 (Univ. Tex. Bull. 1869), called the beds underlying his Caddell clay the Wellborn as.] 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 underlying 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 over-
laid 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. [Possibly listed.] B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17 and pp. 17-23). Caddell fm. (Moodya 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 Euliss 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 cross-bedded 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.


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 port of Garber ss. (Penn.). 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 B. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+). *Caddo Creek fm.* includes only Home Creek Is. 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 Bunker Is., Gonzales Creek sh., Eastland ss., and Finis sh. of Brazos River region.]

*Caddo Gap novaculite.*

Devonian (?) : Southwestern Arkansas (Montgomery County).


*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 sh.* (Genesee sh. of N. Y.), 300 ft. thick in Huntington Co., Pa.; *Cadent shales* (*Hamilton group of N. Y.*), 600 ft. thick in Huntingdon Co.; and *Cadent lower black sh.* (*Marcellus sh. of N. Y.*), 250 ft. thick in Huntingdon Co.

†Cadent shales.

†Cadent slates.

See under †Cadent series.

*Cades conglomerate.* (In Chilhowee group.)

Cambrian (Lower) : Eastern Tennessee and western North Carolina.

A. Keith, 1805 (U. S. G. S. Knoxville folio, No. 16, p. 2). *Cadiz cgl.*—Thick beds of sl., 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).


*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.

Cadwallader series.
Triassic: British Columbia.

Cahill sandstone. (In Franciscan group.)
Jurassic (?): Western California (San Francisco region).
A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). Cahill ss.—Prevailing mass, 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 Is.—the Calera Is. memb.—60 ft. thick, which is overlain by 2,000 ft. of beds belonging to Cahill fm. On summit of Fifield Ridge a thin lens of obscurely fossiliferous impure Is. occurs in Cahill ss. several hundred ft. above Calera Is. This Is. is apparently not persistent and probably nowhere exceeds 10 ft. in thickness. Thickness of Cahill ss. approx. 2,560 ft. Basal fm. of Franciscan group. Underlies Sausalito chert. Named for exposures on Cahill Ridge, San Mateo Co.

Caimito formation.
Miocene: Panama Canal Zone.
†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 Conoquenessing 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).

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.
P. 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-Elkhorn 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. Lava 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
A. 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).
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 Is., 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 Carb., but may
extend down into Dev. It is not intended to include in it the Sil. beds described
by Mr. Diller nor the upper Carb. 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 Is. 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 occup­
ing interval btw. †Birdseye (Lowville) Is. above and Potsdam ss. below,
Generally included Beekmantown Is. 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.
1906 (Vt. Geol. Surv. 5th Rept., pp. 86, 115).
Said to include Waits River Is. (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).
may be conceived as taking its name from Calciferous station of Marquette &
Southeastern R. R.
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. 140, 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.

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, 578, 587, 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.

Probably named for occurrence near old Caledonia mine, Ontonagon Co.

Caledonia group.
Pre-Carboniferous : New Brunswick.

Calera limestone member (of Cahil sandstone).
Jurassic(?): Western California (San Francisco region).
R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 418). 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.]

Named for exposures in sea cliffs at lower end of Calera Valley, San Mateo Co.
Calhoun shale member (of Shawnee formation).
Pennsylvania: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

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.


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. Willmarth, 1936.

†Calhoun limestone.
Pennsylvania: Eastern Kansas and northwestern Missouri.


Same as Deck 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.S.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).
Calico Bluff fm.—Thin-bedded Is., slates, and shales; some igneous rock. Invertebrate fossils of Lower Carb. age. Conformably overlies Upper Dev. slates and shales. 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. Girly.

Calico Peak porphyry.
Tertiary: Southwestern Colorado.
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 alunized (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 Is., 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 ss. [According to Misir, the Calico Rock ss. rests on beds of Devonian age which are not identified as Sneeds Is., the basal memb. of Everton, and which consist of an alternation of blue and gray Is. and some coarse ss. In section W. of Calico Rock measured by writer and Brewer, an uncon. btw. these beds and Calico Rock ss. is suggested. The Calico Rock is unforesiliferous, 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 Is.**—Dark-colored shaly Is., 70 ft. thick, containing Western Hamilton fossils. Overlies Grand Tower Is. and underlies black shales or Louisiana Is.

C. R. Keyes, 1895 (Mo. Geol. Surv. vol. 8, p. 349). 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 Is.**, 60 to 70 ft. thick, underlies "Black" sh. and overlies Grand Tower Is. Consists of (ascending) compact blue or buff to brown highly fossiliferous Is.; sh. 30 ft.; thin-bedded Is. passing at top into calc. sh., some of which may be "Black" sh.


M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines, 2d ser., vol. 16, pp. 49, 52). **Callaway Is.**—Underlies Craghead Creek sh. and uncon. overlies Middle Dev., the top fm. of which is St. Laurent Is. 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 Is.** presents several phases. Its thickest parts are light to dark blue, compact, fine-grained Is., in many places highly fossiliferous. A light to dark-brown compact Is. is usually present in 3 or 4 beds having a combined thickness of less than 8 ft. A third phase is white to gray coarsely to finely crystalline Is., 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 Is., or Burlington Is. Rests uncon. on fms. ranging from Mineola Is. (Middle Dev.) to Jefferson City Is. (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.

Callimah 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.). **Callimah sand**—Gray fossiliferous sand typically exposed on Frio River N. of Callimah, where Whitsett-Callimah 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 Is.**, the correct spelling of the county for which the Is. 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. 788). **Callville Is.**—Dark-colored Is., 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. Iss. Thickness 1,100± ft. [2,000±1]. Fossils are Pennsylvanian (Magdalena), according to G. H. Girty. Top not defined because not known. Is uncon. over lain by Supai fm. Name is applied to all Penn. Iss. in CalviUe Mtn, Clark Co., but all sections there are incomplete. Overlies Bluepoint Is., probably uncon.

Caloosahatchee marl.
Piocene (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 Pl. 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 Caloosahatchie 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 Pl. 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 Olg.

†Calumet conglomerate.
Pre-Cambrian (Keweenawan): Northern Michigan.

Calumet amygdaloid.
Pre-Cambrian (Keweenawan): Northern Michigan (Houghton County).

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.]


G. B. Shattuck, 1904 (Md. Geol. Surv. Miocene vol., pp. lxxi-lxxiv), divided Calvert fm. into Plum Point marl memb. (above) and Fairhaven diatomaceous earth memb., and gave thickness as 50 to 210 ± 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 quartzite 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 Sabine town fm.

Calvin sandstone.

Pennsylvanian: Central, central southern, and central eastern Oklahoma.

J. A. Taff, 1901 (U.S.G.S. Coal gate folio. No. 74). Calvin ss.—Thick-beded 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. 668-682). 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. 668 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.

✿ Calvin's Run limestone.

See Calvin ls. memb.

Camajuaní formation.

Cretaceous: Cuba.


✿ 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 Normanalkill 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.


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).
J. B. Woodworth, 1896 (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 Elver 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 Carb. 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 sas. 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.
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 Is. 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. P. G., 1935, p. 907.)

Cambridge moraine.
Pleistocene (Wisconsin stage): Eastern Minnesota (Isanti, Sherburne, and Anoka Counties).

Cambrovilcan.
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.


Named for exposures in bluffs at Camden, Ouachita Co., Ark.

Camden chert.
Middle Devonian: Western Tennessee.


In 1918 (Am. Jour. Sci., 4th, vol. 48, 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 Is. (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 Is. 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).

E. E. Caster, 1934 (Bull. Am. Pal., vol. 21, No. 71, p. 142). For the red sh. memb. (or composite memb.) that overlies Loyalhanna Is. 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 Is. memb., which is overlain by another red sh. that has been called Upper Mauch Chunk sh. The four members (Loyalhanna Is., Cameron red sh., Greenbrier Is., 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).


Cameron Bay series.

Pre-Cambrian: Canada (Northwest Territory).


Camillus shale member (of Salina formation).
Silurian: Western to east-central New York.


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. Is., 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 iss. 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 Is. No sharp bdry 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.

burg 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 is.—Layer of impure is. 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 is. is a memb. of Kanawha fm., lying 0 to 20 ft. above Campbell Creek coal and 0 to 6 ft. below Lower Monitor ss. of W. Va. Geol. Surv.)

Campbell Creek beds.
Carboniferous: British Columbia.


Campbell Creek (Lower) sandstone. (In Kanawha formation.)
Pennsylvanian: Southern West Virginia.


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., pp. 37-42). Campbell’s Ledge black ss.—Highly bituminous black ss., 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 (58± ft.) of Pottsville fm. at Campbell Ledge, near Pittston, cannot be older than Lykens No. 1 coal.
Campbellton formation.

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.

Camp Cove series.
Jurassic (?): British Columbia.

Camp Creek shale member (of Pueblo formation).
Pennsylvanian: Central Texas (Colorado River region).
E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated Camp Creek sh. of Drake as basal memb. of Pueblo fm., underlining 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 egl. 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 vertebrae of reptiles. Rests on Double Mtn group with slight angular uncon. Best exposed at Camp Springs, near center of E. line of as. 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 quartzite ss., separated by thin layers of siliceous ss., which occur as partings in the dense ss. Upper third of fm. is somewhat more rusty 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.
Named for Camp Nelson, Jessamine Co.

Campobello group.
Silurian: Southeastern Maine (Washington County).
N. S. Shaler, 1886 (Am. Jour. Scv., 3d, vol. 32, pp. 47-60). Campobello series or group.—A series of very compact and highly metamorphosed, nonfossiliferous schists, slates, and quartzites, considerably cut by dikes. Comprises a set of dark greenish and grayish siliceous and argil. 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 1 in. to 2 ft. diam. and 8 in. to 10 ft. long; also many bone fragments, especially from vertebrae 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).
Campton sand.
A subsurface sand, of Dev. age, in eastern Ky.

Campus formation.
Pleistocene: Western California (San Francisco region).

Camulos formation.
Pliocene (middle or upper): Southern California (Los Angeles and Ventura Counties).
C. [R.] Keyes, 1926 (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.

†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.

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.
Canadaway group.


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. 18, 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 brachlopodous ("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 Delthyria menacostalis and accession of Camarotoechia (?) duplicata, the name Cananea 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 Canaddea sh.; and Canaseraga ss. (= Dunkirk sh.). Fall Creek cgl. of Tioga Co., Pa., is included in Dunkirk sh.

G. H. Chadwick, Feb., 1936 (Am. Jour. ScL, 5th, vol. 29, p. 138). 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, 1873) 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. 1108-1109), 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 is. 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. B. 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 Glen 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.


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 Glen Falls ls.

Named for outcrop at Canajoharie, Montgomery Co.

**Canal limestone.**

*Pennsylvanian:* Northeastern Pennsylvania (Luzerne County).


†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.*


†Canaseraga sandstone.

*Upper Devonian: Western New York (Allegheny County).*

O. 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 130 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, 1938 (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.

Cañizas formation.
Age(?): Panama.


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.

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 ss., some of tuffaceous aspect, and occasional thin layers and lenticular bodies of ls. Marine invertebrates in belt 75 ft. thick and 160 to 226 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 ml. 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 ml. 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 ss., 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 ssn. 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 (l.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, 225-238). 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 selurformis var. lisbonensis and Orthophragmina advcna. Type loc. is at Baden Hill on Cane River, 3/4 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.


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 Is. septaria. In lower part, in adjoining Atoka quad., the blue sh. grades into black, friable, bituminous sh. with dark-blue Is. segregations. The Caney sh. throughout is laminated, fissile, and friable, and consequently rarely exposed. Underlies Wapanucka ls.

See 1909 and 1924 entries under Jackfork sh.

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, 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 sh. 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 300 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 (1824) 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. 90 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, 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 lbs. 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 lbs. 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 lbs. members. It is medium to coarse-grained; appears fragmental or coquina; is rather strongly ferruginous; and thickness averages 1 ft. It lies 5 to 15 ft. above the fusulinid-bearing lbs. 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.]

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 harvested 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 reports of W. Va. Geol. Survey.]
I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, pp. 311, 588). Cannelton (Stockton) ls.—The ls. at Cannelton, which Mr. Stockton once harvested 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 reports 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 1. In Logan-Mingo Co. Rept., 1914, the thickness of Cannelton ls. was given as 0 to 4 ft.]
Cannelton sandstone. (In Pottsville group.)
Pennsylvania: 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.)
Pennsylvania: 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 ss. containing fossil plants, or, where that is absent, on Matewan coal.

Cannes de Roche formation.
Pennsylvania: Quebec and New Brunswick.

Cannon limestone.
Middle Ordovician (Trenton): Central and eastern Tennessee and southwestern Virginia.

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 Twp's 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., 8 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 ml. W. of Haley, N. Dak., a total distance of about 130 ml. 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
somer-colored sh., yellow ss., and thin lignite beds composing the lower (non-
marine) 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. B.
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
Cañon rhyolite.
Age (?) : Nevada.
Canter limestone.
Mississippian: Southern Ohio (Jackson County).
occurrence of Maxville Is. near Enoch Canter's (p. 158), and mentioned ore found
on Canter Is. (Maxville or lower Carboniferous) in Hamilton Twp, Jackson Co.]
Canterbury granite gneiss.
Late Carboniferous or post-Carboniferous (?) : Eastern Connecticut and
southern Massachusetts.
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 ml 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 Is. 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).


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.


†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.

Cantwell formation.
Upper Cretaceous: Southern Alaska (Cantwell River region).
Cgs. and coarse ss.; matrix quartz; pebbles are of dark al., perhaps derived
from Sushitna slates, on which they presumably rest. Outcrop for mi. or twd 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.
(See under Dennis fm.)
J. M. Jewett, 1932 (pp. 89, 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.

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.
Largely massive, heavy-bedded ls., 930 ft. thick. Underlies Cisco div. and overlies
Strawn div.

In Palo Pinto Co., type region, consists of 750 ft. of massive IIs., 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 cgs. 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 re­

region).
F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 80–91). 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.

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 aggl. are commonly chaotic and exhibit bedding only when viewed at a distance, but the tuffs, cgl., 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.


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 Canyon Largo group, and on pl. 35 he used Canyon 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 fm. 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.


 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.


Same as St. Peter ss., older name.

Capay formation.

Eocene (middle): Northern California (Sacramento Valley).

These grade in character from purely channel cgl. 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. 1053, 1050, pl. 89). Lower part of middle Eo. in Riggins 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 Domengne (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).

Cape Barré beds.
Devonian: Quebec.

†Cape Beaufort coal measures.
Cretaceous: Alaska.
G. C. Martin, 1926 (U. S. G. S. Bull. 778, 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).

†Cape Blanco beds.
Miocene: Southwestern Oregon (Port Orford quadrangle).
See 1902 and 1913 entries under Empire fm. (Mio.).

Cape Bon Aml 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 Aml W. of Cape Gaspe, may receive the name of Cape Bon Aml lss. Underlie Grande Gèvre 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., 6th, 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.


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.


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). Cape Fear fm.—Arkose and micaceous sands and clays and various intergradations of arenaceous 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 Potomac div. of Patuxent 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, 1933.)

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. sl., 10 ft.; (2) white and bluish white, massive-bedded crystalline sl., of fine texture, carrying Trenton fossils, 60 ft.—the well-known Cape Girardeau marble; (3) white crystalline sl., in heavy beds, 35 ft.; (4) blue schistose sl., 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. 158). Cape Girardeau ss.—Sa., 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. 16, 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 ls.
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 st.—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 Carbt. 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.

Cape May formation.
B. 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 reports 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).

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. (Pilo.) Suggests correlation with San Pablo fm. (upper Mio.), but "fossil evidence is inconclusive," and the beds may be lower Pilo. (Mapped.)

Named for development around Capistrano, Orange Co.

**Capitan limestone.** (Of Guadalupe group.)

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. Formally overlies Delaware Mtn fm. in Guadalupe Mtns. Top not seen but believed to uncon. underlie Castle 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 Castle 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. 18, p. 925, etc.), extended Capitan ls. into eastern Glass Mtns, and included in it the Tessey, Gilliam, and Vidro 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.

R. B. King, 1934 (Am. Jour. Sci., 5th, vol. 45, p. 738). 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 Vidro massive memb.; and, in lower part of Capitan ls. on W. side of Glass Mtns, the Altuda shaly memb. (=lower part of Vidro 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.


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).

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 Wilberas fm.

Named for Cap Mountain, Llano Co.

Capote limestone.
Age (?): Mexico.

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. 2182, pp. 96, 87). *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.

R. 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 *Cappa 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.

Carbon group.

Tertiary: Wyoming.


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, 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 and O. 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. 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.

Carbolic.

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.


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.

Cardenas formation.
Cretaceous: Mexico.
V. R. Garfas, 1915 (Econ. Geol., vol. 10, pp. 109, 202).

Cardiff conglomerate.
Pre-Cambrian (Glenarm series): Southeastern Pennsylvania, Maryland, and Virginia.

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. 10). 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. 129-238). 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 the 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 Soisville 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 Soisville 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.


Caribbean group.

Lower Cretaceous (?): Trinidad.

G. P. Wall and J. G. Sawkins, 1880 (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.


Cariboo schists.

Pre-Cambrian: British Columbia.


†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 Is., forms for several ml. 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. fahery, as well as near Gazelle, NW. of Mount Shasta. Is younger than Grizzly fm. and older than Spanish fm.


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.

nes in Arkansas Valley region, eastern Colo., 175 to 200 ft. Top fm. of Benton
group. Underlies Timpaas 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., re-
respectively. (See also under Niobrara ls.)

Carlile limestone.
Lower Ordovician: Central Pennsylvania (Blair to Center Counties).
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 ml. 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 concre-
tionary 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. 28) and
1926 (Ill. State Acad. Sci. Trans., vol. 19, pp. 287, etc.), the Carlinville ls. lies
100 ± ft. below Shoal Creek ls. and 20 to 90 ft. above coal No. 8. E. W. Shaw,
1923 (U. S. G. S. Carlyle-CentraUa folio, No. 218), also identified Carlinville ls.
as older than Shoal Creek ls. According to Wallace Lee, 1928 (U. S. G. S.
Gillespie-Mount Olive folio, No. 220), the Carlinville ls. lies 53 to 81 ft. below
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.
801-512) to a middle portion of McLeansboro fm. (Penn.) of central
western Ill., based upon the rhythmic-cycle theory of sedimentation. In-
cludes 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, Gon-
zales, and Burleson Counties).
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. [Ex-
posures listed.] Consists of massive gray to white ss., more argill. than older
Beds ss. memb. of the Wellborn; locally semiquartzite; contains impressions of
stems. Thickness 5 to 22 ft. Underlies Manning fm. and lies 10 to 120 ft. above
Beds 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. Melzner, 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, underlymg Castle fm. and overlying Seven Rivers gypsumiferous 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 Castle 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 gypsumiferous memb. of Chalk Bluff fm. (4) In places a thin tongue (Azotea tongue) of upper part of Carlsbad ls. overlies Seven Rivers gypsumiferous 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).
C. N. Gould, 1904 (Okla. Geol. Surv., Dept. Geol. and Nat. Hist., 3d Blen. Rept., pp. 12, 20), mentions Carlton porphyry, which apparently is same as Carleton 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.

Carltonian formation.
Pre-Cambrian (Keweenawan): Northeastern Minnesota (shore of Lake Superior).
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.


Carlyle 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.


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).


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. 6084, March 30, 1926). (Name adopted at joint conference of H. E. Gregory, R. C. Moore, J. Gilluly, and
Carmel fm.—Dense Is., and buff and red ss, at base; toward top dominantly red and green sh. 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, 1836 (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 cqls. of dark color and thinly bedded tawny ss. with some argill. shales. No fossils at Carmelo Bay, but the series appears to be identical with the coal-bearing ss. of Malpaso Canyon, about 2 ml. 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.


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-Unlontown 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).


E. L. Packard and R. Kellogg, 1934 (Carnegie Inst. Wash. Pub. 447, Contr. to Pal., p. 17). Carneros ss. mem. 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 prevalingly 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 Peepee 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, 1853) 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, 1880 (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 Inoceram and oysters, 300 ft.; (2) flaggy, fissile, calc. argill. sh., with numerous oyster shell fragments and Inoceram, 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).
*type of granite porphyry* is variant of Wolf Butte type of granite porphyry.
Named for occurrence (locally) above Carpenter Creek, Little Belt Mtns.
*Creek porphyry.*—In valleys of Carpenter and Snow Creeks is a swarm of dikes
corresponding to what Weed and Pirsson have called *Carpenter Creek porphyry.*
[Assigned to Tert.]

Carper sand.

Devonian or Mississippian: Southeastern Illinois (Clark County).
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. 10, 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. Myllus, 1927 (Ill. Geol. Surv. Bull. 54, table 5), placed this sand in Kinder-
brook.

Carpinteria formation.
Pleistocene: Western California (Santa Barbara County).
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 dis­
tance 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). Carquinez includes Telon (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 dis­
covery well.

Carrasco limestone.
Upper Cambrian (?): Southwestern New Mexico (Silver City region).
fms. of N. Mex., pp. 4, 5). Carrasco *ls.*—Main calc. memb. of Late Ordovician age
well displayed back of Carrasco smelter property near Silver City. Thickness 75
ft. [On p. 4 he puts it in “Late Cambrian;” on p. 5 in “Late Ordovician.”]
Carrigan black lands.

Pleistocene: Southwestern Arkansas.


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 sanda.**—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. ScL 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 1∕2 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 (Unlv. Tex. Bull. 3232, p. 614). Owen did not designate type loc. Berry stated type loc. is the outcrop in the quarries 1∕2 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 Pecan Creek W. of Carrizo Springs. The Carrizo sand is basal fm. of Claiborne group. Grades into underlying 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).

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 sand and silt. It extends N. along W. side of Salton Sea to Santa Rosa Mts., which is most northerly limit of the beds in this region. The lower div. consists of about 200 ft. of more or less coarse arkose sand, 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.


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 slits, 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 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 ss., and these under the recent soil of the flats and gravel hills. The crystalline schists cross Texas & Pacific Ry near Alamo, 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 ss. 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 serpentinitous, 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.


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).


Carrollton Mountain porphyry.

See Carlton porphyry.

Carson lava.

Age (?) : Southwestern Washington (near Carson).


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 cgs., 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."
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Cartago formation.
Eocene (?) : Costa Rica.

Carters limestone member (of Lowville limestone).
Middle Ordovician : Central Tennessee (Nashville dome).
J. M. Safford, 1869 (Geol. Tenn., pp. 258-268). *Carters Creek* is.—Heavy-bedded, light blue or dove-colored, fossiliferous is., 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] is. (This definition of Carters is. (for beds underlying Hermitage fm. and overlying Lebanon is.) 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.)

H. 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 substracted from the Hermitage or the Carters of previous Tenn. repts.

J. J. Galloway, 1919 (Tenn. Geol. Surv. Bull. 22), described Carters Is. 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.

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. 68) 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 Basler'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 is., 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 iss. 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.
Carterville granite.
Pre-Cambrian: Central Virginia.

Carterville formation.
Mississippian (late): Southwestern Missouri.
C. E. Slobenthal, 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 lss. 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 lss. containing the Carthage quarry beds. The Carterville fm. contains Chester fossils (listed). Named for exposures just W. of Carterville, Jasper Co.

Carthage limestone. (In McLeansboro formation.)
Pennsylvania: 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 Is.—Lies in upper part of Coal Measures of southwestern coal field bordering Ohio River 1 mi. below Unontown [Unon 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.
E. R. Buckley, 1911 (Types of ore deposits, p. 117). Carthage Is. consists of 100 ft. of practically noucherty crystalline lss. forming top memb. of Burlington fm. [not Burlington]. Overlies Short Creek oolite memb. and underlies, uncon., Chester.
Is upper part of Boone Is. The Short Creek oolite and the overlying Is. are now considered to be of Warsaw age.
Named for exposures at Carthage, Jasper Co.

Carthage moraine.

Cartright sand.
A subsurface sand in Yegua fm. (Eocene) of Pettus area, Bee Co., SE. Texas.

Carwood formation.
Mississippian: Southeastern Indiana.
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 sily 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 Floyd's 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 weather 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 Hollsclaw ss. of Butts. A number of factors make it advisable to propose a different name. The term Garwood fm. is proposed in this paper, from village of Carwood (Bridgeport), Clark Co., Ind., 4½ 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.]

Gary substage.

Pleistocene: Mississippi Valley.

See under Mankato substage and under Wisconsin stage.

Casadeoga schist.

Early Paleozoic or pre-Paleozoic: Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 70-75, maps). Casadeoga 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 Casadeoga quads, one belt along E. part of quads and another along W. part of quads.

Cascade series.

Carboniferous (?): British Columbia.


†Cascade sandstone. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania (Susquehanna County).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G, 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. 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.


†Cascade formation.

Lower Cretaceous: Central Montana (Little Belt Mountains and Fort Benton region).


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).

Cascades formation.
Pleistocene: Central northern Oregon and southwestern Washington.
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 inter-canyon 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).

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 Willamettlan 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).
Casco Bay group.
 Carboniferous (Pennsylvanian?): Southwestern Maine.
 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., Scarborough 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. 83, 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. Ex­
 posed near Kid'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.)
 Pennsylvaniaian: Southwestern 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 east­
 ern Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Caseyville sandstone. (Of Pottsville group.)
 Pennsylvaniaian: 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 as. (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 ss.. In 20 to 60-foot beds, alternat­
 ing 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.

Cashqua shale.
 Upper Devonian: Western and central New York.
 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 ex­
 posures on Cashqua Creek [Livingston Co.], above junction of Genesee Valley
 canal. Occupies interval btw. Ithaca group above and upper black sh. that over­
 lies Tully ls., but in central N. Y. the Ithaca is absent, and Gardeau or Lower
 Fucoidal group overlies the Cashqua.

J. Hall, 1843 (Geol. N. Y., 4th dist.). Cashqua sh. is 110 ft. thick on the Genesee,
 33 ft. of Eighteen-Mile Creek, on Lake Erie. Overlies Genesee sh. i.—Upper Black
 sh. 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 Middleses sh. This is present generally
 accepted definition of Cashqua sh.]

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Casmalia gypsiferous shale.
Casmalia red beds.
Miocene: Southern California (Santa Maria district).

Cason shale.
Upper Ordovician (Richmond): Northern Arkansas.
H. S. Williams, 1894 (Am. Jour. Sci., 3d. vol. 48, pp. 325-331). *St. Clair Is.* of Dr. Penrose includes beds ranging in age from Cincinnati to Niagara, and should be divided into three fms., here named (descending): *Cason Is.* (containing Clinton-Niagara fauna); *Cason sh.* (the manganese-bearing shales); and *St. Clair Is.* (restricted to beds containing Trenton fauna). The Cason sh. and underlying St. Clair Is. (later replaced by Folk Bayou Is.) and now divided into Fernvale Is. and Kimmswick Is.) are separated by an erosion uncon., the Cason sh. either resting on St. Clair Is. (Fernvale Is.) or in hollows in it, or in hollows in older Izard Is.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28, pp. 421, 486, 558, 559) restricted St. Clair Is. to beds of Niagaran age, and extended Brassfield Is. westward to cover the beds of Median age previously included in St. Clair Is. (The Cason sh. as now defined therefore underlies Brassfield Is., overlies Fernvale Is. (upper part of Folk Bayou Is.), 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 Is.*—Upper part of St. Clair Is. 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 Is.* abandoned and name *St. Clair Is.* restricted to Is. overlying the manganese-bearing beds (Cason sh.), which outcrops at St. Clair Springs. For Is. underlying Cason sh., which does not outcrop in region of St. Clair Springs, J. C. Brammer’s suggested name *Folk Bayou Is.* is adopted. St. Clair Is. as here restricted underlies Sylamore ss. or Eureka sh.

Replaced by St. Clair Is. (restricted sense of E. O. Ulrich, 1911) and Brassfield Is.
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 is. give place to *Casper fm.* 500 to 1,000 ft. thick, consisting of ls., 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 ls. and ss. 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 in 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 Is. 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 Terti. 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 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. 716 +). 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 biw. 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.


Cass Is. is abandoned, as another name [what?] has priority.


Cass Formation.

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 *Sculthorpe* 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 Is. 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.

†Castile 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 Iss. 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 Iss. showing no bedding, and designated Castle ls.

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).

Castlegate sandstone member (of Price River formation).
Upper Cretaceous: Eastern Utah (Wasatch Plateau and Book Cliffs region) and 3½ ml. into western Colorado.
J. B. Forrester, 1918 (Utah Acad. Sci. Trans., vol. 1, p. 24) . Castlegate as., 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 ss. in this fm. It is very compact and broken by joints and cross joints into large blocks. Rests on a layer of sh.
Named for Castlegate, Carbon Co., Utah, where it forms a gate-like passage in Price River Canyon 2± ml. above the town.

Castlegate coal group. (In Blackhawk formation.)
Upper Cretaceous: Central eastern Utah (Book Cliffs).
F. H. 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.

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 report 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.
C. D. Wakcott, 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 sand and shales btw. the quartzite s.s. and siliceous shales of "Bow River group" below and superjacent Ord. graptolitic shales on W. and Banff Is. 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. 90-109). 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 Sedalla, 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. Best 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).

Catadupa.
Eocene: Jamaica.

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 is. In western La. and E. border of Tex. the lower part of this nonmarine ss. is contemp. with marine Vicksburg is., 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 is., 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. 1182) it appears to be older than Tampa is. In southern Tex. the Catahoula becomes a tuff, and uncon. underlies Oakville ss. (late middle and early upper Mio.) and uncon. overlies Frío 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. Blemmey 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.

34, pp. 264-267). Cataldo qtsite.—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 iliac-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 sh.
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 Tekou, 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).

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, 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 a correlation with Fran­
ciscan 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 1) 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 metamorph­
ismic rocks belong to an ancient group which extends northward uncon. beneath typical
Franciscan.

163, 172, 225). Catalina facies of Franciscan series.—Half of Catalina Island is
a complex of albite, amphibolic, chloritic schists, quartz schist, serpentite, etc.,
and there is a small area of similar rocks exposed in San Pedro Hill on the main­
land. They are especially characterized by abundance of albite and by presence
of the unusual minerals glaucophane, actinolite, and lawsonite.

Catalina schist breccia.

Miocene (lower?): Southern California (southeast end of Catalina Island).

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 some­
times 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).


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’s memb.) and some underlying red sss. of uppermost part of original Medina sss.], 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 oppo­
site 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 
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 ss.s. 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.

*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._

No. 1, p. 8).

_Catasauqua Is._

See _Catasauqua Is._

_Catawissa reds._

_Upper Devonian: Eastern New York (Catskill Mountains and to west) and 
northeastern Pennsylvania._

The Cayuta or lower Chemung turns red as it crosses the Susquahanna, 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 Dela­
ware, 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
and two older ss. (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.
Cat Head beds, Cambro-Sil., Canada.
Cat Head l., Ord., Canada.
Cat Head l., 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).

Cathedral limestone.
Middle Cambrian: Alberta and British Columbia.
Cathedral fm.—Massive, aren. and dolomitic ls. Thickness, 1,088 ft. in Mount Bosworth
section, B. C.; 937 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.
Cathedral fm. of Mount Bosworth, B. C., consists of (1) 775 ft. of ls., underlain by (2)
Albertella sh. memb. (7 ft. thick), which rests on (3) 875 ft. of ls. 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 ls. 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 refer­
ence 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 Is. is 2,109 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 Is. 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).


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) merges 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.


**Cathedral Peak granite.**

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 180, 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 Is.—Shales and knotty lss., usually underlain by heavy-bedded subcrystalline lss. 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 Is. and uncon. underlies Ledgers fm.
Cannon Island of Tennessee, as underlying Cathey's Island and overlying Bigby Island. This is present accepted definition of Cathey's Island.

Named for Cathey's 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 district, 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, 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 coarsest texture, associated with the granite; one of fine grain, with large lenses of epidote and quartz; and one with quartz and epidote amygdaloids, 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, sas., 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.
L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 188-194). Catskill group.—Top div. of New York system. Overlies Chemung group. Includes Montrose and Oneonta ss. 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 Mt. series and Montrose and Oneonta ss. of reptls; lower part of Catskill Mt. 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. is down to base of Onondaga salt group [Salina fm., Sil]. The Montrose ss. of Vanu Rhein 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 "diction" as including (descending) Catskill group, Chemung group, Portage group, and Genesee al., 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 interfingerling 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. a. 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 eastern Catskills, along the Delaware, the Catskill proper (of upper Portage age) is overlain by Cayuta reds (the red equiv. of Cayuta, of Chemung age), which to W. is succeeded by true Montrose ss. (= upper Chemung or Weisburg). Bloomsburg, 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. W. Mather, 1843 (Geol. Soc. Am. Bull., vol. 44, No. 3, pp. 497-498), in order to avoid confusion, advocated the continued 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 Katskill (f)."

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 Katskill red beds be used for the restricted unit. (See Kateberg 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).

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K. E. Caster, 1934 (Bulls. Am. Pal., vol 21, No. 71, p. 26). Chadwick's Kateberg red beds Is more acceptable than Willard's Katskill to replace Chadwick's restricted Catskill, inasmuch as type section of Willard's Katskill, on Catskill 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.


Named for development in Catskill Mtns, Greene Co., N. Y.

Catskill division.

Catskill group.

See under Catskill fm.

†Catskill or Delthyris shaly limestone.


L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 120-122). Catskill or Delthyria 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. [Conynans] 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, 1802 (N. Y. State Mus. Bull. 52, pp. 524-528). Red and green shales interbedded with flaggy sand, 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 reports.]

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 silt, with three cgl. lentils, named (descending): Kilbuck cgl. lentil, Salamanca cgl. lentil, and Wolf Creek cgl. lentil. Underlies, 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 Carbt. 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 cgs. in the Cattaraugus, as did Glenn.]

Whether Cattaraugus fm. is late Dev. or early Carbt. 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 cgs., 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.


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 parva facies of an unnamed magnafacies which is characterized by purple shales and cgs.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 370), 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. 680): 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 parva facies.

See under Smethport magnafacies and under Cattaraugus fm., 1934 entry.

Cattasauqua limestone.

Ordovician: Southeastern Pennsylvanian (Northampton and Lehigh Counties).


Only recorded use of name. The name of the town is spelled Cattasaqua.
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.

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.

Caulfield formation.
Paleozoic (?): British Columbia.

Causapscal formation.
Devonian: Quebec (Matapedia Valley).

†Cavanal group.
†Cavaniol group.
Pennsylvanian: Central eastern Oklahoma and western Arkansas.

According to J. A. Taft (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.

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 Is. of Swallow is Wyandotte Is.

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, 1886 (Kans. Geol. Surv. Prel. Rept., pp. 20-21). *Cave Rock series.*—Applies to beds No. 156 (Cave Is., 15 to 30 ft. thick) and No 137 (Einsteine or
Ein stine ss., 45 to 60 ft. thick) of geol. section of eastern Kans. Underlies Stanton is. 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 gypsum 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.]


Named for Cave Creek, Comanche Co., Kans.

Cavell formation.

Lower Cambrian: Alberta (Jasper Park).


Cavendish schist.

Upper Cambrian: Southeastern Vermont (Windham 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. Ig. 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. 212-237.]

Cave Rock series.

See Cave-rock series.

Cave Springs sandstone.

Pennsylvanian: Southern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, p. 60). Cave Springs ss. suggested by G. I. Adams for ss. separating the two lss, composing Elk Falls Is. 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 ss. that occupy interval of Tecumseh sh. S. of Elk River were called Cave Springs ss. by Haworth (1898).


†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 charac-
terized by first appearance of Ostrea selliformia in S. C. and by abundant
association of Petrosia 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 inter-
graded 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
placenta, Petrosia lapidosa, Ostrea selliformia are found. At Kennedy's Scarp
on Tinkers Creek this pea-green sh. incloses a matted mass of soft shales 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 thick-
ness 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 hard to the touch; the latter feature is accentu-
ated by the large angular grains of glauconite. At one locality small semi-
pherical crystals of wessellite 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.

50 ft. thick. Underlies Graneros and overlies Brookville (ss.). 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.

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.

Same as San Cayetano fm., Dickerson and Butt, 1935.

Cayuga group.


period or group.—Includes Manlius Is., Rondout waterline, and Sallua beds,
which are knit together by lithologic and faunal characters and are distinctly
Ontario [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 Is. for lower part of the beds
formerly called Rondout. The Cayuga group (or Cayugan) has, there-
fore, for years been divided into these four fms.; but G. H. Chadwick in 1906 (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 Mankin Is.) 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 Is. 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).

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, 1832 (Rept. Geol. Surv. Wis., Iowa and Minn., p. xix). SW. [of Upper Mag. ls. area] we come upon the Cedar ls., contemporary with the Dev. fm. of English geologists, separating the Mag. iss. of N. from the Carbf. iss. 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 Iss." of his text include the Upper Dev. Lime Creek sh. and the Middle Dev. Cedar Valley and Wapsipinicon iss.]
Some later writers have used "Cedar Is." for Dev. Is. underlying Lime Creek sh., also for Dev. Is. underlying Grassy Creek sh. and Sweetland Creek sh., in which sense it is apparently a shortened term for Cedar Valley Is. 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 ashs., with occasional traces of cgl., the principal stratum of Cedar fm. is ls., which forms conspicuous ledges on road a few ml. W. of Buzzard's Boost. This ls. is rich in Triassic fossils, which clearly show it is same horizon as Hosselkus Is. 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 Bl., which is now known to overlie Hosselkus Is.].

Cedar volcanic series.
Oligocene: British Columbia.
C. Campbell, 1913 (Canada Geol. Surv. Mem. 26, p. 82).

Cedar Bay granite.
Mesozoic(?): Southeastern Alaska (Prince William Sound region).

Cedar Butte basalt.
Pleistocene: Southern Idaho (Power County).

Cedar Cliff limestone lens. (In Wills Creek shale.)
Silurian: Western Maryland and northern West Virginia.

Cedar Creek beds.

Named for Cedar Creek, Logan Co.

Cedar Creek limestone.
Pennsylvanian: Southeastern Nebraska.
G. E. Condra and N. A. Rongston, 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 (Neb. Geol. Surv. Bull. 1, 2d ser., p. 48). **Cedar Creek Is.**, 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., Neb.]. Probably does not extend to Mo. and Kans. [The sh. in which this Is. 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 (Neb. Geol. Surv. Bull. 3, 2d ser., p. 11). **Cedar Creek Is.** is abandoned for another name, which has priority. The supposed Cedar Creek Is. of Bull. 1 is thought to be Iola Is.

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.


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 Is. 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.


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 Is.** 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 Halgalto 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. 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 memtier. (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 Carb. 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).


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, 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.


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 Is.—Predominantly lsa., ranging from pure to argill., dolomitic, or perhaps carbonaceous; sometimes regularly divided by smooth bedding planes, again massive, elsewhere thinly 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 Wapashicanon Is.]

See Davenport beds.


T. E. Savage, 1925 (Jour. Geol.), classified Cedar Valley Is. as Upper Dev. According to E. O. Urich, 1911 (Geol. Soc. Am. Bull. vol. 22, pl. 28), it is of Middle and Upper Dev. age and — upper Hamilton and Tully Is. of N. Y.
C. H. Belanski, 1927 (Am. Mid. Nat. vol. 10, No. 10), restricted Cedar Valley Is. to Middle Dev. beds uncon. below his Mason City substage. Subsequent repts of Iowa Geol. Surv., however, have continued to use Cedar Valley Is. for all beds below Lime Creek sh. and above Wapsipinicon Is.

C. H. Belanski (1928) included Upper Davenport beds (Middle Dev.) of Iowa Geol. Surv. in Cedar Valley Is. (See second entry under Davenport beds.)

The Rept. 9th Ann. Field Conf. Kansas Geol. Soc., 1935, fig. 1, adopted Belanski's 1927 restricted definitions of Cedar Valley Is. and Shellrock fm. (see under Shell Rock Is.), 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, Queil, or Pentamerus Is.—Series of mag. lss., 10 to 90 ft. thick, characterized by abundance of large and noticeable fossils, most prominently Pentamerus oblongus and Megalomura canadensis; also includes series of very thin-beded 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 Is. Underlain by Blue Cliff or Springfield Is. Best exposed at Cedarville, Greene Co.


Cedarville sandstone. (In Monongahela formation.)

Pennsylvaniaian: Northern West Virginia and western Maryland.


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, aggs., intercalated flows, and about 5 per cent of non-volcanic sediments); (2) andesite lava flows 150 to 500 ft. thick; and (3) Lower Cedarville (3,700 ft. of andesitic aggs., tuffs, etc., intercalated flows, and about 5 per cent of non-volcanic sediments. The Upper Cedarville contains fossil flora considered by Chaney to be of Mascal (Upper and Middle Mio.) age. [Mapped over large part of Warner Range, W. of Cedarville.]


Cedarville andesite.

Miocene: Northeastern California (Modoc lava-bed quadrangle).


Ceja Glorieta sandstone.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 64, No. 4, 1936, 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 iss. 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 Ordovician 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.


R. C. Moore, 1932 (see under Drum Is.), divided Drum Is. into Corbin City Is. above and Cement City Is. below, and this definition of Cement City Is. 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 Is., according to Moore, is true Drum Is. at type loc.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 43+). Cement City Is. Is basal part of true Drum Is. 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 Is. members of Drum Is. are uncon.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Cemetery limestone.

Upper Cambrian: Western central Montana (Elkhorn region).


Cenocene series.


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).

These rocks were later subdivided into 4 fms., Ajax Is., Opex dol., Cole Canyon dol., and Bluebird dol.

Center iron sandstone. (In Clinton formation.)

Silurian (Niagaraan): Central southern Pennsylvania (Perry County).

C. K. and F. M. Swartz, 1831 (Geol. Soc. Am. Bull., vol. 42, pp. 625, 628, 632, 634, 638). Center iron sq.—Massive red-brown iron sq. 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 sq., 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 Is.; Canandaigua sh. [=Ludlowville sh. less Centerfield Is.]; Encrinal (=Menteth) Is.; 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 Is. and above Skaneateles sh., which are "probably equiv. in part to the Ludlowville shales of Hall," because they were not certain the Encrinal Is. of Hall (the fm. overlying the Ludlowville sh.) is same as Tichenor (Encrinal) Is. The Centerfield Is. was treated as basal memb. of Canandaigua sh.

D. D. Luther, 1909 (N. Y. State Mus. Bull. 128), included Centerfield Is. in Ludlowville sh.

C. A. Hattangel, 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 Is. (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 Is. as top memb. of Skaneateles sh.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 223). Centerfield Is. 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 Erle. Type section is on Schaffer Creek, 1 mi. N. of Centerfield.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 399), included this Is. in Ludlowville sh. but B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 11, 38, 44), included it in Skaneateles sh., although stating that it is usually included in the Ludlowville.

The U. S. Geol. Survey treats Centerfield Is. 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 Is. Thickness to E. Is not faultually 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 (Niagaraan): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402, 407). Centerville Is.—Includes Baker (Clinton) Is., South Tunnel bed (Osgood shaly clay), and Whites Bend (Laurel) Is. At Centerville the Osgood bed is lithologically simply a softer
phase in general Sil. section, although paleontologically it separates fauna of Clinton Is. below from that of Laurel Is. above. South of Harpeth River, where Clinton-Osgood-Laurel beds form practically a single lithological unit, the name Centerville Is. 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. P. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 173, 184-185). Until recently the Brassfield Is. 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 underlain 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. ScL 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. Tleje, 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. Recon. Tenn. 1st Rept., pp. 149, 154-156). Central Is. 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 clayey, 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 lss., 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 Is. 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 Is.—Thick-bedded, cherty, fossiliferous lss., of light-blue or dove color, 100 ft. thick. Basal fm. of Trenton

Nongeographic name. Replaced by Murfreesboro Is. Named for fact it outcrops in exact center of State.

Central marble bowlder member. (In Davis formation.)

Upper Cambrian: Southeastern Missouri.


Nongeographic name.

Central group.

Pre-Cambrian (Keweenawan) : Northern Michigan.


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, p. 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 Is., lying 17± ft. above Shoal Creek Is. and 17± ft. below Macoupin Is., which it resembles, is very fossiliaferous, and fauna differs from that of Macoupin Is. [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, 1927 (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 Pumpey'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 cgs., in all respects like underlying group. Thickness about 5,540 ft. Rests on Bohemian Range group and is overlain by the Sub-Greenstone group, 1,800 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, phaae, or div.—Bed 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 Esagyla 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. ScL, Sd, vol. 38, p. 601). 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 ml. 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. Pliosaurs, 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. a., 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.
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.

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 lls., very fossiliferous, containing three distinct faunules. Lower part or Striatala 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 Is. Basal part of Hackberry stage [restricted]. Underlies Owen substage of Hackberry stage and uncdn., or discon. overlies Sheffield fm. [Juniper Hill fm. of Van Tuyl, 1925], which was referred to the Hamilton by Webster in 1899.

Named, apparently, for exposures in Cerro Gordo Co.

Cerro Gordo moraine.

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.

Chaco marl.
Eocene: Northwestern New Mexico.
C. R. Keyes, 1908 (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. [Torreon] by Canyon Largo lss., 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 lss. 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 as. memb.—Buff, gray, and copper-colored as., gray sh., some carbonaceous sh., and sub-bituminous coa1. Thickness 0 to 360 ft. Top memb. of Mesaverde fm. in Chacra Mesa coal field. Replaces Cuff House as. as used by M. Bauer and J. B. Boeside, Jr., in this region. Appears to be same as Chacra as. 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. 66). 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 (Jamesstown) 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 as. of Pa.
W. Goldring, 1931 (N. Y. State Mus. Hdb! 10, p. 398), included Chadakoin beds in Chemung, and called underlying beds Cuba as.

Chadron formation.
Oligocene (lower): Western Nebraska and South Dakota, eastern Wyoming, and northeastern Colorado.

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. ScL, 5th, vol. 22, pp. 229-230). Chaffee fm.—A name applied to the Dev. deposits, of protein lithologic character, in areas to N. and E. of typical region of Ouray Is. 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 ss., shales, dolomites, and relatively small amounts of Is., and is characterized throughout by Dev. invertebrate fauna so well known in Ouray Is. 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. 192± 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).


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 Is. memb. of Thrifty fm. and Lower Chaffin bed of Drake is probably Blach Ranch Is. 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 Is. as top memb. of Thrifty fm. in Colorado River region, its type area, and as overlying Parks Mtan 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.

Chagrin shale.
Upper Devonian: Northern Ohio.


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, 1923 (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.

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-adjolining province. For this magnafacies the name Chagrin is being used. The Chagrin "fm." of 0. 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 fruvexion 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 quite 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).


Chalk Bluff formation.
Permian: Southeastern New Mexico (Pecos Valley region).

W. B. Lang, 1937 (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, ss., red beds, and dolomitic ls. 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. Interflngers 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.


Forms mass of Chalk Mtn, Eagle and Summit Counties.

Chalk Mountain dacite.
Recent (?) : Northern California (Lake County).


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, 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.

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 ss., of N. Mex., both Eocene, which correspond to Wasatch fm. of present terminology. Overlies Torreyon 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).
W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 282). Chamberlain shales.—Dark gray, almost black, shales, frequently arenaceous, 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 arenaceous 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 Is. It thus grades into overlying Newland Is. Estimated thickness in Little Belt Mtns 2,000 ft. Typically developed along Chamberlain and Sawmill Creeks, S. of Neihart. Estimated thickness on Sawmill Creek 2,075 ft.

Chamberlin's Brook formation.
Cambrian: Newfoundland.

Chambersburg limestone.
Middle Ordovician: Central southern Pennsylvania, western Maryland, and northwestern Virginian.
E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 27), transferred to Martinsburg sh. the shaly beds [0 to 245 ft. thick] at top of Chambersburg Is., 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 Is. memb. from Chambersburg Is. (because it is a distinct and mappable fm. over a large area) and restricted Chambersburg Is. to beds of post-Lowville Black River age. This is present approved definition of Chambersburg Is.

Chambly member (of the Lorraine).
Upper Ordovician: Quebec.

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 ssg. 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 unconf. underlies Datil fm. (late Tert.). Named for Chamiso Creek, T. 2 N., R. 9 W., Socorro Co.

Champaign morainic system.

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 1 1/2 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.

†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. Lawrencean terrane.” Also see Hochelagan fm. Champlain was preoccupied (1842) in same general region when introduced for these clays (about 1887).

†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.

Champliniic 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).
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.

Chancellorian series.

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, qgl., qtzite, and crystalline is. 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).

†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 Carbt to E. This embayment of red shales and ass. 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, 1924 (A. A. P. G. Bull., vol. 9, 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, 1835 (Geol. Soc. Am. Bull., vol. 40, No. 8, Aug. 31, pp. 1278, 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-wearing, 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 is. 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. 384). *Channahon Is.*—Dark-gray argil. is., 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 Is., 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) 1 1/2 ft. of dark-gray to brown, rather fine-grained, impure, fossiliferous Is. in layers 3 to 6 in. thick; (2) 2 1/2 ft. of dark Is., 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 Is. Rests on Maquoketa sh. and underlies Essex Is. Assigned to Alexandrian series, of pre-Clinton Sil. age.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 311-12, 351-376; Ill. State Geol. Surv. Bull. 23). Name Channahon Is. memb. will be retained for easy reference to the strata seen only along Desplaines River 1 mi. SE. of Channahon, Will Co. This Is. is considered a part of Edgewood fm., but cannot yet be correlated with any particular part of that fm. because of incomplete isolation of area from other exposures of Edgewood Is. and slight difference in its fauna from that of typical Edgewood Is. 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.

In his later papers Savage continued to include this is. in Edgewood fm.


Chanate sh. memb., 0 to 20 ft. thick, is probably near middle of Edgewood fm.

Chanute shale. (In Kansas City group, Kansas.)

Pennsylvania: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.


As thus defined apparently overlies Drum is., the top div. of †Erie is. as defined. Subsequent repts defined Chanute as overlying Drum is. and underlying Iola is., 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 iss. 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 is. and overlies Drum is. The Chanute sh. of Mo. geologists included true Chanute sh., true Drum is., and underlying Quivira sh., which is top part of Cherryvale sh. of SE. Kans. The Iola is. 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 is. and overlies Drum is. Early usage of Chanute sh. is somewhat confused because of miscorrelations of iss. above and below. It is clear, however, it was intended to designate the sh. and thin shs. that form plain extending E. from Chanute to the prominent escarpment made by the Bronson iss. The Iola is. is well exposed in vicinity of Chanute and it can be traced without difficulty to Iola, about 20 ml. to N. †Thayer sh. is synonym of Chanute sh. There is discord at base of Chanute sh. in part of SE. Kans. and northern Okla., also in vicinity of Chanute, where Drum is. and underlying sh. are eroded, so that ss. of basal Chanute rests directly on different beds of upper part of Dennis is., 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.


Chapapote formation.

Eocene (upper): Mexico (Tampico Embayment).


Chapelton formation.

Eocene (upper): Jamaica.


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 is., lower part at some localities altered to dol., followed by fine-grained yellow sh. 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 ml. W. of Chaplin, 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). Chaplin memb. of Hampton fm. (basal memb. of the Hampton in north-central Iowa) consists (above) of 8 ft. of oolitic Is. grading into dark-brown sugary dol., very fossiliferous; and below of 24 ft. of thin-bedded hard gray Is. containing Productus ovata. The fossiliferous brown dol. (7 ft. thick) that is found in upper part of this 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 Is. memb. that underlies it is faunally and lithologically like the oolitic Is. that caps top of North Hill memb. in SE. Iowa province; the gray Is. 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 Is. beneath and brown chert-filled dol. above. This makes possible a correlation of memb. with memb. The oolitic Is. then is considered top of Chaplin 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 Is. 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.


Chapman dolomite.

Permian: Central Oklahoma (Blaine County).


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 Eoedevonian fauna which corresponds closely with that of Gaspe 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 ss., some shaly layers. Thickness 300+ ft. Fauna seems to correspond closely with Lower Oriskany of N. Y. as recognized at Beacraft, and indicates the fm. is older than Mapleton and Moose River ss. and younger than Square Lake ss. Type loc. along E. bank of south branch of Presque Isle Brook, about 1 ml. from S. line of Chapman Twp, and about 1 ml. W. of Tweedy on road running SW. from Presque Isle.

H. S. Williams and C. L. Broger in 1916 (U. S. G. S. P. P. 89) assigned this fm. to late Helderbergian time.

†Chapman trachyte.

Devonian (?): Northeastern Maine (Aroostook County).


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 Is., 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 Chappel 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 pellets 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.


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 sh.; 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 sss., 7' 8" to 9' 9" 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.


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, over-
lying Kanawha black flint, and extending upward to the red shales ["Pittsburgh Red"] are all exposed in bluffs back of Charleston. The s.s.s. 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).


Named for occurrence at Charlestown, Washington Co.

Charlestown formation.

Ordovician: Anticosti Island.


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.]


Charlotte morainic system.


Charlton formation.

Tertiary? (Pliocene?): Southeastern Georgia and extreme northeastern Florida.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 29, pp. 69, 352-400). Charlton fm.—Soft, white, argill. Is., 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, Flia. 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 Flia. line in extreme SE. part of Charlton Co., Ga.]

Named for development in Charlton Co., Ga.

Charlton group.

Pre-Cambrian: Canada (Northwest Territories).

Charrette limestone.

Middle Ordovician: Eastern Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Rept. 1855-71, pp. 49-50). Charrette 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 Charrette 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.


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.


†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, 1859).

Chatham granite.

Late Devonian or late Carboniferous: Northern New Hampshire (North Conway quadrangle, White Mountains).

M. Billings, 1828 (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 Mtn batholith."


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. Chattooga River and a line extending southwesterly from a point on N. C. line about half way btw. Taxaway and Whiteswater 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 Is. 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 Chattooga River, on NW. bdy of Oconee Co.

Chatsworth morainic system.


†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 [Succarnochee 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 ml. by water, above Chattahoochee or River Junction, Fla., the white orbifodal ls. disappears, and in lieu thereof there is a rock more argil. and siliceous in character resembling some phases of Eocene Buhstone. This ls. is very well developed in a railroad cut about ½ ml. E. of Chattahoochee River, Ocheesee, 15 ml. below railroad bridge, and again at Rock Bluff, 2 ml. below Ocheessee section at Ocheesee, Fla.
2. A purer, more granular Is., creamy white and soft, resembling "chimney rock" phase [Marianna Is.] 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 Is. varying in purity, as at Ocheecee. For this older memb. of Miocene or newest memb. of Eocene White Is., 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 Is. yet observed in Ala. or Miss. On the rich black loam, derived from disintegration of these slightly phosphatic Is., the unique Torreya 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 Is. 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 Is. series. [Same description is given by Langdon in Geol. Soc. Am. Bull., vol. 2, pp. 604, 605, 1891, except Chattahoochee Is. 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.]


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 Is. and in spite of fact that it contains more impurities than typical Tampa Is. 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 formal rank.

Named for exposures along Chattahoochee River, especially at Chattahoochee Landing, Gadsden Co., Fla.

Chattanooga bed proper.

Miocene (lower): Southwestern Georgia and adjacent parts of Florida.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 41-54). Chattanooga bed proper.—Main element is peculiar gray or white Is. tinged with yellow; a soft friable rock well exposed at Old Chattanooga 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 Is. (†Chattahoochee fm.) of present usage.

Named for exposures at Old Chattanooga 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.


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 Heiderberg Is.

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. (?) (p. 349).

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.

Chattanooga 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.

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.

Chaufont formation. (In Black River group.)

Middle Ordovician: New York.
Glenburnie Is. (in Ontario), and Leray Is. 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 ss. alternating with the softer shales have produced by erosion an irregular topography difficult to describe and unequalled 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 ss., 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 S. of Buffalo, Fredonia, and Tyro, while its western border runs approx. from Yates Center to Toronto, Fall River, Elk Falls, Sedan and Egin. 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.  

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 Chautauqua (and to the Chemung) he correlates with Cayuta sh. and Wellsburg ss. members of Chemung of central N. Y.


Chaves shale.  
Permian; Southeastern New Mexico (Guadalupe Mountains).  
[Derivation of name not given. See also Pan-Am. Geol., vol. 65, No. 1, Feb. 1938, pp. 42, 46, 49.]
Chazy group (limestone where not divided).
Lower Ordovician: Eastern New York (Champlain Valley).


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 Maculurea 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. 508-574) 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. 18, pp. 155-159) Cushing applied Pamela 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 Is. and Crown Point Is., but which rest unconf. on Camb. Theresa fm. and are uncon. overlain by Lowville ls. Later (N. Y. State Mus. Bull. 145, 1910) Cushing applied Pamela (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 Is., Pamela Is., Crown Point Is., and Day Point Is. The Pamela does not occur in same section with the other Is., 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 Pamela Is.) At present the U. S. Geol. Survey classifies Pamela as Lower Ord.

Cheaha sandstone member (of Talladega slate).

Probable Paleozoic; Eastern Alabama.


Named from fact that Cheaha Mtn, Clay Co., is formed by the ss.

Cheboygan moraine.
Checkerboard limestone member (of Coffeyville formation).
Pennsylvania:
L. C. Snider, 1913 (Petroleum and nat. gas in Okla., pp. 44–49). Checkerboard Is. is probably 100 ft. above Lenapah Is.
R. W. Clark and C. M. Bauer, 1921 (A. A. P. G. Bull., vol. 5, pp. 282–292). Checkerboard lime is a hard blue Is., 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 Is.
A. W. McCoy, 1921 (A. A. P. G. Bull., vol. 5, No. 5, pp. 541–550). According to general strat. relation of Checkerboard Is. to Lenapah Is. of Okla., as described by Ohern, the Checkerboard Is. has been tentatively regarded as the base of Kansas City fm. or the Hertha Is.
C. N. Gould, 1925 (Okla. Geol. Surv. BulL 35, p. 72). Checkerboard Is. memb. of Coffeyville fm. lies near base of that fm. It is 1 1/2 to 3 ft. thick, fine-grained, fossiliferous, bluish white on fresh surfaces but weathers yellowish white. In bare stream 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 Is. 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.

Chediaki white sandstone member (of Troy quartzite).
Cambrian(?): Central eastern Arizona (Fort Apache Indian Reservation).
E. F. Burchard, 1931 (U. S. G. S. Bull. 821C). Chediaki 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 Is. Forms cliff on NE. face of Chediaki Mtn, and is conspicuous for many miles.

Chegoggin Point formation.
Age (?): Nova Scotia.

Chehalis sandstone.
Eocene: Southwestern Washington.
A. C. Lawson, 1894 (Am. Geol., vol. 13, pp. 436–437). Chehalis ss.—Soft, friable ss., generally clayey, bluish gray to yellowish, with thick beds of lignite associated with them in vicinity of Chehalis. It is very probable that the ss. 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 ss. at Chehalis, which T. W. Stanton says are either Eocene or Mio. and correlate with nonmarine Puget group.
Chehalis formation.

Miocene (lower) : Southwestern Washington.


Chelan physiographic stage.

Pleistocene: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. F. 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. 606). 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.


Chelmsford sandstone.

Pre-Cambrian (upper Huronian): Ontario.


Chelsea sandstone lentil (of Cherokee formation).

Pennsylvanian: Northeastern Oklahoma (Rogers County).

This name was first used by D. W. Obern 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 s.s. The Chelsea ss. is shown as 250± ft. below Fort Scott coal (top of Cherokee sh.) and as 200± ft. above Bluejacket ss.]


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. 322-328). Chemung group.—Rocks and fossils very distinct from underlying Ithaca group. Essential difference is lithological characteristics 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. ss. 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 pyrities, 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 ss., 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., Cashqua sh., and Middlesex sh., all of which were said to carry the Naples fauna.


G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 80, 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.
  - Cayuta memb.
  - Enfield or Attica memb.
  - Ithaca or Sonyea [new] memb.
  - Sherburne memb.
  - Gorum memb. (Clarke).

- **Naples group**
  - Hanover unit.
  - Pipe Creek unit.

- **Genesee group**
  - Portage unit.
  - Letchworth (sh.) unit.
  - Gardeau unit.
  - Grimes unit.
  - Hatch unit.
  - Rhinestreet unit.
  - Cashqua unit.
  - Middlesex unit.
  - Standish unit.
  - West River unit.
  - Gebhardewa unit.
  - Genesee 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 Conevango 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 Cheneysville ss. memb. The U. S. Postal Guide spells the town Cheneyville.

Chengwatana series.

Pre-Cambrian (Keweenawan): Eastern Minnesota (Kanabec and Pine Counties).

C. W. Hall, 1900 (Am. Ass. Adv. Sci. Proc., vol. 49, p. 191). Chengwatana 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.


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. Resta 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 tUpper 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 Beckmantown, 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.


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 Beckmantown group.

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


†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). 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. 82). 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.—Semin metamorphic clay slates and shales, s.s.s., grits, qtzites, c.q.s., and ls. Occupy in direct cross section a space of more than 10 mi. Occur along Smoky Mtns,
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

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.


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, 1916 (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, Bevler 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 Bevler or Williams coal lies in upper part of Cherokee sh., 60 to 100 ft. below Mulky coal.


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 Thicketsy 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 Klin, at Masters Klin and at Rayors Klin. Siliceous slates (slightly carbonic), qzite, hornblendes slates variously merging to ls. and marble; oxtellite schists; itacolomite; slates interbedded with hematite; lithia granite; gneiss; black slates; mica slates; meta-
morphosed 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.


Cherric period.
Pre-Cambrian: Montana.
See under Bitterroot period.

Cherry limestone.


Cherry shale.

Lower Ordovician: Eastern Nevada (Ely region).


A part of Pogonip ls.

Cherry Creek group.

Pre-Cambrian: Central southern Montana (Three Forks quadrangle) and southwestern Montana.

A. C. Peale, 1898 (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 quadrangle] 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.


Cherry Ridge group.

Upper Devonian or Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Ge., p. 64). Cherry Ridge group.—Consists of an upper div., divided into (descending): (1) Cherry Ridge qtzl. 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 ss., 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.

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. & 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 cgs., probably the lower ones, all the way to Susquehanna Valley. [The other important unit in his Cherry Ridge red beds is his Dyberry conglomerate, q. v.]

Cherry Ridge sandstone.
Upper Devonian or Mississippian: Northeastern Pennsylvania.
I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Ga, p. 64). Cherry Ridge ss.—Gray, current bedded, pebbly ss., 15 ft. thick. With underlying Cherry Ridge Is. 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.

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. Ga, 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. Gs, 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 ss. 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. Gs, pp. 65-66). Cherry Ridge ls.—An aggl. of chips of sh. 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, 1938 (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.


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 sh. was adopted by Moore and G. E. Condra in their Oct 1932 revised classification chart of the Penn. rocks of Kans. and Nebr.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 98). Type Cherryvale sh. overlies Winterset Is. and underlies Drum Is. 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 is locally occurring above flaggy Is. and below Drum Is. Correlation of Cherryvale sh. with Fontana and other Is. btw. Winterset and Drum Is. 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 Is., 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 Is.]

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 Is. with Anarcestes plebeiformis and the Agoniatites Is. The latter Is. 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 Is. as not to be readily distinguished from it. For these calc. layers specially characterized by the goniatites found therein, the name Cherry Valley Is. (1903 Clarke) has been suggested.

T. C. Hopkins, 1914 (N. Y. State Mus. Bull. 171, pp. 6-28), gave thickness of Cherry Valley or Agoniatites Is. in Syracuse quad. as 3 ft., and described it as impure Is., very fossiliferous, lying 15 ft. above base of Marcellus sh.


Chesaning moraine.


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.

**Chesewalla 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). *Chesewalla* 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 ss., with, in a few localities, a very thin ls. a few ft. above the Chesewalla. The Chesewalla 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 lenthls of red sh. a ml. or less long, which cause the formation of benches. It lies 60 or 70 ft. above Revard ss. Is well developed near point where Chesewalla 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. 109). *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.


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.

medes or Chester Is. usually consists of 3 subdivisions: (1) Upper Is., 40 to 60 ft. thick in Pope Co., Ill., massive, gray, in regular beds with argill. partings; (2) aren. or calcarea-argill. material, which in Pope Co. contains shaly ss. with terres-
trial plants; (3) lower Is.

A. H. Worthen, 1866 (Ill. Geol. Surv. vol. 1, pp. 40, 77, 284–292, 305–308). Chester group.—In 1854 I designated in my notes the beds at Chester as Chester Is. In 1856 Hall read a paper before Albany Inst. His reasons for substituting Kaskaskia for Chester Is. 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 is. with intercalated beds of aren. and argill. shales and ss., 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 is. in Ill., its type area. According to original definition of Ste. Genevieve Is. (Shumard, 1860), that fm. underlies the †Ferruginous ss. and overlies St. Louis Is. (restricted to pre-Ste. Genevieve beds) in Ste. Genevieve Co., Mo., the Ste. Genevieve type area. In 1802 O. 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): Kin-
kaid Is., Degonia ss., Clore Is., Palestine Is., Menard Is., Waltersburg ss., Vienna Is., Tar Springs ss., Glen Dean Is., 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 Is. belongs in whole or in part to Chester group or to Meramec group. (See under Ste. Genevieve Is.) The U. S. Geol. Survey did not for many years assign the Ste. Genevieve to either group, but in May 1927 it was decided to adopt Well's interpretation that "Upper Ohara" of repts belongs to Renault fm., and to transfer the remainder of Ste. Genevieve Is. 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 Ver-
mont.

B. K. Emerson, 1802 (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 saxomite, 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, faggy hornblende schist, in places changed to serpentine and emery, with beds of altered basalt. Which are believed to be contemporaneous with Bellowspipe Is. 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).


**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. Ailing, 1918 (N. Y. State Mus. Bull. 199, pp. 114-115 and fig. 25). *Chesterfield Is.*- 50 ft. thick, seems to be a new one in Grenvillian stratigraphy, although it may be a phase of Faxon Is. 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 Is.

**Cheestnut sandstone member** (of Pottsville formation).

Pennsylvanian - Central Alabama.

C. Butte, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 19). *Cheestnut 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.

†**Cheestnut Hill schists and gneisses.**

Pre-Cambrian (Glenarm series) - Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C, map and pp. 24-27). *Cheestnut Hill garnetiferous schists* [on map]. *Cheestnut Hill group* of garnet schists, serpentine,
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).


Chetang limestone.
Cambrian: British Columbia and Alberta.


Chetopa shales.

Cheverie formation.
Mississippian: Nova Scotia.


Chewacla marble.
Pre-Cambrian: Eastern Alabama (Lee County).


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.


Chewelah argillite.
Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 05, map). Chewelah argillite.—Interbedded quartz mica schists, phyllites, argillites, calc. argillites, dolomitic lls., argill. lls., 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 Is. 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.

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.

P. 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.]


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. 256). 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 Clitecton 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.]


Chicago formation.


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 ss., the shales predominating and being gray to drab, rather soft, poorly bedded; the ss. 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, cpl. 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.


The iss. 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 Lignite or lignite-bearing beds of the Eocene, which lie beneath the Orangeburg, Tallahatta, or Buhrenite fm. It is not the Lignite 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 Lignite by Hilgard (Agric. and Geol. Miss., 1869, p. 110) ; Heilprin has termed it Eolitigitta (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, 1885, 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. 195-264.

In table on p. 334 of U. S. G. S. 18th Ann. Rept., pt. 2, Dall shows Chickasaw as occupying interval btw. Claibornian above and Midwayan below. This interval corresponds to Wilcox group of present classification. But ?Northern Lignitic of Hilgard, which ?Chickasaw 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 ?Chickasaw 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, 18-19, 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.

of variegated ss. 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, 8 divisions can be recognized in the Chickasha—an upper purple ss. memb., 70 to 80 ft. thick; a middle pink sand memb., 60 ft. thick; and a lower purple ss. memb., 50 ft. thick.

Chickies quartzite.

Lower Cambrian: Southeastern Pennsylvania.


J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. CC, on York, Adams, and other counties, index). "Chiques (or Chickies) quartzite, page 226." (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 (Chique's rock, etc.).")

J. P. Lesley and P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C, map of Lancaster Co.). Chickies 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, pp. 6-8, 19-20, 108). Chickies qtzite.—The qtzite of Chickis 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 150 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 Chickis qtzite are much more chloritic than those which overlie it. The qtzite of Chickis rock can be followed out into and across the river, and it plays a part in the long ridge on the York Co. side. Chickis 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). Chickies 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, 303-400). Hellam qtzite, Cambrie.—Same as Potsdam ss. and Formation No. 1. The base of the Paleozoic. A part of it composes Chickis Mtn. Contains Scolithita linearia. The Hellam or Chickies 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 Reps. of Prog. (probably not same as Potsdam ss. of N. Y.) and Primal ss. Only fossil found in Chickies 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 Is.) and is underlain by South Valley Hill hydromica slates.


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. 120). 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.), Penca's ranch, and Tuscan Springs.

The Chico rocks consist of ssis., shales, and cglis. 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.

Chicotepec formation.

Eocene: Mexico (Tampico embayment, north end).


Chicopee shale. (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.


B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 59; 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 sily calc. sh. or shaly sa., 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 caelcete. 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 ss. 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 thk 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 intertongues laterally, into the shales S. of that stream.
Two prominent tongues of the Is. (Rock Hill Is. at base and Devils Den Is. at top) are well developed S. of the river. They thin to SW., however, and lens out near Willow Point, Wine Co., and Joplin, Jack Co., respectively. To S. of river the interval btw. Rock Hill and Devils Den Is. is filled with more than 300 ft. of shales and sss., here named *Jasper Creek* shales, which are exact strat. equivalents of Chico Ridge Is. N. of river. Most of the Is. 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).


**Chief Consolidated limestone.**

Ordovician: Central northern Utah (Tintic district).


Crane's Chief Consolidated and Gemini lss. compose Bluebell dol.

**Chief Hill volcanics.**

Tertiary (?): Yukon Territory.


**Chignik formation.**


W. W. Atwood, 1911 (U. S. G. S. Bull. 467, pp. 24, 41-48, map). *Chignik* fm.—Cgl., ass., sh., and coal seams, 600+ ft. thick. Underlies Kenai fm. (Eo.) and overlies Herendeen Is. (Lower Cret.). Occurs on shores of Chignik and Herendeen Bays and near Douglas Village. Type section is in Whalers Creek, ½ ml. 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 *Children 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 referred 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.]
Childress dol. and gyp. is top memb. of Blaine fm., and lies 100± 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.


Chilhowee group.


J. M. Safford, 1856 (Geol. Recon. Tenn., 1st Rept., pp. 149, 152-153). Chilhowee ss. and shales.—Great group of dark-gray, micaceous, sandy shales and ss., 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 knoria. Underlies Camb (provisionally) Mag. Is. and sh. group (Calcareous ss.) and overlies Azoic Ocoee, cgl. and shales.

J. M. Safford and J. B. Killebrew, 1874 (Resources of Tenn.) and 1876 (Elem. Geol. Tenn.), included in Chilhowee ss. all beds between Knox ss. (Rome fm.) and Ocoee group. This usage probably did not include the so-called "Beaver" Is., which was discriminated many years later.


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.


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 Ervin qtzite and lowest fossils found occur in Murray ss.; and consist of Olenellus and brachiopods.

†Chilhowee conglomerate.

Lower Cambrian: Southeastern Tennessee.


Preeoccupied. 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 Is.)
Carboniferous and older(?) :

Chilliwack series. (Argillite, quartzite ss., and ls., with interbeds of grit and cgl.)

Exposed along Chilliwack River, B. C.


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, tufts, and aggs. The Chilliwack volcanic fm. is overlain by (ascending): Gray calc. quartzite and argillite 50± ft.; light-gray ls., 50 ft.; dark-gray argillite, 20 ft.; quartzite 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.


Chilton sandstones. (In Kanawha formation.)

Pennsylvaniaian: 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 Is. 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, 65, 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 ared., 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 Is.—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 Hunton sh. and uncon. overlies Sylvan sh. Corresponds to Ohio Clinton (Brassfield Is.). It is named after Chimneyhill Creek, which crosses the fm. in NE. corner of Arbuckle Mts. 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.


Chinatni series.

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

Assigned to Perm. by C. L. Baker, 1929 (Univ. Tex. Bull. 2901, pp. 73+). Is a local name for all of Perm. in Chinatni 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.—Shs., with subordinate amounts of ss. and shs. Thickness 1,300 to 2,400 ft. Rests with apparent conformity on Tuxednl shs. 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, southwestern Colorado, and northern New Mexico.

For distribution and further details see U. S. G. S. P. P. 98, 1917 (by H. E. Gregory); U. S. G. S. 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. 132, 1923 (by C. R. Longwell); U. S. G. S. Bull. 751, 1924 (by H. D. Miser); U. S. G. S. P. 150, 1928 (by J. Gilluly and J. B. Reeside, Jr.); and U. S. G. S. 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. 633-647, map). Chino Quarry qzst.—Interstratified thin-bedded qzstite 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. 633-647, map). Chino Quarry ls.—White, medium- to thin-bedded and, medium to coarsely granular ls.; graphitic
beds throughout, but more common near base. Thickness 470-4 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 Cattaragus 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 Is.

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.


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.
†Chipolain stage.

Terms used in early repts to include Miocene deposits (Alum Bluff group and Tampa Is.) of Fla., and now abandoned in favor of better-estab-
lished 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 clg. 300 ft. thick. The pebbles of this clg. are either jasper or amorphous quartz. The clg. 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 qtzite* 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, pi. 1), mapped *Chippewa Valley qtzites.*


Named for exposures on Chippewa River, Chippewa Co.

†Chippewa felsite. (In Ashbed group.)
Pre-Cambrian (Keweenawan): Northern Michigan (Porcupine Mountains).

W. C. Gordon, 1006 (Mich. Acad. Sci. 7th Rept., pp. 186–195). 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. 590, 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 P. E. Wright and A. C. Lane, 1909, Mich. Geol. Surv. Rept. State Board for 1908, pi. 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).


Chiricahua limestone.
Permian: Southeastern Arizona (Chiricahua Mountains).

B. E. King's proposal to use Gyp in for the Perm. of S.E. Ariz., as present evidence does not warrant detailed and direct correlation. Considered younger than Snyder Hill fm. Forms top of Carb. sequence in Chiricahua Mts 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, 1918 (Smithsonian Misc. Coll., vol. 64, No. 5, Pub. 2420, pp. 408-410). 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.


Chisholm 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. 61-69). Chisholm cpl.—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 Chisholm 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.). Chisholm cpl. at type loc. on Chisholm Island, is 300-400 ft. thick, and is conformable with both Chinitna sh. and Ascella-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 cgl. 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 Carb. or Dev.

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, chart opp. p. 52, pp. 82-83), referred Chisna fm. to Carb.

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. Graded 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 Mts., 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 or 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, 451). 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.). 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 quartzite with siliceous cement. In most places it forms a persistent cuesta. Underlies Omakaska 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).*


G. C. Martin, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 690), introduced *Nizina Is.* for the thin-bedded is., shaly toward top, forming upper, and conformable, part of Chitistone is. as first defined, and restricted *Chitistone is.* to the lower massive is. This is present approved nomenclature of U. S. Geol. Survey. (See also G. C. Martin, U. S. G. S. Bull. 778, 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 is. 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 Onatka Creek sh. of western N. Y. Type section is in a small gully 0.7 ml. N. of village of Chittenango Falls, where entire section, 120 ft. thick, is exposed. At top it interdigits with the blue-black Cardiff sh.

G. H. Chadwick, 1933 (10th Int. Geol. Cong. Guidebook 9A, p. 4), divided the Marcellus W. of Catskill region into (descending): Mount Marion sh., 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).*

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 Is. (Miss.).

Chloridian series.
A term introduced by C. [R.] Keyes to cover 75 ft. of Upper Camb. iss. (called by him Carrasco) in N. Mex., and Abrigo Is. (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, 1877 (Geol. N. H., pt. 2, pp. 154, 230, pl. xl). 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 Eozolc or early Paleozoic. They cut Eozolc 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 riебеккite 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.]


†Choctaw buhrstone. (In Claiborne group.)
Eocene (middle): Southern Alabama and Mississippi.


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 lime*stone.

Lower Cretaceous (Comanche series): Northeastern Texas.


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.


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) *CANCELARIA* zone and (2) "aluminous clay," both upper Mi.; (3) *Ecophorus* zone, (4) *Arca* zone, and (5) *Foldia* zone, all middle Mi.

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 limestone between thin beds of dol. Lower beds as a rule are rather massively bedded chert-bearing dark-mottled dol., locally calcitic and cross-bedded and containing thin lenses of dol. cgl. These beds are supplanted higher in fm. by thinner bedded dol. with sandy limestone or, locally, by bands of chert. Lower Ord. fossils near top. Thickness 850 to 1,060 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. 329-379). *Chopaka schist.*—A large patch of schist that crowns Chopaka Mtn. Very similar to Kruger schist (Carb.?), with which it may be contemp. May possibly be Triassic.

Chopaka basic intrusives.

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


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.


Chouteau limestone.

Incorrect spelling of Chouteau Is.

Chouteau limestone. (Of Kinderhook group.)

Mississippian: Central and eastern Missouri and southwestern Illinois.

opp. pp. 98, 103). **Chouteau Is.**—In Cooper Co. region upper part is thick­
bedded, brownish gray, earthy, silico-mag. ls. 40 to 50 ft. thick; lower part com­
pact, blue or drab, thin-bedded Is. 20 ft. thick. Underlies Emerinita [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. 190). 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. **Redalia Is.**, 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] Is.

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.

Stephenson in unpublished ms. In N. C. the Talbot terrace divides into two 
terraces, constituting Chowan and Pamlico fms.

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 sep­
arating it from Wicomico plain above. Where it passes up river valleys, how­
ever, it probably reaches max. elevations of 70 ft. at inland extremities of ex­
tensions. 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.

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.


Christie member (of Dundas formation).

Orдовиций: Онтарио.


Chrysler waterlime.

Silurian (Cayugan): Central New York (Syracuse region).


B. Smith, 1935 (N. Y. State Mus. Bull. 800, pp. 16-18), named the basal fm. of Manlius group in Skaneateles quad. the Oney la.; 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, 1894 (U. S. G. S. 14th Ann. Rept, pt. 2, pl. 89, etc.). Chuar terrane.—Upper div. consists of 1,700 ft. of sas. and shales with some las. beds, reddish, brown, black, gray, buff, etc. in color; base is massive bed of reddish brown sas. Lower div. consists of 3,420 ft. of shales and sas. with some las. beds; of brown, gray, black, drab, and chocolate color; basal part consists of argill. shales resting on massive mag. las. 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).


Chu Chua formation.

Eocene: British Columbia.


Chuckanut formation.

Eocene (lower): Northwestern Washington (San Juan Islands).

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.

Chuotenunda.

Middle Ordovician: Eastern New York (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 Col. 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 Opechee 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 red beds rest on Dinwoody fm. In other parts of Wyo. the red beds 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 Pecosout 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. 728 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 Is. In mapping these deposits it was found that while Lee's subdivisions were discernible in places, it was impracticable to separate them generally. Although Is. is conspicuous feature of San Andreas Is. 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 1938 (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 Is. (considered to be same as San Andres Is. memb. of Chupadera fm. to W.), and (3) Nogal fm. (considered to be same as Yeso memb. of Chupadera fm. to W.).


Church limestone. (In Howard limestone.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.


R. C. Moore, 1938 (Kans. Geol. Surv. Bull. 22, pp. 207-208). Church Is. Is most persistent and important memb. of Howard Is. It overlies Aarde sh., or where Bachelor Creek Is. is absent and Aarde sh. is not differentiated, it forms basal unit of Howard Is. and rests on Severy sh. It underlies Winzeler sh. Thickness 1½ to 6 ft. Type loc. Church farm, on Turner Creek, SE. of Du Blos, 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.


Church Run conglomerate.

Churn Creek member.
Mississippian: Southern Ohio.
J. E. Hyde, 1916 (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 Pant 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. overlaid 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 ChuBa 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.

Chuschina formation.
Lower Ordovician: Alberta and British Columbia.

Chuska sandstone.
Tertiary (Eocene?): Northwestern New Mexico and northeastern Arizona.

Cibao limestone.
Tertiary: Puerto Rico.

Cibola limestone.
Silurian (?): Southwestern New Mexico (Silver City district).

Cibolo formation.
Permian: Southwestern Texas (Shafer district, Presidio County).
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P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, p. 908), state that underly­ing Clenegulta and Alta beds of Udden have been proved to be Perm.

Named for Cibolo Creek and Cibolo ranch, Presidio Co.

Clenegulta beds.

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

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10-25). Clenegulta beds.—Chieflly 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), cgs., dark Iss., 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). Clenegulta and Alta beds, of Shafter region, formerly classed as Penn., have been proved to be of Leonard (Perm.) age.

Named for Clenegulta 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. 580-614). 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 Belones 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 Is.-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.


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 quad.

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."
tCincinnati group.
Originally proposed for the rocks now called Cincinnatian series. For definition see U. S. G. S. Bull. 769, p. 85.

tCincinnati shale.
A name applied in early reports to Maquoketa sh. of Miss. Valley.

tCincinnati 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 Is.” to the blue Ord. Is. of Cincinnati group.

[Cincinnatian series] of Cincinnati.

tCincinnati 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 Is. 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 boundary 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 tCincinnati 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.

Cincinnatian system.

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, Otselc 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 especially characterized by Spirifer mesastria. Typical exposures are along Otselc River.


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.


Cinquefoil limestone.
Upper Devonian: Alberta (Interlaken to the Palisade).
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 Kfn fms. of area to E.

Cintura formation.
Lower Cretaceous (Comanche series): Southeastern Arizona (Bisbee region).

P. 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 Is. Consists of (descending) : (1) 800 ft. of reddish nodular sh. interbedded with flaggy cross-bedded s.s., 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 s.s. with occasional layers of red sh.; (3) 700 to 800 ft. of red nodular sh. with occasional beds (some 6 ft. thick) of buff s.s. and very subordinate beds or lenses of impure, greenish nodular ls.; (4) 100 to 150 ft. of red sh., thin-bedded s.s., and aren. gray or greenish ls., 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.

Cinturn series.

Circle erosion cycle.
Pleistocene: Central western Wyoming.


Circle volcanics.
Mississippian (early): Northeastern Alaska (Engle-Circle district).

J. B. Merrill, 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.


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.
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

Citadel series.

Ordovician: Quebec.


Citico conglomerate.


A. Keith, 1895 (U. S. G. S. KnoUville folio, No. 16, p. 2). Citico cgl.—Entirely siliceous, varying from fine white as, 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. [Following 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 an yellow and red sands and clays, locally gray when 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 ml. 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. 29th 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 aand. 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.


Named for City Bluffs (now known as Burlington Junction), Nodaway Co., Mo.
City Lake sandstone member (of Springer formation).
Pennsylvaniaian: 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 s. 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 (Scl., 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.]
B. 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)."
B. 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.).

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.


C. E. Weaver, 1910 (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. (Area montereyenais 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, 261-284). 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.

Clansyes beds.
Cretaceous: Mexico.

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.

Clarendon formation.
Pennsylvanian: Northeastern and central eastern Oklahoma.
C. N. Gould, D. W. Obern, 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 ls. and two sh. beds, the lower Is. coming in below Fort Scott ls. of Kans., which consists of two ls. beds and one sh. bed. Basal fm. of Tulsa group.

Clarendon beds.
Pliocene: Panhandle of Texas.
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. 82, 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.


Clarendon Springs dolomite.

Lower (?) Cambrian: Southwestern Vermont (Rutland County).


C. Schuchert, 1933 (Am. Jour. ScL, 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.


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).


I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). Clarion group extends from top of Substrate iron ore that overlies Ferriferous (Vanport) ls. to base of fire clay that underlies Brookville coal.


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.


H. M. Chance, 1884 (2d Pa. Geol. Surv. Rept. H, 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.


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 ss., 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.


†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 Nacapoch sand, Saratoga chalk, Marlbrook marl restricted and Annona chalk.

Named for exposures in Clark Co.

Clarke interglacial.

Pleistocene: Ontario.


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.


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).


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 Is. — Compact blue is., usually sharply separated from overlying Jamesville Is. and underlying Elmwood beds, all included in Manlius group. Undoubtedly included in Vanuxem's Manlius. Some authors have included this Is. and overlying Jamesville Is. in Helderbergian. Thickness 0 to 2 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.

Clarksburg limestone member (of Conemaugh formation).
Pennsylvania: Southwestern Pennsylvania, western Maryland, West Virginia, and eastern Ohio.
I. C. White, 1891 (U. S. G. S. Bull. 65, p. 88). Clarksburg Is. — 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 80 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 Is.

Clarksburg volcanics.
Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette district).
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.)
Pennsylvania: West Virginia and southwestern Pennsylvania.

Clarksburg fire clay shale. (In Conemaugh formation.)
Pennsylvania: Northern West Virginia.
Clark's Mill beds.

Lower Devonian: Central Pennsylvania (Perry County).


†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.


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. 1,258 and 1,274 ft. in Gilbert No. 1 well, on Gilbert farm, 2 ml. N. of Richburg, Allegany Co., N. Y.

Clarno formation.

Oligocene (lower) and Eocene (upper): Central northern Oregon (John Day Basin).


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.


F. H. Knowlton, 1928 (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. 348). 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).


Clarysville sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland ( Allegany and Garrett Counties) and northeastern West Virginia.


C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 67, pl. 8). 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 Is. in upper Kanwaka sh. is named Clay Creek la. and the portions of the Kanwaks above and below are given the names Stull sh. and Jackson Park sh., respectively. [On p. 52 Clay Creek la. is described as consisting of 2 ft. of hard bluish Is. that weathers brown; shelly. Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 171), more fully described this Is. 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.

Pennsylvania: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 9+1. 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 ss. 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.)


Clayville 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 la.
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 Ostracod (?); sometimes irregularly indurated; in upper 10 ft. pockets of white sand enclosed in black clay; (2) light-yellow siliceous ls., large Ostracod 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.

Clayton clay.

†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).
Claytonville dolomite. (Cheney, 1929) replaced "Sweetwater dol.," which is preoccupied. Claytonville dol. 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-Vandalus 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 ml. 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. 8.-SW. of Bessemer.

Clear Creek limestone.

Middle and Lower Devonian (Onondaga and Oriskany): Southwestern Illinois and southeastern Missouri.

A. H. Worthen, 1866 (III. Geol. Surv. vol. 1, pp. 126-129). Clear Creek Is.—Fossiliferous Iss., 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 Iss., underlain by 10 to 25 ft. of mottled Iss. with, locally, at base, 4 ft. of fossiliferous coarse-textured dark bluish gray Iss. Overlies Niagara Iss. and underlies Oriskany ss.

A. H. Worthen, 1868 (III. Geol. Surv. vol. 3), assigned Clear Creek Iss., 200-250 ft. thick, to Oriskany.

In some subsequent repts Clear Creek Iss. was assigned to Oriskany and Lower Helderberg.

A. H. Worthen, 1882 (Eccon. Geol. Ill., vol. 1), assigned Clear Creek Iss. (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 Is. 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 Iss. to beds said to be of Oriskany age, and named the beds of New Scotland (Helderbergian) age Bailey Iss. As he defined it, it was said to be overlain by Grand Tower Iss.


restricted Clear Creek to 200 to 240 ft. of chert and is. of upper Oriskany age, over lain by Grand Tower Is. (of Onondaga age), and uncon. under lain by New Scotland Is. (of Helderberg age). This classification was followed by E. F. Lines, 1912 (Ill. Geol. Surv. Bull. 17, pp. 59-76); R. S. Blatchley, 1915 (Ill. Geol. Surv. Bull. 22, pp. 26-32), and 1914 (Ill. Geol. Surv. Bull. 25, 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, 800+ ft. thick, of chert and is. 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 Is.; in SW. Ill. it is uncon. on Backbone Is., of Helderbergian age. It 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 Ullstein (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. 550-555), 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 Is.

C. P. 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 Is. (of Oriskany age). In Mo. It is underlain by Little Saline Is. (= lower part of Backbone Is.) and overlain by Dutch Creek ss.


The U. S. Geol. Survey at present classifies Clear Creek 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 Is.; to N. contains considerable clay and in places is divided by 20 to 50 ft. of clay. Upper is. 5 to 15 ft. thick; lower is. 25 to 75 ft. thick. Fossiliferous. Total thickness 20 to 140 ft. Mem. of Canyon div. Underlies bed No. 7 (25 to 100 ft. of clay) and overlies Cedarton bed.

F. R. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 36; Univ. Tex. Bull. 2132, pp. 109, 111, 113, 115). Clear Creek Is., 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 Is. 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.
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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 Is. members. He also discarded Clear Creek Is., 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. Culver, 1935 (Univ. Tex. Bull. 3501), divided Brad fm. of McCulloch Co., Colorado River region, into following members (descending) : Ranger Is., Placid sh., Clear Creek Is., and Cedarton sh., and stated (p. 205) ; Clear Creek Is. is also known as Merriman Is.

Named for Clear Creek, Brown Co. According to Wallace Lee (ms. soon to be published by Tex. Geol. Survey), Merriman Is. of Brazos River region as originally defined by Reeves corresponds to only the upper (3 to 4 ft. thick) of the 2 int. that were included in Clear Creek Is. of Drake and of Plummer and Moore in Colorado River region. The beds called “Clear Creek Is.” (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 Is. as much younger than Merriman Is., and included both in Brad fm., drawing base of Brad considerably lower than Merriman Is., and at top of Staff Is. 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 Devon-Carb. 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.].


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).

Clear Fork group.
Pennsylvanian: Western Missouri.
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 Sedalla to Kansas City. Overlies lower Carbt.
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.
Some geologists include Arroyo fm. of Beede and Waite in Clear Fork group, but Beede, Waite, and Watrer 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.

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 ss., 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 Is. 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 158± ft. above top of Avant Is. and 175± ft. below Bigheart ss.

Clemville formation. (In Chaleur series.)
Silurian (Niagaran) : Quebec (Gaspe Peninsula).

Cleopatra quartz porphyry.

Clepsydrops shale.
A paleontologic name (listed in U. S. G. S. Bull. 191) applied by E. D. Cope, 1870 (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 (McKeen County).

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R, pp. 46, 128). Clermont (Ferriferous) Is.—Bluish gray siliceous Is., 4 to 8 ft. thick. First studied in vicinity of Clermont, McKeen Co. Has been traced through and identified as Ferriferous Is. Lies 30 ft. above Clermont (Clarion) coal and 8 to 32 ft. below Lower Kittanning coal.

Same as Vanport Is. memb., the older name.

Clermont group. (In Allegheny formation.)

Pennsylvanian: Central northern Pennsylvania (Elk County).


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 Is., of Maquoketa stage [group], and underlain by Elgin shaly Is., also of Maquoketa stage.

Named for exposures at Clermont, Fayette Co.

Cleveland shale.

Upper Devonian or Mississippian: Northern Ohio.


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.


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 green-sand 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.

Cliff limestone.
Silurian and Devonian: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.
John Locke, 1858 (Ohio Geol. Surv. 2d Ann. Rept., pl. opp. p. 205, pp. 206, 211). Cliff Is.—Generally compact, often soft and friable, sometimes porous and spongy Is., also aren. Is.; fossiliferous in places; of yellowish, reddish, gray, or nearly white color. Thickness 89 ft. Overlies the blue Is., 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.

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. F. 134). [See under Mesa verde group, 1924 entry.]

Cliff Lake granite porphyry.
Pre-Cambrian: Manitoba.

†Cliffwood clays.
Upper Cretaceous: Northeastern New Jersey.
H. B. Kümmler 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 16 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].

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 la.—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.] ls. is located on lower part of fm. Same as Menisco la. Underlies Linden ls. [Dev.], and overlies Dyestone group.

Clifton formation.
Pennsylvanian: New Brunswick.

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. ss. and shaly ss., 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). Interbeds 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 la.—A bed of ls. nowhere more than 2½ ft. thick. Named for East Fork of Little Clifty Creek, Eureka Springs quadr., where, within an area not exceeding ½ sq. mi., all its known exposures occur. Lower 1½ ft. ls. 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 conchoi dal 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 la. Contains Hamilton fossils in lower 18 inches.

†Clifty conglomerate lentil.
Pennsylvanian: Eastern Tennessee (White County).
Clifty shale.
Pennsylvania: 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; Vandeaver 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. Reconno. Tenn. 1st Rept., p. 157). Clinch Mtn ss.—Light-gray, generally thick-bedded ss., at many points abounding in fusoids; 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. 13) 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.


Probably named for Cline, Uvalde Co.

Clingman conglomerate. (In Chilhowee group.)


A. Keith, 1885 (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.


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. Grabaub (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 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 is. and ore to what he described as "really a ferriferous is., 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 is. 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 is.) the upper 20 ft. of calc. beds ("really a is.") heretofore included in the Rochester.

In 1923 (Md. Geol. Surv. SII. 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,
Ulrich again redefined the Clinton by including 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 Is. 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.


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. 86). Clipper Gap fm.—A highly compressed sequence of black clay slates and dark argill. ss. Bodies of ls. abun-
dant 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 silification. 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 ls. [than underlying Swift Current beds] probably reaching thickness of 150 ft. Are of post-Leray Black River age. In lower part fine-grained ls. alternate with coarser grained layers for vertical distance of about 30 ft.; these are overlain by coarser grained ls. 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 ls. 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.

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 ls., 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.

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, 1928 (Okla. Geol. Surv. Circ. No. 13), suggested that "it might be well to consider the Day Creek the basal part of Cloud Chief gyp."


R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40111). 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 Kan.

B. L. Cutten, 1930 (A. A. P. G. Bull., vol. 14, pp. 101-172). 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.]

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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. 3282, p. 149), 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, 1455, 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 gypsuns 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 gypsuns 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.


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.

See also M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps and text).
Clover quartzites.
Clover Canyon quartzites.

Pre-Cambrian: Northwestern Nevada.

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).

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 Fusion fm., underlain by 10 to 60 ft. of course-grained buff or dirty gray cross-beded 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 Mtsn to the Fusion 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 Cleverly, 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 Cleverly, 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, 1905), 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 Thermopollas 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. 22-28), 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 Is. 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 olivine and underlies Mission argillite. [Mapped around headwaters of Clugston Creek.]

Clyburn formation.
Pre-Cambrian (?): Canada (Cape Breton Island).

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 Is. memb. of underlying Belle Plains fm. and top of Talpa Is. bed of Drake. Thickness averages 475 ft. In Colorado Valley is overlain by higher Is. strata that outcrop 2 mi. E. of Talpa, on Santa Fe R. R. Named for town of Clyde, 8 mi. W. of Balm, 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.

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, 301, 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.

Coahulla silt.
Pleistocene: Southern California (Imperial County).
G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, p. 435). The Yuba Reefs are followed by an enormous thickness of silt deposited in fresh waters of ancient Lake Coahulla, an appropriate name for which is “Coahulla silt.” It is exposed where San Diego-EI Centro highway crosses New River about 1 mi. W. of El Centro. Total thickness of these slts is not known but they contain fresh-water fossils to base of exposure indicated.

†Coal Bluff series.
†Coal Bluff beds. (In Wilcox group.)
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 NanafaUa group and above Coal Bluff lignite, inclusive.

This term, as above defined, restricted NanafaUa fm. by separation, from its basal part, of these beds as well as the underlying lignite. The 1886 and 1892 uses of NanafaUa by E. A. Smith were NanafaUa 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. 145-152) 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 aa.—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 aa.—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 aa.—Massive, gray and brown, medium-grained and aren. stratum, 20 to 60 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 Mt., 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.

Coal Creek formation.

Silurian to Mississippian: New Brunswick (Queens and Sunbury Counties).

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. Boes, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 2, p. 306), mentioned the pre-Camb. Coal Creek qzsite and Ruthton 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.


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, 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 Tombol 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 sh. 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.


Coamo Springs limestone series.

Eocene: Puerto Rico.


†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-Cambriam): Southern California (northwestern part of Monterey County).

B. Willis, 1900 (Geol. Soc. Am. Bull., vol. 11, p. 410). Coast complex.—Crystalline rocks, chiefly metamorphic, including marble, quartzitic 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.


See also C. R. Van Hise and C. K. Leith, 1900 (U. S. G. S. Bull. 300, index).
Coastal series.

Pleistocene: Jamaica.


Coastal limestone.

Quaternary: Sierra Maestra of Cuba.


Coasters Harbor Island arkose.

Carboniferous: Southern Rhode Island.


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.


†Coata sandstone member (of Atoka formation).

See Coody ss. memb.

Coatzacoalcos formation.

Miocene: Mexico.


Cobble 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.

Cobequid series.
Silurian: Nova Scotia.

Cobham conglomerate member.
Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).
K. E. L. 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 Tidoute 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.)
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 waterline 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.

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 Hurmolottia zone. The Lower Cobourg
(Lower Picton of former papers) corresponds to Rastrinaquisca deltoidea zone of the Trenton, and rests on Trenton restricted.


Cobre.

Tertiary: Jamaica.


tCobscook 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 ss. and dark-blue and blackish shales, which at certain points contain a good deal of lime, but rarely are pure lms. The fossiliferous rocks are mostly thin bedded, even the impure lms. 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.


Cocalico shale.

Ordovician: Southeastern Pennsylvania (Lancaster County).


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. Head 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 Is. and 125 ft. below Oread Is. 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.


**Cochise formation.**

Middle Cambrian: Southeastern Arizona (Whetstone Mountains and Bisbee region).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 486, 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 Is., 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 *Neoelmus intermedius wulstig* Walcott; (2) yellow, pink, gray, white, purple, buff, and red shales, in upper part alternating with calc. sh. and thin rubbly Is.; the pink and gray sh. containing *Obolus* (Westonia) *chaurensis* (Walcott) and *Apatodus* n. sp., 116 ft.; (3) pink and reddish, thin-bedded ss.s., 30 ft. Rests on Pima ss. and underlies Abrigo fm. [restricted to middle part of Abrigo Is. of previous repts, or to 420 to 430 ft. of thin-bedded, cherty, dolomitic gray Is. containing listed fossils]. Is Middle Camb. [Derivation of name not stated.]

**Cochran conglomerate.** (In Chilhowee group.)


A. Keith, 1895 (U. S. G. S., Knoxville folio, No. 16, p. 3). **Cochran cgl.—Sa.** 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.


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.

Coekeys ville volcanics.

Pre-Cambrian: Maryland.

E. B. Mathews, 1933 (Md. Geol. Surv. geol. map of Md.). Coekeys ville volcanics.—Volcanics interbedded with Coekeys ville marble.

†Cockfield formation. (In Claiborne group.)

Eocene (middle) : Northwestern Louisiana, eastern Texas, and Mississippi.

T. W. Vaughan, 1895 (Am. Geol., vol. 15, p. 220). Cockfield Ferry beds.—Lignitic 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 "Cockfield 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.


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: Jamaical.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 422). The White or Cockpit Is. group, about 1,500 ft. thick, was divided by [R. T.] Hill into 3 members (descending): Cobre chalky-white Is., 1,000 ft.; Moneague Is., no great thick­ness; and Montpelier Is., 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). Cocos 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 Zewulodon-bearing bed (which consists of gray or drab sandy and argill. marl with hard blocks and irregular calc. concretions, very argill. in upper part, and 11 ft. thick). Separated from underlying Perkarchia-bearing bed (so-called Seutella 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 SW 1/4 sec 13, T. 11 N., R. 5 W., Choctaw Co., Ala., about 2¼ mi. E. of Melvin, on road to Gliberton. 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.
K. F. Mather, J. Gilluly, and R. G. Lunk, 1928 (U. S. G. S. Bull. 798B), 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 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).

Cody shale.
Upper Cretaceous: Northern Wyoming (Bighorn Basin).
C. T. Lupton, Jan. 21, 1916 (U. S. G. S. Bull. 621, pp. 160, 171, table, etc.). Cody sh.—Gray and dark sh., with 1 bed of ss. near base and several thin fossiliferous ss. near top. Thickness 3,380 ± 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. 2320, 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.; Priehrd 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.

**Coeymans limestone.** (In Heiderberg 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 Heiderberg group.

In central Pa. the Heiderberg is treated as a fm. and these beds are designated **Coeymans ls. memb. of Heiderberg ls.**

**Coffee 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.

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 Is. 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 ml. 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.


Coffeyville formation.

Pennsylvanian: Southeastern Kansas and northeastern and central Oklahoma.


In NE. Okla. overlies Lenapah Is. and underlies Hogshooter Is.


Named for exposures at Coffeyville, Montgomery Co., Kans.
Lexicon of Geologic Names of United States

Coffeyville limestone.  
Pennsylvanian: Southeastern Kansas.

*Coffeyville* Is.—Overlies Walnut sh. and underlies Pleasanton shales.

Preoccupied. Same as Lenapah Is.

Named for Coffeyville, Montgomery Co.

Coffman conglomerate member (of Maroon formation).  
Pennsylvanian (?) : Central Colorado (Park and Chaffee Counties).

*Coffman* qgl. 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.

*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 Is., and they have since been included in that fm.

*Coggon* phase of *Otis* Is.—Soft mag. Is., 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 Is.; in Cedar Co. It is in places uncon. on Leclaire beds of the Gower, and in places conformable on Anamosa beds.


Cohansey sand.  
Tertiary (Miocene?): New Jersey.

*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.

*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. 505-513), 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 hereunder under Columbia group.

Cohutta 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, pt. 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.

Colimar formation.

Oligocene or Miocene: Cuba.


Colbert porphyry.

Pre-Cambrian: Central southern Oklahoma (Arbuckle Mountains).


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.


Colchester formation.

Lower Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 110, 129). Colchester fm.—Diffs from underlying fms. in that it contains numerous shaly and slaty beds; is interbedded with ass. 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. bedded in a sl. matrix. The fm. also contains another set of lenses of massive blue marbelized sl., sharply separated from the sh. 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
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). 2½ mi. N. 60° W. of Georgia. May include some Middle Camb.


Coldbrook group. Pre-Cambrian or Cambrian: New Brunswick.

G. F. Matthew, 1883 (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.]


Cold Spring granite. Pre-Cambrian: Southwestern Oklahoma (Kiowa County).


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, 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.

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 Eocene and some to Tertiary.]

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 Mts., there are 400 to 500 ft. of hard white ss. with intercalations of light-pink, pale-green, and grayish shales. The ss. carry a dwarfed estuarine fauna of Eocene age. These beds have heretofore been included with the Sespe, but since they are fossiliferous, and 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 sand, top memb. of Tejon fm., is about 2,500 ft. thick near Matilija, Ventura Co. It is characterized by white friable arkose ss. interbedded with reddish sandy sh. and massive hard ledges composed of numerous shells of Ostrea idriaca (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. A. 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.


E. B. 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. Buhl and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 257, 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).


Coleman limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Somerset County).


Probably named for exposures at or near Coleman, Somerset Co.

†Coleman division.

Permian: Central Texas.


R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 210-213). *Coleman div.*—Alternating lss., clays, shales, and sass. 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 la.*, 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 la.* 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.


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. Is. Exposed at mouth of Coles Brook and 1 mi. to E.

B. K. Emerson, 1899 (U. S. G. S. Bull. 130, pp. 41-43). *Coles Brook ls.*—A remarkable linear outcrop of Hinsdale Is. 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 Bankcroft 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 Is. 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. Is., locally white and pure, generally graphitic and greatly changed to a mass of silicates—chlorodrite, wollastonite, wernerie, hyperbathene, pyroxene, amphibole, titanite, adularia, periclase, 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.


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 ls., 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 *Simbirakis* sp.

Is upper part of Mariposa ls. 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. 189-196). *Colgate as. 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 ss.s. 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 as. 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 fluvialitic 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. Sc., 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.


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 sh., 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 cystoida ls. 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).


Collier shale.

Cambrian: Southwestern Arkansas and southeastern Oklahoma (McCurtain County).

A. H. Purdue, 1009 (Geol. Soc. Am. Bull., vol. 19, p. 537; State of Arkansas, Ark. Geol. Surv., pp. 30, 31). Collier sh.—Dark, soft, graphitie, 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 Colliver Creek, Montgomery Co., Ark.

**Collingsworth gypsum member** (of Blaine gypsum).

**Permian:** Central northern Texas, Texas Panhandle, and southwestern Oklahoma.

F. W. Crayin, 1897 (Am. Geol., vol. 19, p. 356, footnote). **Collingsworth gyp. fm.**—A higher gyp. than Quanah gyp. May represent Cave Creek fm.


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 (Manitoullin Island) and Michigan.

P. E. Raymond, 1912 (Canada Geol. Surv. Summ. Rept. for 1911, p. 254). **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 is.

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.]


W. Malcolm, 1915 (Canada Geol. Surv. Mem. 81, p. 23), included this fm. in Utica.


W. A. Parks, 1927 (Geo. Soc. Am. Bull., vol. 38, p. 229). If Collingwood black sh. Is to be defined by presence of Opygites canadenésis it must include not only the black sh. with l.s. beds but also many ft. of upper Trenton.


**Collinsville limestone.**

**Pennsylvania:** Southwestern Illinois (Madison County).

A. H. Worthing, 1873 (Ill. Geol. Surv., vol. 5, p. 215). **Collinsville ls.**—Fossiliferous ls., in upper div. of Coal Measures near Collinsville. Madison Co., lying about 116 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, p. 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.


Collores limestone.
Age (?) : Puerto Rico.

†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).

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.

Colorado group. (Colorado shale or Colorado formation where undivided.)
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, 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 (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. Atkins, 1933 (Univ. Tex. Bull. 322, pp. 239, 271, 441, 452). From Val Verde to Terrell Counties westward to beyond Terlingua, the Austin consists of thin Is, 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 Is. 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.

Colqultz gneiss.
Jurassic: British Columbia.

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 boulders 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.

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.).

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, 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 Kansas.). [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 Is.]

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.

1. 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 N. W. 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 there 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 somewhat near middle of Tert. [The map accompanying this rept. covers Yakima, Kittitas, Okanogan, and Douglas Counties and parts of counties adjacent on the E.]

1. 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 ss. It has been thought best to abandon the provisional name first used. [p. 118, footnote.] The Columbia lava, in common with Swauk and Roslyn.ss., 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 outflows 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.
Columbia River lava.—In previous reports this formation has been termed Columbia lava, but to avoid confusion with similar names 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 formation 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 the geology of an area drained by Columbia River. In regions discussed by Russell there are several distinct horizons of Columbia lava, separated by important formations belonging to different geological periods. Obviously only one of them can retain the name, if it is to be used as a series or formation name in geological classification. This one should be the horizon which is most prominent along Columbia River, as it was this formation which suggested the name. In John Day basin it is found that the lavas of the Columbia form a well-defined series which lies between the John Day [upper and middle Olig. and Miocene] and Mascall [middle Miocene] formations. 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 the world and one of the most important formations on the continent. It would seem advisable to restrict the name Columbia to this horizon. The lava series is composed of a large number of lava 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 Miocene part of Columbia River basalt, which he stated included basalts of Eocene, Miocene, and Pliocene age.

J. P. Buwalda, 1923 (Idaho Bur. Mines and Geol. Pam. No. 5). Columbia River basalts are generally assigned to Miocene in southwestern Idaho where they lie on granite or on early phases of Payette Formation and are intercalated with it. They appear to be continuous with the great Columbia River basalt flows of Washington, Oregon, and central Idaho. V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 201-239). Columbia River basalt (Miocene) unconformably underlies Idaho Formation in Idaho and includes, 300 to 1,000 feet below its top, the 1,000- to 2,000-foot-thick terrestrial deposits and lake beds known as Payette Formation, which carry a Miocene flora.

The U. S. Geol. Survey at present recognizes Columbia River basalt as a convenient blanket term, covering basalts of Eocene, Miocene, and Pliocene age in the broad region described by Russell. Some geologists restrict the name to the Miocene 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 Limestone, 138 to 190 feet thick, underlies 15 feet of Devonian strata and overlies 2 feet of gritty sandstones. [As thus defined included at top Delaware.] J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, pt. 1, p. 89). Columbus Limestone.—Very light-colored limestone containing boulders of chert. Forms lower part of Corniferous Limestone, while Sandusky Limestone forms upper part of Corniferous.

E. Onstott, 1878 (Ohio Geol. Surv. vol. 3). Columbus Limestone.—White and buff limestone, 45 feet thick, underlining the bone bed (6 to 8 feet thick) or basal bed of Delaware Limestone and overlying Waterlime group or Lower Helderberg Limestone. Includes "Delhi Stone" near top. Is lower part of Corniferous Limestone, the Delaware Limestone being upper part of Corniferous.
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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 ms.). 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.
Pennsylvanian: Southeastern Kansas.


H. B. Kümmer 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: New Jersey.


H. B. Kümmer 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 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.


Later work proved Upper Cret. age of lower part of this “series” and Plio. age of upper part.

Colville granite.

Colville granodiorite.

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 1/4-inch diam. Locally the belts become schistose and even argill. South of Kettle Falls along Columbia River they grade into schists and argilites 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, 29). *Colvin's Run ls.—Buffalo 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 Colvin 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.

Colvis Run limestone member.

See *Colvin ls. memb.*

Colwood sands and gravels.

Pleistocene: British Columbia.


Colwood formation.

Recent: Northwestern Washington (San Juan Island:).


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. 799, 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. 709, p. 60.

Comanche Creek bed. (In Strawn formation.)
Pennsylvania: Central Texas.
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 Is. and buff and cream-colored Is. of greater or less compactness. Thickness 300 to 400 ft. Underlies Caprina Is. [Shumard's section of this "group" at Shovel Mtn, Burnet Co., shows it included Comanche Peak Is., 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.
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. 455, 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 Parachucia marl.
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:
Middle Jurassic: Hull aggl., Moonshine cgl., Mormon ss., Thompson red sh., Fant volcanics, Hardgrave tuff.
Lower Jurassic: Lilac argillite.


Combined Metals bed.
A name locally applied to 40 or 50 ft. of Is. 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.


Comerio beds.
Early Cretaceous (?): Puerto Rico.

Comet Creek bed.
Lower Cretaceous: Western Oklahoma (Custer County).
R. T. Hill, 1885 (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 Is., 5 ft. thick, containing one fossil species, 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. 95°14'40".]

Comers sandstone.
Tertiary: Southeastern Missouri (Scott County).
C. L. Dake, 1918 (Mo. Bur. Geol. and Mines, vol. 15, 2d ser., p. 191). Comers 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 Is. memb. of Bingham qtzite.—Most extensive Is. body of Bingham region. Commonest strata are blue Is. and altered white marbles, with here and there beds of light-blue, gray, dark-blue, and black Is.—precisely the same kinds of rock as in Jordan Is., which lies a considerable distance below it. Thickness 0 to 200 ft. May possibly be same as Yampa Is. and Jordan Is. may possibly be same as Highland Boy Is. memb. [Evidently named for Commercial mine.]

Commonwealth ore formation.
Age (?): Northern Michigan.

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 1886. 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. Helm, 1922 (Geol. Mag., vol. 58, p. 542).

Comox formation.
Cretaceous: British Columbia.

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).

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 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 (U. S. G. S. Bull. 81, p. 304). In section from Rome, Ga., to Gadsden, Ala., Conasauga sh. is 1,600 to 2,000 ft. thick, and consists of (descending): Thin-bedded seamy sh., sometimes blue and massive; yellow calc. shales grading into seamy sh.; sandy sh. interbedded with shales, often wanting and locally carrying nodules of chert; yellow shales; oolitic sh. and thin beds of light-green or yellow shales; variegated sandy shales, purple, green, brown, etc. Overlies Rome sh.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2). Conasauga sh.—At base thin lls., in part oolitic, interbedded with shales; in middle yellow or greenish clay shales; at top blue seamy lls. or calc. shales. Where the oolitic is. is absent this div. of Conasauga and underlying Rome fm. becomes very indefinite. The same is true when upper part of the Rome contains lls. 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 lls. 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 lls., and finally of 1,000 ft. or more of calc. shales interbedded toward top with blue lls. To S. of Rome the lls. 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 sh. 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 between quartz and chert. The intermediate div. of the Conasauga in Coosa Valley is clay sh. containing varying amounts of lls. 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 lls., dol., and sh. of varying proportions in different areas: in places it is chiefly lls., in other places chiefly sh. Thickness ranges from 500 to possibly 3,600 ft. Overlies Rome fm. and underlies Brierfield dol. and younger fms. In which Knox dol. has been divided in this region.

Named for exposures in Conasauga Valley, Dalton quad., NW. Ga.

Conception slate.

Pre-Cambrian: Newfoundland.


Conchos gravels.

Age(?) : Mexico.


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 Pittsfield. [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 granite gneiss with very different degrees of crystalline coarseness. The finer grained rock often displays no visible marks of stratification, thought there is no reason to doubt its sedimentary 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 granite gneiss by its fineness of texture.


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 Carbt] 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 sh., 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 discord. 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.

Concrete shale.

Pennsylvanian: Southeastern Kansas.


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 Is. 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): Concrete may properly be used for beds btw. top of Iola Is. 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 Is. thin out.

Named for Concrete, 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. Talafarro, 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.

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 boulders.

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 Tosaas 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 NE. part of Summitville quad. and N. and E. of Quen 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.


E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 6, p. 55). *Conestoga ls.*—Strongly crumpled, gray to blue, crystalline ls. with partings of black graphitic al. Is gashed by numerous veinslets 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 cgl. In a transgressive series of probably Chazy age. Edgewise cgl. occur near base in some places. Named for outcrops along Conestoga Creek S. of Lancaster.


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. G1, 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 argil. ss. and cgl. 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 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-Chautauqua and assigned them to "Bradfordian" (Upper Dev.). On p. 19 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 discredited "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" Kushequah sh. (to replace his Smethport sh.).

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 48, No. 2, p. 332). It 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 Kushequah) 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.


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 Is.; 40 to 95 ft. thick. Underlies Coney Is. 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 Monongie 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, 1929 (Okla. Geol. Surv. Bull. 46, pp. 39-40). Confederate Is. memb., basal memb. of Hoxbar fm.; consists of two resistant ledges, each 15-20 ft. thick, of coarsely granular, semi-crystalline gray to buff Is., sparingly fossiliferous, separated by a 30-foot interval of weaker material, part of which is also Is. 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 SE1/4 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 Is. memb. has been traced SE. into, instead of below, Westheimer Is. 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 Is. 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 Is. 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 Is. 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 Wartley 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 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 Wartleys Hill). The materials consist of brusstone and sands, shales, and marl. Named for exposures on western escarp of Congaree River and the embayments of its tributaries to Lang Syne and Wartley Hill, Orangeburg Co. [On p. 449 of Bull. 2 cited above Sloan showed Congaree as consisting of (descending) brusstone,
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. 287), 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).


Conglomerate series.

Conglomerate group.

Conglomerate measures.

Names applied in early repts to Pottsville group of Appalachian region.

Conasauga shale.

See Conasauga sh.

Connaughtic.

A term introduced by C. [R.] Keyes for a pre-Camb. epoch, separating his Anianic from his Nisconlitic. (See Pan-Am. Geol., vol. 55, pl. 8, p. 132, 1831.)

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., Bulla. 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 (Bulla. 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 Conneaut 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 Delthyria mesacostalis and accession of Canarutoedchia (?) duplicata, the name Conneaut group.


G. H. Chadwick, Nov., 1935 (Am. Mid. Nat., vol. 10, 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. Pale., vol. 21, No. 71, table opp. p. 61), proposed Conneaut Is. memb. to replace upper Meadville Is. of early repts on NW, Pa. On p. 138 of same book he substituted French Creek Is., for his proposed Conneaut Is. 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 Is. and about 40 ft. above Pittsburgh (Morgantown?) Is. [The Pittsburgh Is. is a much younger bed than Morgantown or Connellsville ss. 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 Is. 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.

Connell long conglomerate. (In Oriskany group.)

Lower Devonian: Southeastern New York.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346-348). Connell cgl.—Pebble beds, 18 to 20 ft. thick, typically exposed on hill above South Rondout (Connell P. O.) [Ulster Co.] and in creek bank opposite. Included in Oriskanian. Underlies Gleaner Is. 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.), 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 Is.*—Closely banded dark-blue Is., 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 cgs. of two kinds.

G. W. Stose, 1909 (U. S. G. S.—Mercersburg-Chambersburg folio. No. 170), gave 1,635 ft. as thickness of Conococheague Is.


Conover slate.

Pre-Cambrian (upper Huronian): Northeastern Wisconsin (Vilas County).


Conroe sand.


Conshohocken clay.

Cretaceous? or Ordovician?: Southeastern Pennsylvania (Montgomery County).

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 Is., and qtzite. It overlies, uncon. (?), the Manganiferous or Luck-Sure series of massive, thick-bedded Is. [Derivation of name not stated.]


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).


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, 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 ScL, 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, 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, voisite, and many beds of dark impure Is. 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).
Pennsylvania: Eastern Oklahoma (Muskogee and McIntosh Counties).
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 this stream, and it 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*.

Coody 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. Levering, 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).

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 Mt. series.*—Extensive series of marine beds, prevailing greensands, but including green- sand marls, altered greensand with thin strata of carbonate of iron, indurated altered fossiliferous greensand, green fossiliferous clays, glauconitic s.s.s. 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. 38 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 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.) is uncor. on Sage Creek fm. (Eocene), and is overlain uncor. by p. Sel and f. upper Olig. (?) or Miocene (?) age.)

Cooks Canyon agglomerate.
Upper Jurassic: Northern California (Menite: Jura).

Cool Creek formation.
Ordovician: Southern Oklahoma.
B. 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 formalional 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).
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 Is. 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 Butte 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. 2, Whole No. 203, 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 the 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 as.
  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).
  bed.—S.s. and egl., 0 to 75 ft thick. Membr. of Cisco div. Underlies Stock­
  wether 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. port 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 Is. and overlying Camp Creek sh.
  ss., and redefined Camp Creek sh. memb. to include all beds in McCulloch Co.
  beneath Stockwether Is. and above Saddle Creek sh.
  C. O. Nickell (Univ. Tex. Bull. soon to be published). Coon Mtn ss. memb. of
  Pueblo fm. underlies Stockwether Is. 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).
  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 gives 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 beda (pp. 162, 164), and the beda along
  Cooper River are called Ashley and Cooper beda and (p. 139) Cooper River marla.
  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.
  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 con­
  formably 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.
  marble.—Upper part bluish drab compact Is. containing cavities filled with yellow­
  ish 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 la.* is discon. overlain by Callaway is. Contemp. with Grand Tower is., but deposited in separate sea, which came from Arctic ocean and did not connect with Grand Tower sea.


D. K. Greger, 1920 (Am. Jour. Sci., 4th, vol. 50, pp. 20-24). *Cooper la.* of Monticello, 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 la.* is contemp. with Mineola is., 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 is. memb.—* Underlies Lone Butte ls. and overlies Glen Creek sh., all members of Jefferson ls. Thickest (508 ft.) in Deerhorn 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 SW1/4 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, 1871 (Geol. Surv. N. H. Rept. for 1870). Sections of **Cooa 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 Is., 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). **Cooa group**—Embraces “calciferous mica schist” of eastern Vt., the hard mica schist of Essex Co., 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). **Cooa 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 Is. of Helderberg age.

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, 3,300 ft.; and qtzite, 1,000 ft., overlying Camb. slates of Conn. Valley.


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 slates, and ss.; calciferous mica-schist with Trenton to Utica graptolites; **Cooa 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 **Cooa 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 **Cooa group** in Hanover and Lebanon region, N. H., to Dev., and stated that they are — Bernardston fm.


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.
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. 338-343). 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.


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 ss. of Pleist. age.


†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. 182). Coosa shales on p. 148, Flatwoods shales on map legend, and Coosa Valley or Flatwoods shaly iss. on structure section.—Shaly iss. 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.
Lexicon of Geologic Names of United States

Copake limestone.

Lower Ordovician (Beekmantown): Southeastern New York (Dutchess County).

J. D. Dana, 1879 (Am. Jour. Sc., 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 Is. ls. is not the only southern extension of the Copake ls."

E. B. Knopf, 1927 (Am. Jour. Sc., 5th, vol. 14, pp. 429-458). Copake ls.—Mainly mottled gray and white ls. carrying Ophiuleta 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 Ophiuleta. Thickness 0 to 400 ft. Overlies, probably conformably, Rockdale Is., 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 Is. of early Trenton and Black River age. [This fm. was included in Rockdale group of Dwight, 1887.]

Copan formation.

Pennsylvanian: Northeastern and central Oklahoma.


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 Is. above and top of Hogshooter Is. below. The Stanton Is. thins out a few mi. S. of Kansa Iine, 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 Is. 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.


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).


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. 128). 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 Is. (Middle Dev.), and is
oldest fm. exposed in Redding quad. In places Bragdon fm. rests on it. Named
for occurrence in vicinity of Copley.

Copperas Creek. (In McLeansboro formation.)
Pennsylvanian: Central western Illinois (Fulton County).
sh. and ss. to that part of McLeansboro fm. in Fulton Co. lying beneath his
Rolls Ford sh. and above his Brereton Is. 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.

Copper Creek beds.
Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Douglas
County).
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. 689, 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 volcanism,
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.

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).

greenstone or amphibolite schist.—Constitutes almost entire mass of Copper Mt.
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. 894).

Copper Queen limestone.

Upper Cambrian: Southeastern Arizona (Bisbee-Tucson region).


Copper Queen Is.—White-gray granular and algal Is. with Idahoia, Irvingella, and
Maladia; cliff-forming in lower part; at top Parting quite membr., 8 ft. thick; at
base thinner bedded gray Is. with Billingsella colorodosensis. Thickness 81 ft.
Overlies Abrigo fm. [here restricted to middle part of Abrigo Is. of previous repts]
and underlies Martin Is. (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 Bloco Is. (new) of Whetstone Mtns., and with Peppercorn
Canyon ss. of Santa Catalina Mtns. [See last sentence under Peppercorn
Canyon ss.]

Copper Ridge dolomite.

Upper Cambrian: Eastern Tennessee, southwestern Virginia, and Alabama.

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 Montevello, 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 638.]
Basal div. of Knox dol. (s. s.)—Rather generally in eastern Tenn. and SW. Va. grayish
dol. and Is., 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 Murphee's 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 Is. 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 Is. 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 380 ft., the latter only 200 ± ft. [Pages 635-638.]

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 slits 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 slits 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. 607). 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 true basal cgl. Uncon. overlies Presque Isle granite and Aniuitke, 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.


Coquihalla series.

Tertiary: British Columbia.

†Coral limestone.

Descriptive term applied in early Ala. repts to Glendon Is.

†Coralline limestone.

A descriptive term applied in early N. Y. repts to Is. later named Cobleskill Is., also to Is. later named Wilbur Is. memb. of Salina fm., and to a ls. in Niagara group.

Coralline Falls limestone.

Devonian: Kentucky.

D. D. Owen, 1858 (Ky. Geol. Surv. vol. 1, pp. 95-97). Gray Coralline Falls Is. include the Devonian ls. 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.—Is. included in upper part of Cedar Valley ls., consisting of (descending) 2 ft. of gray, fine-grained ls. containing Idioestroma; 6 ft. of gray earthy ls.; 10 ft. of gray, massively bedded ls. containing Acervulitera 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± ml. 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 ls. 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).


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 [non-oollitic] 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 Cherrysvale [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.


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.

Cordilleran system.

Cordova sands and gravels.
Pleistocene : British Columbia.

Corey limestone.
Ordovician : Quebec.

Coriba formation.
Tertiary (Miocene) : Central northern Oregon and southern Washington.

Coriba erosion surface.
Late Pliocene: Central northern Oregon.

Corinth sandstone. (In Conemaugh formation.)
Pennsylvanian: Western Maryland (Alleghany and Garrett Counties) and northern West Virginia.

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 Lowe: 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. 800, 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 states 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.


G. B. Shattuck, W. B. Clark et al., 1906 (Md. Geol. Surv. Pliocene and Pleistocene vol.), assigned the beds of Cornfield Harbor (Waltes 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. F. P. 150, pp. 130, 136-140).

Cornfield Springs formation.

Middle Cambrian and later (?): Southeastern California (San Bernardino County).

J. C. Hazard 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 is. (Dev.) of Goodsprings qud., 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 ls., also to Jeffersonville ls. alone; in
Ohio to Delaware and Columbus Is.; in Mich. to Dundee Is. 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 Is., 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 sa. memb.—One of highest members of Cisco (?) [Clear Fork?] red beds of Carter Co. Consists of a white, massive, cross-bedded ls. 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.


See further explanation under Perryville fm.

Named for Cornishville, Mercer Co.

Corniferous limerock.

A descriptive term used in early N. Y. repts. According to L. Vanuxem (N. Y. Geol. Surv. 3d Rept., 1839), the "corniferous rock" of Amos Eaton (1824), who probably originated the term, is middle part of Onondaga Is. 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 12 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 Is. 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 Is.

†Cornwall limestones.

Devonian and Silurian: Southeastern New York.

E. C. Eckel, 1902 (N. Y. State Geol. 29th Ann. Rept., p. 148). A series of thin beds of Is. 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 Is." 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 Is. to New Scotland Is., 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 sh., in both N. Y. and N. J.] Named for occurrence at Cornwall, Orange Co., N. Y. Eckel's use of Cornwall sh. 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.


Coronach shale.

Upper Devonian: Alberta (Jasper Park).


Coronado quartzite.

Upper Cambrian: Central eastern Arizona (Greenlee County).

W. Lindgren, 1905 (U. S. G. S. P. P. 43, p. 59). Coronado qtzite—Chiefsy heavy beds of brown, pink, or maroon qtzitic ass., 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 Is. 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.


†Corral sandstone. (In Cheyenne sandstone.)

Lower Cretaceous (Comanche): Central southern Kansas.

F. W. Cragin, 1896 (Am. Geol., vol. 16, pp. 361, 368). Corral sh.—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 egis. 100 ft.; which are, apparently, the same rocks that were called "Hector fm." in earlier repts.

Derivation of name not stated.

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'Hara'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 jerseyiensis zone of Keyser memb. of Helderberg fm. He named them [unpublished ms.] Corrigan fm. and correlated them with Cobleskill, Boudout, and Manlius fms. of N. Y., and Decker Ferry, Boudout, 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.

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, 1926 (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.


H. P. Cushing (1888) and E. Orton (1893) correlated Corry alone with Berea ss.; J. J. Stevenson (1903) correlated Cussewago and Corry with Berea.


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.


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.


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 Williamstown 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. 122-124.] [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." Fauna 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."]


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 Chitonoporella 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.


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 NE. edge of Greenville, and in ditches along Dixon road for a mi. or more S. edge 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 (?).


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 Peckskill 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. ScL, 5d, vol. 35, pp. 438-448, and vol. 36, pp. 254-260). 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.

O. 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, 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, sodalitic syenite, diorite, gabbro, norite, biotite norite, hyperite, 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 Peckskill, 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.


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-Jappinger-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).


Named for Corwin Bluff, about 30 mi. E. of Cape Lisburne.

*Corophodon 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 BartlesvUle 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.

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 backly on the surface and becomes dark on exposure. Contains some chert and a little interbedded saccharoidal ss. and green sh. Thickm.—ss 500+ ft. Uncon. underlies Powell Is. Base not exposed in these quads, but in Mo., and farther E. in Ark., where erosion has cut through it, the Jefferson City Is. 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 2¼ 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.


†Cottonwood shales. (In Council Grove group.)

Permian: Eastern Kansas.


†Cottonwood beds.

Miocene: Central northern Oregon (John Day region).


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 Mascoall fm., and stated that at Rattlesnake Creek, near Cottonwood, the Mascoull is not less than 800 to 1,000 ft. thick.

Cottonwood white layer.


Cottonwood rhyolite.

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


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).


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 Is.

†Couchiching.

Same as †Coutchiching.

Coudersport member (of Cattaraugus formation).

Upper Devonian or Mississippian: Central northern Pennsylvania (Potter, Tioga, and probably McKean Counties).

B. Willard, 1938 (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.


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.)

†Coulters Ferry sands.

Upper Cretaceous: Northeastern Mississippi (Monroe County).

H. W. Hurd, 1860 (Rept Geol. and Agric. Miss., pp. 66, 67, 73). Coulters Ferry sands.—Grayish yellow, stratified, non-effervescent sand, 120 ft. thick at Coulters 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 sand, usually very hard, sometimes soft. Underlies Rotten Is. [Selma chalk] and overlies dark-colored, bluish, laminated clay.

Replaced by Coffee sand, the better established name.

Named for exposures at Coulters 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. 706). Council Grove stage.—It is perhaps a more satisfactory classification to regard base of Perm. as marked by lower limit of Wreford Is., 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 Is. 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 Is. 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 Is. This change was not adopted by other geologists, however.

tion, 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.


†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.


Courtney granite.

Mesozoic: Northern California (Trinity County).

O. H. Hershey, 1900 (Sct., 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.


†Coutchichingan series.

A term used by C. [R.] Keyes for Coutchiching series of other geologists.

Covada group.

Probably Mesozoic, Carboniferous, and Devonian: Northeastern Washington.


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.


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 Is.—Predominantly argill. Is., like underlying Is. 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 800 ft. has considerable proportion of fairly pure Is. conspicuously shown along Cove Creek (Scott Co.) and elsewhere. Includes some coarse-grained crinoidal Is. and one bed of red ss. was noted. Underlies Pennington sh. and overlies Fido ss.

Covington limestone.

Coventry phase of Waits River limestone.

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 Is. 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, 1920 (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 facetted 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 Is. and sl. Writer believes this rock is a fault breccia cgl. This breccia-cgl. is located about 10 mi. N. of Craftsberry, 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 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 Is. 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.

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†Covington group.

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

R. S. Baseler, 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.

Cowaselon clay.
Pleistocene: Southeastern New York (Madison County).

Cow Creek beds. (In Travis Peak formation.)
Lower Cretaceous (Comanche series): Central Texas.

Named for Cow Creek, Burnet Co.

Cow Head limestone breccia.
Middle Ordovician: Newfoundland.

Cowichan group.
Upper Cretaceous: British Columbia (Vancouver Island).

Cowiche gravel.
Pleistocene: Central Washington (Ellensburg quadrangle).

Cow Island beds.
Upper Cretaceous: Central northern Montana (Judith River region).
C. H. Sternberg, 1914 (Sci., n. s., vol. 40, pp. 125-135). 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 Clagett 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 Clagett sh. The Cow Island beds of Sternberg therefore appear to belong to Clagett sh., since he states that the fossils are older than Judith River fossils.]

Cowitz 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 600 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.


Cow Run sandstone. (In Conemaugh formation.)

Pennsylvania: Eastern Ohio and western West Virginia.


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 Potterville 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. G1), 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. Slater, Pa. Geol. Surv., 4th ser., Bull. Ma., 1933, p. 6.) According to W. Stout et al., 1935 (Geol. of nat. gas, A. A. P. G., pp. 800–901), the First Cow Run sand of Ohio lies btw. Cambridge and Ames Is. 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 1881.

Cox sandstone. (In Trinity group.)

Lower Cretaceous (Comanche series): Western Texas.


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.

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 Haccon Creek at Coxville.

Coyote sandstone member (of Madera limestone).
Pennsylvanian: Central northern New Mexico.

Coyote formation.
Eocene (?): Central southern Oregon.

†Coyote Mountain clays. (In Imperial formation.)
Miocene (lower) : Southern California (Imperial County).
G. D. Hanna, 1926 (Calif. Acad. ScL Proc., 4th ser., 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 "Yuba Reefs" has been selected. Assigned to Pilo., probably middle or upper Pilo. [For further explanation by Hanna see 1926 entry under Imperial fm.]

See W. P. Woodring, 1931, under Imperial fm.

Coyes 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 granite.—Coarse porphyritic biotite granite.

Cozy Dell shale member.
Eocene: Southern California (Ventura County).

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.).
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. Fayles and C. H. Richardson, 1929 (18th 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, glauco phane, 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.

Craighead Creek shale.
Upper Devonian: North-central Missouri.

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.

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 formal name, though, as suggested by Lowe, they may actually be representative of Nahoena 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. Aroean.
Named for development at Cranberry, Mitchell Co., N. C.

Cranberry formation.
Upper Cretaceous: British Columbia.

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 slaggy 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 quartzite 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 Carfb."
Named for development in Great Cranberry and Little Cranberry Islands, S. of Mount Desert Island.

Cranbrook formation.
Cambrian: British Columbia.

Crandall Hill sand.
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 ss. 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 ss. and Pawtucket shales. Rest on Wamsutta series.

†Crawford shale.

Mississippian and Devonian (?) : Northwestern Pennsylvania.


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. III, 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. IV, 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 ls., which have played so distinguished a role 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 fmn. (See U. S. G. S. Little Belt Mtns folio, No. 56, 1889.)
Crazy Mountain granite.

Eocene: Central southern Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mts 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 Mts.]

†Creamy sandstone.

Pennsylvanian: Eastern Colorado (Denver Basin region).

G. H. Eldridge, 1896 (U. S. G. S. Mon. 27). [See definition under †Wyoming fm.]


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.


Creede formation.

Miocene (probably upper Miocene): Southwestern Colorado (Creede dist.).

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 (Muskgogee County).


Cresaptown iron sandstone.

Silurian: Western Maryland.

C. K. Swarts, 1923 (Md. Geol. Surv. Sill. 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.


underlies Clallam fm. Named for occurrence in vicinity of Port Crescent. Com­
prises 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 shs. and whitish shales full of Mio.
fossils] occur by wharf at Crescent City (Crescent City beds), and among their fos­
sils Dr. [W. H.] Dall recognizes Pecten parmeleei and Terebratulites hemphilli, spe­
cies 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.
[See under West Prospect basalt.]

Cresswell limestone. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.
Is.—Top memb. of Winfield fm. Has been called the "concretionary Is." Persists
from Nebr. to Okla., in a thickness of 4 to 11 ft. Is solid massive Is. 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. Be­
comes 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.
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 Is. in central and southern Kans. The
Luta probably does not extend to Nebr., where Odell sh. memb. of Enterprise sh.
overlies Cresswell Is. [On p. 58 Luta Is. is included in Marion fm. On pp. 57-58
Condra says:] The Luta Is. 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 Is., 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 Is. 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 Is.
Luta Is. as top memb. of Winfield Is. 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.
indurated, thick platy structure, gray shs., with occasional intercalations of argill.
material. Thickness 9,800 ft. Conformably underlies Kitchener qtzite. Both proba­
bly pre-Camb. Occurs at int. bdy. 46 Par., in section from Port Hill, Idaho, to
Gateway, Mont.
R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 4, 115° 20' to
118°). Creston fm.—Generally thick-bedded gray qtzite and metargillite; some­
times dolomitic.
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.


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 conglomerata. 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).


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. 59-61.

†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 as.

†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 is.

†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 as.

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.


See Keyes’ statement under †Dixon chalk.

Named for old site of Crill mill, on Sioux River, above Sioux City.

Crinert 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.


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, 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 Is. to be same as Confederate Is. (basal memb. of Hoxbar fm.) and Westheimer Is. has been dropped. (See under Confederate Is. memb.) It has also proved that Union Dairy Is. is same as Crinerville Is., and Union Dairy has been dropped.

†Crinoidal limestone.

Descriptive term applied in early repts to many Is., of different ages, containing crinoid remains. In early Pa., Ohio, W. Va., and Md. repts it was applied to Ames Is. memb. of Conemaugh fm. (Penn.).

†Cripple Creek breccia.

Tertiary: Central Colorado (Teller County).


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.


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.


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, 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 ah, 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.


Cristobal formation.

Cretaceous: Southern Mexico.


Critzer limestone.

See Critzer Is., correct spelling.

Critzer limestone.

Pennsylvanian: Eastern Kansas.


J. M. Jewett, 1932 (pp. 99, 100, 103 of book cited above). Critzer Is. is second Is. lentil from base of Swope Is. It is brown, earthy, massive, and varies from an oolite to a dense crystalline Is. A large Bellerophon abundant. Thickness locally 15 ft. To S. pinches out near Linn-Bourbon Co. line. Type loc. is S. of Critzer, Linn Co., in sec. 17, T. 22, R. 23 E. It 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 Is., and, according to F. C. Greene, N. D. Newell, and me, based on 1934 field work, assigned it to erroneous position above Schubert Creek Is. It is believed by Greene and me to be = “Fragmental Is.” of Iowa geologists. For present recognition of “Critzer” as a named memb. of Bourbon Is. is withheld, although it may prove to be useful name for a marker bed near top of Bourbon Is. from Linn Co., Kans., northeastward.

Croasdale quartzite.


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.


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 Pli. forbids us to regard the fauna as later than Pli.

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.—Named 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 Sabine Bayou and Milams members. A composite section extending from 1.8 ml. N. of Crockett on Palestine road to 2.6 ml. 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.


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.


Croghan syenite granite complex.
Pre-Cambrian: Northwestern New York.
See under Diana syenite complex.

Croghan West moraine.
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. Risom 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). Crowell 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 360 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 Is. [Miss.] in south-central Okla., and as older than Gilcrease
sand.
also under Papoose sand (of Okla.).]
This sand at its outcrop has been named Union Valley ss. memb. of
Wapanucka Is., 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.

Crooked River formation.
Recent (?): Central northern Oregon (Cascade Mountains).
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.
[As there is about Crooked River fm. and Madras fm. As the other fms.
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 trans-verse 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.
tCropsy 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 Is. (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).


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.

tCross Timbers.

See under tUpper Cross Timbers and tLower Cross Timbers. Named for development in physiographic province in eastern Tex. locally called "Cross Timbers."

Crosswicks clay.

Upper Cretaceous: New Jersey.


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.


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 ls. 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. In 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.]

Croton Falls hornblendite.
Age (?): Southeastern New York (Westchester and Dutchess Counties).

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 Fusulinias, 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.

Crowleyan series.
Crown conglomerate.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 66-67). Crown cgl.—Three cgl.s., each 10 or 20 ft. thick, interbedded with strata resembling typical Chisos beds. Many of pebbles and boulders well rounded; most of them consist of various kinds of lavas and trap rocks, but iss. 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. Brainard and H. M. Seely in 1888 (Am. Geol., vol. 2, pp. 323-356), as explained under Chazy group, and proposed Crown Point Is. 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).


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).


Crow’s Mill limestone. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Springfield quadrangle).


G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 28). Crow’s Mill Is. of Springfield region lies 230+ ft. above coal No. 6 and may = either Carlinville or Shoal Creek Is. [On p. 37 he says it lies 275 ± ft. above coal No. 6. On p. 43 he says it is probably same as Carlinville Is.]


Crownest volcanics.

Cretaceous: Alberta and British Columbia.


Crow Wing formation.

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

C. Zapffe, 1830 (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.

Crusoe oil zone.

Tertiary: Trinidad.

Cruse sand.
Miocene: Trinidad.

†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 Is.

†Crusher Hill alternating shales and limestones. (In Council Grove group.) Permian: Central Kansas.
L. C. Wooster, 1905 (The Carb. 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 Is.] and overlie 12 ft. of sh. [Florena] which rests on Cottonwood Is. 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 κρυπτος, hidden.

†Crystal sandstone.
A shortened form of †Crystal City ss., employed by C. [R.] Keys.

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 Is. and overlying Potosi Is., 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.

Crystal Falls limestone member (of Harpersville formation).
Pennsylvanian: Central northern Texas (Stephens County, Brazos River region).
F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 161-164). Crystal Falls Is. lentil of Harpersville fm.—Lowermost Is. of Harpersville fm. Lies 40 to 80 ft. above base of the Harperville. 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 Is. lentil of Harperville. (Plummer and Moore distinctly showed 3 other Is. in interval btw. Crystal Falls Is. and Belknap Is., one of which is so-called "Upper Crystal Falls Is." 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. 10, p. 557; Slates of Arkansas, Ark. Geol. Surv., pp. 30, 32). Crystal Mtn ss.—Lower 200 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. 600, pp. 67-68). "Ouachita sh." divided into 3 fms. and abandoned. The basal of the 3 fms. (here named Mazzam 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 550 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).


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.
Cuba sandstone. (In Carbondale formation.)

Pennsylvania: Central western Illinois (Fulton County).


H. R. Wanless, 1931 (IU. 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.


Cuchara formation.

Eocene: Southern Colorado (Huerfano County).


Cuchillo formation.

Lower Cretaceous (Comanche series): Southwestern Texas (Presidio region) and northern Mexico.

B. H. Burrows, 1900 (Min. and ScL 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 Vegas fm. and underlies the heavy-bedded main Is. called Aurora by Burrows, Mountain Is. by Hill, and upper Glen Rose-Fredericksburg. The Cuchillo is identifiable as the main horizon of Dufrenoya and Downtonitrititres, which Bise collected near Aurora mine, 5 km. S. of Cuchillo Parado.

Cucuracha formation.

Oligocene: Southern Colorado (Huerfano County).


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. Helm, 1922 (Geol. Mag., vol. 59, p. 543).

Cueva rhyolite.
Tertiary (?): Southern New Mexico (Dona Ana County).

Cuitaca granodiorite.
Age (?): Mexico.
S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 328).

Culberson series.
Permian: Western Texas.

Culebra formation.
Oligocene and Miocene: Panama.

Cullom limestone.
Pennsylvanian: Southeastern Nebraska and eastern Kansas.
G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 45). Cullom Is. was named by Condra and Bengston from near Cullom Station, Cass Co., Nebr. It consists of 2 Is. separated by about 1 ft. of bluish gray argill.-calc. fossiliferous sh. The upper Is. is 2 ft. thick, gray, massive. In most places lower Is. is somewhat thinner than upper one and weathers yellowish brown. The Cullom Is. is very persistent, holding its faunal and lithologic features—from southern Kans. to Rock Bluff, Nebr., and Folsom, Iowa.

Cultus formation.
Triassic: Southern British Columbia and central northern Washington.
B. 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 crf. Overlies Chilliwack series. [Mapped around S. shore of Cultus Lake, B. C., at and near 122° mer.]
Cumberland sandstone.

Ordovician (Upper): Southern Kentucky.


A. F. Foerste, 1900 (Ind. Dept. Geol. Nat. Res. 24th Ann. Rept.). The Clinton Is. 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, 1902 (Am. Geol., vol. 30, btw. pp. 350 and 369). Major part of Shaler’s *Cumberland ss.* is of Lorraine age, but it probably also included some beds of Richmond age.


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 Sneeck Pond, along to main street southeastward for 1½ ml. in village of Cumberland Hill.

B. K. Emerson and J. II. 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.


Cumberland Gap shale member (of Chattanooga shale)

Devonian or Carboniferous: Southern Tennessee and southwestern Virginia.


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 Is.]

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 Is. of Trenton Falls and Watertown region, and called underlying Is. Trenton Is.
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 stratigraphic equivalence have been mapped as Cumberland Head sh. by Cushing (1905).

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 108–118). Cumberland Head sh. (Cushing 1905, pl. 13) consists of blue-black slaty lls. and calc. shales with some firmer lls. 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 lls. 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 lls.

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 cgs.) 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).


G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 40). Three ledges of Is. outcropping in E. part of Jack Co. near Cundiff, take their name from the village. The Upper Cundiff Is. consists of 3± ft. of hard crystalline Is. apparently of algal origin; it is present in Wise Co. The Lower [Middle] Cundiff Is. consists of 3± ft. of hard crystalline Is. apparently of algal origin; it is present in Wise Co. and is separated from Upper Cundiff Is. by 75± ft. of sh. The lower of the 3 Is. ledges pinches out before Wise Co. Is reached. The Cundiff Is. 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 Is.; 1,500 to 1,800 ft. thick. Is easily distinguished by a white Is. near top, which carries a large cup coral (Campophyllum torquium); S. of Ardmore this Is. is exposed in only one place. To S. of Woodford 5 of the 7 ss. beds are asptalt bearing. Fossils listed. Underlies Deese memb. and overlies Otterville Is. memb.


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.


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 granite bodies of the region. Chiefl y 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.


Same as Coffeyville fm., older name.

Named for Curl Creek, Nowata Co.

Curlew limestone member (of Tradewater formation).

Pennsylvania: 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 underlying 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.)

Pennsylvania: 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 ss. 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).


**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.


Curtis formation. (In San Rafael group.)

Upper Jurassic: Southeastern and central Utah and southwestern and northwestern Colorado.


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.).

Curzona limestone.

See **Curzon ls**.

Curzon limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri, southeastern Nebraska, and northeastern Kansas.


G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). Years ago Mo. Surv. used name **Curzona** for what seems to be basal 5 to 8 ft. of Topkea 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 Topkea 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 Galaher referred as **Curzona's ls.** is unidentifiable; and therefore Condra is author of name. Condra gives no type loc., but presumably 1 is in vicinity of Curzona (Holt Co.), Mo. Name is discarded. Condra agrees (personal communication, July 8, 1934) **Hartford** is preferable to **Curzona**.

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser.), restricted **Curzona's ls.** as explained in June 1937 entry under **Topkea ls.** On p. 51 they state: Type loc. of Curzona ls. is E. of Curzona Station, SE. of Forest City, Holt Co., Mo. Reason for apparent change in spelling of name of station since Galaher worked there has not been learned. It is assumed Galaher had opportunity to secure correct spelling and that R. R. may have changed spelling through error.

Named for Curzona, Holt Co., Mo.
Cushina formation.

Lower Ordovician: British Columbia (Robson district) and Alberta.


Cushing granodiorite.

Late Carboniferous (?): Southwestern Maine.


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 Is. memb.* The Cushing memb. has been traced farther S. into the red beds than any other ls. It is exposed near [about ½ ml. 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, 1923.)

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, gray, 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 ("Renfoes marl" of Veatch) separate Cusseta sand memb. from underlying 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. 60), repeated foregoing description of Cusseta sand mem. but did not repeat the Blufftown section and did not describe any typical Ripley beds as underlying Cusseta mem., but described the Cusseta as basal mem. of Ripley fm. and Tombigbee sand as upper mem. 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. 177–178, 1919) treat Cusseta sand as basal mem. of Ripley and Tombigbee sand as upper mem. 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 mem. or in underlying Eutaw fm. is not apparent, but, being marine, they are probably included in Tombigbee sand mem.

Named for exposures in vicinity of Cusseta, Chattahoochee Co.

\[\text{Cussewago sandstone.}\]

Devonian or Carboniferous: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q., pp. 91–98). \textit{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 \textit{Cussewago Middle shales and flags} and overlies Riceville shales. In basal fm. of Oil Lake group.}\n


\[\text{Cussewago shales.}\]

Devonian or Carboniferous: Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q., pp. 94–96). \textit{Cussewago Upper shales.—Bluish or ashen gray shales 5 ft. thick. Underlie Corry sh. and overlie Cussewago ls. (2 ft. thick), which rests on \textit{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 ls. but is a better ls. All included in Oil Lake group.}\n

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 60, etc.), included Cussewago Is. of White in Hayfield sh. of Chadwick.

\[\text{Cussewago Limestone.}\]

See under \textit{Cussewago shales.}\n
K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202), introduced \textit{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 \textit{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 Is. "Hayfield Is."

\[\text{Cussewago stage.}\]

\[\text{Cussewago monothem.}\]

Terms applied by K. E. Caster (Bulls. Am. Pal., vol. 21, No. 71, 1934, table opp. p. 61, pp. 53, 105) 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.


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 ls=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.] Keyses, 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 Cretaceous 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 Fusion, Minnewasta, 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 Cutter fm., for exposures on Cutter Creek, which enters
Uncompahgre River about 4 mi. N. of Ouray, Colo. The Cutter is a complex of
bright-red ss., and lighter-red or pinkish grits and cgs. 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 Cutter 1,000+ ft.

The present definition of Cutter fm. in its type region (SW. Colo.) con-
forms 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 Cutter is overlain by Moenkopi fm. (Lower Triassic) and under-
lain 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, Grant Co.)
where the lss. of Rico fm. are absent, the red beds corresponding to Rico
fm. of SW. Colo. are now included in Cutter fm. (See U. S. G. S. Bull.
563, 1935, by C. H. Dane.)

Cutler limestone member (of McLeansboro formation).
Pennsylvanian: Southwestern Illinois (Perry County).
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 18± ft. above
Galum ls. memb. and 52± ft. above Herrin (No. 6) coal in vicinity of Pinckney-
ville and Jamestown, Perry Co. Named for typical exposures in vicinity of
Cutter, Perry Co.

Cutright sandstone member.
Mississippian: Southern Indiana.
P. B. Stockdale, 1921 (Ind. Dept. Comm., Div. Geol. Pub. 98, pp. 76, 118, 181, 182,
189, 212+, 250, 256, 278, etc.). Cutright Is. memb. of Edwardsville fm.—Massive
ss. with Taonurus; 7 ft. thick at Gent, where it lies 6 ft. above base of Edwards-
ville. 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., 1½ 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 Floyd's 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 ss.]

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 form-
ing topmost fm. of Waverly group in northern Ohio. Underlies Sub-carb. [Max-
ville] 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).


**Cuyamaca basic intrusive.**

Probably pre-Tertiary: Southern California (Cuyamaca region, San Diego Coun.).


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. 161 he spoke of the “probable equivalence of the Cuyuna and Carlton series.”

C. Zapffe, 1930 (Lake Superior Min. Inst. Proc., vol. 28, pp. 99-108), described the rocks of Cuyuna dist., Minn., and divided them as follows:

Post-Keweenawan shaly sediments and cgs.

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 non-magnetic).

Gradation.

Attikis fm. (gray slates and phyllites; volcanics absent; contains some iron carbonate, but extensive iron-bearing lenses virtually lacking; non-magnetic).

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. 101-108). **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 quite 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, 1909 (Denison Univ. Sc. 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), described **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).


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 sas.—Quartzose sas, 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.

Cyrene member (of Edgewood limestone).
Silurian (early): Southwestern Illinois and northeastern Missouri.
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 ass. 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 marmorlzed iss., all cut by quartz diorite dikes; in gorge of Chichokno Creek several varieties of schist outcrop. The phases of schists on Dadina and Chetasllno Rivers that are not demonstrably igneous are very similar to Klutina series of Schrader. The rocks are pre-upper Carb., tentotlvely 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 iss. 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 marmorlized sand. Moderately coarse-grained s.s., 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 iss. pass up into flaggy and thinly laminated brown and greenish micaceous ss. with much interbedded sd., 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 iss., and clear quartz pebbles in a brown sandy iss. matrix. To NE. of Woods Hollow Tank nodular layers of sandy iss., which weathers to peculiar chocolate-brown velvety surface, are plentiful. Underlies Marathon iss., 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 lsa.**—Argill. Iss., 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 Iss. and overlies Teutonic Iss. Named for Dogmor Mine.

**Daguilla diorite schist.**

Age (?): Isle of Pines.


**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 ss. 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 (Phil. 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 (f) 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 Laramie 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.


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 Camb.} of Utah. Overlain by 100 ft. of unnamed sh. and underlain by Monon series. [Derivation of name not stated.]

Dalhousie limestones.

Silurian: Canada.


Dalhousie shales.


Dalhousie sand.
A subsurface sand at base of Blairmore fm. of southern Alberta, Canada.

Dalhousie Mountain andesites.
Age (?): Quebec

†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 (Esopitya 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. Titton, 1913 (Sci. n. s., vol. 58, 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.

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 Miocene deposits in Oreg. are disturbed; this deposit was not disturbed. In a Pilb. lake bed. Years ago writer designated [but did not publish] the group of rocks to which this gray ss. belongs as The Dalles group, Pilb. [He appears to consider Dalles older than his Silver Lake group (Pilo.) and younger than his Yakima group (Pilo.).]
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 uplifted on flank of eastern anticline. Though no pebbles of quartz 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 Pilb. 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.: (a) 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. 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. u. a., vol. 67, p. 236). Geologists have differed regarding ages of "Satsop" and Dalles fm. 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 fm. 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. fm. Hood River fm. is now 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, 1. 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 ss. that laterally replace the upper part of Dillco 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 ss. 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 Is.—Most distinguishable feature is bright buff color to which it weathers. At type loc. consists of platy, dull-gray to tan-gray, fine-grained, fairly pure Is. 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 Is. Thickness averages 25 ft. Overlies Wolsey sh. (Middle Camb.) and underlies Nannie Basin Is. Forms the steep slope at foot of the cliffs on SW. side of Pagoda Mtn in NE. 1/4 sec. 9, T. 22 N., R. 13 W. This slope lies at head of Damnation Creek, which flows SW.

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 prevalently porphyritic, with plagi 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.


Danby formation.
Lower Cambrian: Southwestern Vermont (Rutland County).
A. Keith, 1982 (Wash. Acad. Sci. Jour., vol. 22, pp. 280, 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 variicolored 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 greenshist sl. Beds considerably folded. Thickness 300± ft. Grades into overlying Wallingford dol. In = Hubbardton sl., Stiles phyllite, and Breese 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, 1883, pp. 89, 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.

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 perlithic 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 silt. 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 varie-
tiers, which grade into one another through intermediate varieties. Whether Danne­
mora 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 district 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 lsa. 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 (Saranaco 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.

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. Ailing, 1918 (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 Saranaco 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.

Pennsylvania: Western Arkansas coal field and central eastern Oklahoma.


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. Gravel, 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 (Wsh. 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 sh. 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 sh. 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.


Darien moraine.


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 Kootenal 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).


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).

Darlington granodiorite.
Jurassic (?) : British Columbia.

Dashner limestone.

Pennsylvanian : Northeastern Kansas.
Dashner Is.—Basal memb. of Topeka Is. Rests on Calhoun sh. and underlies Jones Point sh. Consists of light-bluish Is. that weathers brown, fine grained, dense, massive; upper 1 ft. contains chert nodules and Osage; lower 2% ft. has some large Trifolites, Allorismas, and Osage. Brachiopods and Bryozoans common throughout. Thickness 5½ ft. [Derivation of name not stated.]

Dr. Moore in 1935 [not regarded as publication] and again in 1938 (10th Ann. Field Conf. Kans. Geol. Soc. Guidebook, p. 41) used “Dashner Is.” for the lower memb. of Topeka Is. but in a publication issued in 1938 (Kans. Geol. Surv. Bull. 22, pp. 104, 195 [issued Aug. 31, 1936]) did not use the name. Dr. Moore states (personal communication) that his type loc. is Dashner farm, SE. of Haynles 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 Kansas River Valley, but also the Iowa Point sh. and Curzen Is. 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 Is. is separated from Curzen Is. 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 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 Is. members both above and below.

Datil formation.

Tertiary (probably late) : Southwestern New Mexico (Alamosa Creek Valley, Socorro County).

Daube member (of Hoxbar formation).

Pennsylvanian : Central southern Oklahoma (Carter County).
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. cgls. 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 ml. 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.

Some 400 to 600 ft. above Anadarche memb. occurs the 10-foot Daube Is., so named for occurrence at abandoned coal mine of Daube, Westheimer, Munzeshheimer, and Zuckerman, in SE% of sec. 8, T. 5 S., R. 2 E. Of similar character to Anadarche Is. Immediately beneath it lies only known coal bed (4 ft. thick) in Ardmore Basins. Lies 400 to 500 ft. below Zuckerman memb. of Hoxbar fm.

Davenport beds.

Middle and Upper Devonian : Eastern Iowa.
The name Lower Davenport beds is suggested for lower nonfossiliferous Is. at Davenport, which furnished the fragments for second stage of Fayette breccia; and Upper Davenport beds is suggested for fossiliferous Is. overlying Lower Davenport beds and heretofore called Gyroceras beds, also included in Fayette breccia. The Lower Davenport beds overlie Kenwood beds.

In 1896 (Iowa Geol. Surv. vol. 4, pp. 121+) Norton introduced Wapsipinicon stage for beds underlying Cedar Valley Is. 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 Is. This definition of Wapsipinicon Is. was followed for many years; but in 1928 (Iowa Univ. Studies, vol. 12, No. 7, n. s. No. 16) C. H. Belanski treated Upper Davenport beds of Iowa Geol. Survey as basal memb. of Cedar Valley Is., "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 Is. 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 Is. [Upper Dev.].

Davenport member.
Upper Ordovician: Toronto, Canada.
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 Plielst. 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, 332-383). David City fm. (Nebraskan) consists of outwash fluviglacial 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. Filis old burled 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).

†Davlin rock.

Miocene: Southern Mississippian.
B. L. C. Walles, 1854 (Rept. Agric. and Geol. Miss., pp. 214-216). Davlin Rock of Fort Adams.—Ss. of argillic-alkaline 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). Davlin 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 Davlin Rock of Walles is now considered to probably be Catahoula ss. The Davlin 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 Roche à Davion, so named for a pious and devoted priest of that name, who had established a mission there."

**Davis formation. (In Elkines group.)**

Upper Cambrian: Missouri.

E. R. Buckley, 1907 (Mo. Bur. Geol. and Mines vol. 10, 2d ser., separate), in a table divided Elkines fm. into (descending) Doe Run, Derby, and Davis, without defining the subdivisions.


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 Bonne Terre fm. and conformably underlies Derby fm.


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).


**Dawn limestone member** (of Monte Cristo limestone).

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


**Dawson arkose.**

Upper Cretaceous and Eocene (?): Eastern Colorado (Douglas County region).

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.


Day Creek dolomite. (In Cimarron group in Kansas; in Woodward group in Oklahoma.)

Permian: Central southern Kansas and northwestern Oklahoma.

P. 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 ss. [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. 40(HH). 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 dolomite ls. Characteristic Whitehorse sand and sh. are below it, and above it 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. 2323), 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. ls=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 Is. 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.
stone (1870 rept.), Dayton Is. (1871 rept.). Even-bedded massive Is. 5 to 10
ft. thick, sparsely charged with fossils and containing at least 90 per cent of
carbonate of lime. Lowest memb. of Niagara group in Montgomery and High-
land Counties. Overlain by Niagara sh. and underlain by Clinton [Brassfield] Is.
E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28), assigned this Is. 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.
Dayton Is. is probably younger than Oldham Is.; 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.
thick. A memb. of Nugget ss. of Fort Hall Ind. Res. Overlies Higham grit and
underlies Wood sh.
memb. of Nugget ss.—Dense purplish-gray Is. 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, 62), treated Deadman Is.,
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 presently 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 Corritos beds to upper part of
San Pedro.
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. Dead-
man 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.
Red brown qtzite and ss., locally conglomeratic, and partly massive. Thickness 4
to 150 ft. in Black Hills. Upper part is thinner bedded softer ss., 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 crown of large rounded masses
of crystalline rocks and vein quartz in a red-brown matrix. Rests uncon. on pre-
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Camb. granites and schists and underlies Englewood is. [Miss.]. In northern Black Hills is separated from Englewood is. by a mass of buff is. of Sil. age [Whitewood is., 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 is. (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. No 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. Delos, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 47 and passim). Dean Lake chert mem.—Generally thinnest memb. of Madison Is. 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 b/w. the lss. In type loc. lower 23 ft. is black-gray lss. interbedded with blue-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 Is. memb., all in Madison Is. 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.

Dearborn limestone.
Middle (?) Cambrian: Northwestern Montana.

C. F. Delos, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 26 and passim). Dearborn ls.—At type loc. (North Fork of Dearborn River, in W. ½ 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, 150 ft. Thickest (459 ft.) in Dearborn region; thinnest (135 ft.) in vicinity of Prairie Reef. Overlies Nannie Basin Is. and underlies Steamboat Is.

Dease series.

Permian to Ordovician (?): British Columbia.

Death Canyon member (of Gros Ventre formation).

Middle Cambrian: Western Wyoming (Teton, Owl Creek, and Wind River Mountains).

B. M. Miller, 1938 (Jour. Geol., vol. 44, No. 2, pp. 119- ). Death Canyon memb.—Largely fine-grained dark-gray and black lss. mottled with brown; the lss. thin- bedded for most part, in layers 1/2 to several inches thick, separated by argill. seams and partings. Fossils. Thickness 285 ft. in Teton Range. Gradually thins and interbeds 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 Terry Creek; about 40 ft. at Bull Lake Creek. [See Bull Lake Creek sh. of Branson.] Overlies lower sh. div. (100-2 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 mapable units. Apparently nonfossiiliferous. 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. 48, 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 sh. and overlie Maclurea lss.

According to C. W. Hayes (U. S. G. S. Rome' folio, No. 78, 1902) these beds belong in lower part of Rockmart sh. and rest on Chickamauga lss.

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 lss.—Massive white crinoidal lss. 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. lss., 2 ft.; massive white mag. lss., 30 ft.; argill. grayish lss. weathering into sh., 11 ft.; massive mag. lss., grayish at top and yellowish toward bottom, 20 ft. Top fm. of Niagara of West Tenn. Uncon. underlies Linden fm. (Lower Dev.) and overlies Lobelville fm., top fm. of Brownport group. [See also under Brownport fm.]

E. O. Ulrich has for years classifled this fm. as of late Cayugan age.

Decatur sand. (In Claiaborne 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 Koscuisko ss. memb. of Lisbon fm. Named for exposures near Decatur, Newton Co.

Decaturville limestone.

Upper Cambrian: Central Missouri.


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. ml.

The 1926 geol. map of Mo. shows the rocks at and around Decaturville to be pre-Gasconade.

J. Bridge, 1930 (personal communication). The Decaturville Is. is Bonnetteer dol., and Proctor dol. is absent at Decaturville.

Named for exposures at Decaturville, Camden Co.

Decaturville chert.

Upper Ordovician (Richmond): Central Missouri (Camden County).


Decaturville chert.

Lower Devonian (Helderbergian): Western Tennessee.


Decreation porphyry.

Pre-Cambrian: North-central Arizona (Jerome district).

L. E. Reber, Jr., 1922 (Am. Inst. Min. and Met. Engrs Trans., vol. 69, 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?] Decreation 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.**


M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 189). *De Cew la.*—Fine-grained, dark grey, argill. is., 2 to 9 ft. thick. Basel 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. Herefore included in the Lockport. Difficult to separate from Rochester memb., which is essentially sh., although toward top some calc. beds appear. Underlies Gasport is. [Schuchert (Geol. Soc. Am. Bull., vol. 25, p. 307, 1914) stated 5 ft. of DeCew is. is present at Lockport, N. Y., beneath Gasport is. and 2 to 5 ft. at Rochester, N. Y.]

**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 is. containing a fauna of marked Onondaga aspect and extending up to where typical Onondaga sh. 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 Decewville, 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 Gienere. 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. 25, p. 376) C. R. Stauffer stated that *Decewville 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 "*Decewville fm.* has no standing, and that Decewsville section of the "formation" consists of 2 ft. of Onondaga sh., underlain by 17 inches of Oriskany ss., which rests on 30 ft. of is. belonging to Salina fm."

**DeChelly sandstone member (of Cutler formation).**

**Permian: Northeastern Arizona, southeastern Utah.**


H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380), and 1917 (U. S. G. S. P. P. 33). *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 ss.) 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 Halygiton 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.

bed (which separates it from the overlying Stormville Is.) and overlying Decker
Ferry ss., which rests on Decker Ferry shales. The Is. 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 Is. and in base of overlying Stormville
Is. The Decker Ferry Is., Decker Ferry ss., and Decker Ferry shales are all
exposed near Decker's Ferry below Flatbrookville, Sussex Co., N. J.

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 Is. 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 Is., or to equivalents of
Rosendale and Wilbur Is. 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 Is. and shales, underlain by 2 ft. of
red crystalline Is. characterized by **Ptilodictya frondosa**, which rested on
24 ft. of highly fossiliferous hard crystalline Is. designated **Chonetes
jerseyensis** zone. In 1906 (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 Is.); Binngewater Is.; 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 Is.). 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 Is.** and was applied to 50 ft. of dark-gray impure
siliceous and shaly Is. overlying Longwood sh. and containing fossils
which correlated it "with the lower portion of the 'Decker Ferry' Is. 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** Is. of N. J.
with **Decker Ferry** of N. Y., and with Cobleskill, Rosendale, and Wilbur
Is., the Cobleskill being overlain by Rondout Is. 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 Is., 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. Kliimmel gave the following sequence of Sil. fms. of N. J. (de-
scending): Manlius Is.; Rondout Is.; Decker Is. (52 ft. of Is. to NE. and calc. sss. to SW., with Salina fossUs); Bossardville Is.; Poxino Island sh.; High Falls fm. (= Longwood sh.); Shawangunk cgl.

The age and strat. relations of Decker Is. are still debated.

/Decker Ferry limestone.
/Decker Ferry formation.

See under Decker Is.

Decker Ferry shales.

Silurian: Northeastern Pennsylvania (Monroe County) and northwestern New Jersey (Sussex County).


Decker Ferry sandstone.

Silurian: Northeastern Pennsylvania (Monroe County) and northwestern New Jersey (Sussex County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G., 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 ls 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
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Included in Platteville Is.). 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. 288) his restricted Spechts Ferry memb. includes a thin bed of metabentonite 18 inches above its base. On p. 289 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 Is. 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 Is. 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 Is., Decorah is no longer an appropriate name for the sh. separating Plattin and Kimmswick Is.

Decota sandstone. (In Kanawha formation.)

Pennsylvania: West Virginia.


De Courcy formation.

Upper Cretaceous: British Columbia.


Dederick shale member.

Pennsylvania: 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 Is. 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. 1/4 SE. 1/4 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.


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 biotite 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."


"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.'"


Deep Canyon fanglomerate.

Quaternary: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calf. 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 parenthesis, *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 Is. and Beekmantown Is. 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. Normanskil sh. above and Schaghticoke sh. below.


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 Is. (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 Is., 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. Is. 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 metaquartzite.—Coarse to fine, massive to slabby metaquartzites, 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. 295, 273+). Deep River series (also Deep River fm.).—Trias and Perm. rocks of Deep River region, consisting of (descending): (1) red ss., marls, etc.; (2) black or blue ss. with plants and a coal seam; (3) cgl.; (4) drab-colored ss., 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.]


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. 85, 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.—Bristle 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 Jacob's 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 Koshong 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).


Deer Creek quartzite.

Pre-Cambrian (Glenarm series): Northern Maryland.


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 ss., 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 ss. The ss. is rich in quartz and locally becomes conglomeratic.

According to E. B. Knopf ('letter dated Feb. 11, 1957) 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 iss. 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. is as originally defined by Bennett included 3 iss. and 2 shales. The following names are proposed for the subdivisions (descending): Ervine Creek ls., Mission Creek sh., Haynes 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 Is. of Kans. into (descending): Ervine Creek Is., Larsh-Mission Creek sh., Rock Bluff Is., Oskaaloosa sh. (formerly erroneously identified as Larsh sh. but older than true Larsh sh.), and Ozwakie Is. (formerly erroneously identified as Rock Bluff Is.). He stated that his Ozwakie and Oskaaloosa 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 Is. is treated as a memb. of Pawhuska Is.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Also 1937 entry under Topeka Is.

Named for exposures on Deer Creek, E. of Topeka, Shawnee Co., Kans.

†Deerfield diabase.

Upper Triassic: Central Massachusetts (Connecticut River region).


B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 87, 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 shs. 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 typicus posterus and Glossograptus quadriradiatus, 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 typicus 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 quadririmusornatus, 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.

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 is.,
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): Northwestern Minnesota (Cuyuna
district).
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.
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. Adja-
cent rock fms. support this view.
C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. 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 is., and (4)
collie sand or "mealy" is. The Dees sand varies from that of true quartz
sand to sandy ls. interbedded with sandy sh. Its av. thickness is 15± ft. Under-
lies 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 ss., cgl., shales, and a few
ls. 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 NW.-SE. exposure just E. of Deese.
Thickness 6,000 to 8,000 ft. Fossils listed. Underlies Hoxbar memb. and overlies
Cup Coral memb.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7-21). Deese fm., 5,060± 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 Is., and basal memb. of Hoxbar fm. is here named Confederate Is. 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 Is. 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 ss., 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 Is., with apparent conformity. Overlain, apparently conformably, by Kinkaid Is. Heretofore included in Pottsville, but discovery above it of Kinkaid Is., 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.


J. L. Tilton, 1921 (Iowa Geol. Surv. vol. 27, p. 186) and 1924 (Iowa Geol. Surv. vol. 29), correlated DeKalb Is. and Westerville Is. with Drum Is., and called the sh. underlying it Chanute sh. and the sh. underlying it Cherryvale sh. He also called the Is. overlying Chanute sh. the Iola Is., instead of Westerville.


R. C. Moore and G. E. Cordua, Oct. 1932 (revised classification chart of Penn. rocks of Kans. and Nebr.) adhered to latter definition of Cherryvale sh., but discarded DeKalb Is. for Westerville Is., 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 Is." 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 Is. 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 "Algonian" 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 Nosonl fm. and underlies Bully Hill rhyolite. Thickness approx. 1,000 ft. Named for exposures along Dekkas Creek.

DeKoven formation.

Pennsylvaniaian (Allegheny): Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 27). DeKoven fm.—Shales with thin ss. 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.

Delanleys Creek facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 77, 160, etc., 1931) to a lithologic facies of his Carwood fm. in Washington Co., Ind.

Delano moraine.

Pleistocene (Wisconsin stage): Southern Minnesota.


Delaware limestone.

Middle Devonian: Ohio.

N. H. Winchell, 1874 (Ohio Geol. Surv. vol. 2, pp. 290–302). Upper Cincinnatian 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 Is. (Tully Is.), 4 to 9 ft. thick, forms upper part. Rests on Delhi Is., the top bed of Lower Corniferous [Columbus] Is.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3). Delaware Is., the upper part of Corniferous Is., consists of (descending): (1) Thin-bedded Is.; (2) Ferris Quarry ("Delaware stone"); (3) siliceous blue Is.; and (4) bone bed 6 ft. thick. Rests on Columbus Is. (Lower Corniferous) and is overlain by Huron sh. [The bone bed has been included in Columbus Is. since 1880. See under Columbus Is.]

In central Ohio the fm. overlying Delaware Is. 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. Ga, pp. 73, 76, 77, 80). Delaware flags.—Alternating beds of bluish-green and greenish-gray ss. 20 to 40 ft. thick, and greenish sandy shales, with one reddish bed 10 to 15 ft. thick. The ss. 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 ss. and shales, on which lies Lackawaxen egl.

†Delaware Limestone.

Silurian (Niagaran): Central eastern Iowa.


Replaced by Hopkinton Is. (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 Is., though locally includes some sh. At base 200 ft. or more of blue-black thin-bedded Is. Greatest exposed thickness 2,300 ft., but base not seen and relations to Pennsylvanian Hueco fm. not determined. Underlies Capitan Is.

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 Is.; (2) Delaware Mtn ss.; (3) basal black Is. (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 Is. (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 Is. (also to the beds above Victoria Peak memb.). Includes near base a thin bed of gyp. (here named Dos Alamos gyp.)
Lexicon of Geologic Names of United States


P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–795). Delaware Mtn fm. restricted to beds above Bone Spring Is. (here treated as a distinct fm.) and below Castle gyp. in Delaware Mtns, and below Capitan Is. and above Bone Spring Is. in Guadalupe Mtns, the Victorio Peak memb. being here included in Bone Spring Is.

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 Is., and upper portion of middle part of the Delaware Mtn grades laterally into Dog Canyon Is. The Delaware Mtn rests on Bone Spring gneiss.

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 Is. and underlie the upper dark Is. 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). 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.


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, 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 sh. Include Lackawaxen cgl. and Delaware flags. In Wayne and Susquehanna repts (G4) 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 ss. 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.


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 Anatolimnk red sh., after village in Monroe Co., where at least 100 ft. of it is well exposed. The underlying Starucca
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 Is.—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. at Lower Corniferous, and overlain by Upper Corniferous or Delaware Is.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3). "Delhi stone" belongs near top 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 Böse, 1921 (Am. Jour. Sci., 5th, vol. 1, pp. 188, 194), assigned these beds to Perm.

Delville sandstone.

Upper Devonian: Southern central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F., pp. 77-78, 394). Delville 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 Delville, 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 Delville 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 prevalingly 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 Zornorian stage, R. M. Kleinpell, 1934.

DeLong cyclical formation.
A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1881, 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.
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 Bllen. 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. Is.; 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. 210+). 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.
Named for Del Rio, Valverde Co.

†Delthyris shaly limestone.
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 Is.) is applied on map to rocks btw. Eufaula (Ripley) above and Eutaw below. This is first geographic name introduced to replace "Rotten Is.," but in 1894 Dr. Smith introduced Selma chalk to replace "Rotten Is." 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, 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.


DeNay limestone member (of Francis formation).

Pennsylvaniaian: 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 ½ 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 ¼ 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, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 517). Denison beds.—Laminated aren. cllys at base, grading upward into sandy clays and occasional ls., 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 flasile indurations, generally of brown color; (2) more sandy and ferruginous beds, oxidizing into ironstone and almost indistinguishable from Dakota s.s.; (3) impure yellow ls. underlying Main Street in Denison. Underlies, uncon., Dakota s.s. [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 Is.—Fossiliferous Is., 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 Is. 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 Is. was discarded by U. S. Geol. Survey, and Winterset Is. 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.

B. 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, flasile 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 Is., Stark sh., and Winterset Is., 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 Is. 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 Is. 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 O. 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, 18). 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.
Dense limestone.

Ordovician (Lower): Central northern Oklahoma (Lucien field, Noble County).

B. B. Zavoico, 1934 (Tulsa Geol. Soc. Digest 1934, p. 60). Dense Is., top memb. of Simpson group in Lucien field, is 0 to 20 ft. thick. Underlies Prosser Is. and overlies Simpson dol. [This name is capitalised 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.


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 Is. 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 cgl.s. 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 cgl.s., grits, ss.s, sandy clays, and nearly pure clays; pebbles seldom exceed 3 in. in diam.; ss.s 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 cgl.s. Lower 915 ft. is as a rule fine-grained strata, yellowish brown friable ss.s prevailing, with all manner of gradations into clays and cgl.s.; 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 ss.s and cgl.s. and in lower part made up almost exclusively of volcanic rocks representing many varieties of andesite.

C. J. Hares, 1928 (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 egl., while upper div. is wholly conglomeratic, with no shales or ss. observable. The egl. 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. 1933, 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. 1/4 of sec. 11, T. 10 N., R. 5 E., about 1/2 mi. NE. of Denzer, Honey Creek Twp. In previous reps. has been called rhyolite. Assigned to pre-middle Huronian.


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.


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 interfinger 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. It 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 Depeauville waterlime of Emmons constituted a small part. (See first entry under Pamelia ls.)
The village name is spelled Depauville.

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 la. mem. 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 80 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 Doe Run 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 Haysstack country, to N. and E. of Opal Canyon.
Is exposed in wall of Deschutes River for at least 25 ml. upstream from mouth of
Crooked River, probably is present for a long distance below that locality, and no
doubt underlies several hundred sq. ml. 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 scoria-
ceous 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 peb-
bles 6 to 8 inches diam. Claylike beds are also present, also a bed of white
diatomaceous earth.

sists of several basalt flows and interflow lake and torrential beds. Lies absolu-
tely 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 stratifi-
ced fluvial 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 skele-
tons that compose the diatomite deposits. In places rests on Columbia River basalt
(Mio.); in other places rests on andesite considered to be of Mioc. 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, 1928 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands,

Deseret limestone.
Mississippian (upper) : Central northern Utah (Oquirrh Mountains region).
J. Gilly, 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. Thick-
ness 850 ft. Contemporaneously underlying Humbug fm., the body being arbitrarily placed
at base of first ss. or qtzite bed of notable thickness. Rests conformably on Madis-
on 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 sas., 5,000+ ft.
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.

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).


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. B. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 86-114). *Des Moines beds, or Lower Coal Measures.—Shales s.s.s., l.s.s., clays, and coals underlying Missouri fm., or Upper Coal Measures, and uncon. overlying Lower Carbt 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 sh., cgl., and sh. in Okla. and Ark., but to N. and S. thickness is much reduced and there are l.s.s. 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. 546). *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.


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. Bise, 1918 (Univ. Tex. Bull. 1758, p. 17). Devils Den Is.—Quite uniform gray or dark bluish hard Is. 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 Is. by 140± ft. of ss's with intercalated shales, which compose E. slope of Jim Ned Mtns. “The highest Is. of the section [which would seem to include his Devils Den and Elm Creek Is.] should perhaps be considered as belonging to Canyon div.”

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 33). Devils Den Is. belongs in Graford fm., and because top of Graford cannot actually be determined in Wise Co., the top of Devils Den Is. is arbitrarily taken as top of Graford fm. To N. of Trinity River this Is. is top tongue of Chico Ridge Is. It is older than Adams Branch Is. Is overlain by Ventioner beds.

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†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). Devil's 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 plakiokists spots. Lower beds generally thinner and contain less magnesia than upper ones. Thickness (609 ft.) in Dearborn region, thinnest (41 ft.) in Pentagon Mtn region. Top is eroded. Overlies Switchback ss. and uncon. underlies White Ridge bs. memb. of Jefferson Is. (Middle Dev.). Named for Devils Glen, a local feature in S/4 sec. 1, T. 17 N., R. 8 W., which is formed of the dol.

Devil's Gulch beds.

See under Valentine beds (Plio-f), where occur only known usages of this name.

Devils Island sandstone. (In Bayfield group.)


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 ss., each 00 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.


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). Devil's Lake fm.—Gray and yellow, more or less glauconitic ss. and quartzite pebble cgl. Thickness not definitely known: max. may be over 100 ft. Known only in a few exposures near the quartzite 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 overlain by glauconitic ss. and purple spotted dol. unlike anything known in normal section outside the quartzite 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). Devil's Lake ss. of southern Wis., about 100 ft. thick, underlies Mendota dol. and overlies Jordan ss., Is basal ss. 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). Devil's Lake ss. of Ulrich included (1) typical Devil's 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. Twswaites, 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 Devil's Lake fm., which he placed at base of his Ozarkian system in Wis. This proposed fm. was described by Twesaites (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 Devil's 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 Devil's Lake fm. and faunas.

Devil's River limestone.

Lower Cretaceous (Comanche series): Southwestern Texas (Valverde, Presidio, and counties).

J. A. Udden, 1907 (Augustana Lib. Pub. No. 6, p. 56). Devil's 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 ls., 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.


Devoice moraine.


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, 1897 (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, 184). Dewdney fm.—Chiefly qtzite, with two thick congl. 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 Mts. Named for Dewdney Trail, B. C., on both sides of which it is exposed.

**Dewdney Creek series.**

Jurassic: British Columbia.


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.


Bluish semicrystalline is., usually somewhat shaly but often massively bedded, 3 to 15 ft. thick. Stratigraphically 50 to 100 ft. above Hogshooter is. Is above horizon of Drum is., 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 is. = upper part of Drum is. of Kans., and it is so treated on the 1926 geol. map of Okla., but many geologists now consider it younger than Drum is. The beds separating Dewey and Hogshooter lss. were in 1925 named *Nellie Bly fm.*


**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, course, gray, semi-indurated, highly calc. ass., 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.


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.**


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 Elliscott sh. memb. and overlies Llilbridge 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 James-town, 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 Elliscott sh. memb. for relations to that memb. On pp. 64-66 detailed section of his
Dexterville memb. is given, aggregating 138 ft. without explanation as to which memb. (Elliotsh sh. or Dexterville) the covered interval of 140 ft. belongs.

† Diabolo sandstone.

Pre-Cambrian: Western Texas (Sierra Diablo region).

W. H. Von Streeterwitz, 1891 (Tex. Geol. Surv. vol. 2, pp. 682, 683). [The red ss. that extends along foot of southern cliffs of Sierra Diablo is in one place called Diabolo red ss. and in another place Diabolo ss. It is overlain by grites, 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).


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. Hydrg. Bull. 1.)

Diamond Hill felsite.

Carboniferous: Northeastern Rhode Island.


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 (U. S. G. S. P. P. 108, p. 170). Diamond Island sch.—Chiefly black, pyritic, graphitic, and slightly micaceous quartz sch. of very fine grain; but in lesser part a black or bluish black, somewhat graphitic and also pyritic quartz-sericite phyllite. Is characteristically studded with small masses and crystals of pyrite, which weather out and give rise to abundant cupperras and rust coatings. Equally characteristic are intricate crumbling 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).**

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.


According to G. H. Girty the fossils in the ls. 500 ft. above base of Diamond Peak qz. are upper Miss. and rest of fm. is not fossiliferous. He would therefore tentatively assign whole fm. to upper Miss.

The Diamond Peak qz. has 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 (?).


†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 quada. 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.]


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).


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 Durable 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 la. (basal bed of Lazy Bend memb.). [Derivation of name not stated. Fauna is listed.]

Dickson moraine.


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 la. lentil of Trinity fm.—Fossiliferous la. 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).


Dighton conglomerate.

Carboniferous: Southeastern Massachusetts and Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 35, pp. 134, 184-187, and pl. 17). Dighton cgl. group.—The name Dighton cgl. is here given to a group of coarse cgl., with
alternotlons 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-Zufii 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 ss., shales, cgl., 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. ScL, 4th, vol. 23, pp. 401-421). Primarily upon geological 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. Winclerak 38.5-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 Falla City sh. Been traced across Atascosa, Karnes, and Gonzales Counties.

B. C. Renlck, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17 and pp. 34-36). Dilworth ss. memb. of Manning fm.—In Gonzales Co., ½ mi. SE. of Dilworth, extending across the E. Kramelng 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 Washington 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).*


C. Schuchert, 1927. [See 1927 entry under Tesnus fm.]


Is chiefly Is.

Named for exposures in and near Dimple Hills, Pecos Co.

**Dingess limestone.** (In Kanawha formation.)

*Pennsylvanian: Southern West Virginia.*


**Dingess shale.** (In Kanawha formation.)

*Pennsylvanian: Southern West Virginia.*


**Dingess sandstone.** (In Kanawha formation.)

*Pennsylvanian: Southern West Virginia.*


**Dingus limestone.** (In Pottsville formation.)

*Pennsylvanian: Northeastern Kentucky (Morgan County).*

L. C. Robinson, 1927 (Ky. Geol. Surv., ser. 6, vol. 26, p. 239). Dingus Is.—Fossiliferous Is., at some localities so sandy it is impossible to separate it from overlying and underlying ss. Varies in color from light gray, to yellow, and black. Overlies Amburg 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.


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.


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. Thickness to W.; being 350 ft. thick at N. end of Hoback Range. Thickness 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. lentit, 0 to 120 ft. thick), near middle. Thickness 400 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 rep. 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.

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.
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 blotite. 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
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 (sulfatized), 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 is. memb. of Richmond fm.—Coarse-grained crystalline fossiliferous Is., 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 Is. 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 ~ mi. N. of Divine.]

Dixie sand.

A subsurface sand, 20 to 40 ft. thick, in middle of Goodland Is. (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 2,500 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.


Dixon earthly limestone member (of Wayne formation).

Silurian (Niagaran) : West-central Tennessee.


Top memb. of Wayne fm. Overlies Lego Is. memb. of Wayne. Underlies Brownsport fm.

Named for Dixon Spring, Decatur Co.

*Dixon sandstone. (In Henshaw formation.)

Pennsylvanian : Western Kentucky.


Preoccupied in Sil. of Tenn.

Named for Dixon, Webster Co., where it is well developed.
**Dixon formation.**

Pennsylvanian: Western Kentucky.


Preoccupied in Sil. of Tenn. Replaced by *Henschaw fm.*

Named for Dixon, Webster Co.

**Dixon schist.**

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Ailing, 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 Is. 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. Ailing, 1919 (Am. Jour. ScL, 4th, vol. 48, pp. 52-88). "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 Flack Graphite Co.'s mine, in Saratoga quad., a parting of thin beds of Is. 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 Is.

**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 Is.*, has manifest priority over all other designations by many years, and as such should be used. If Gilbert's Greenhorn Is. 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 Is.] 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 Is. 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 Is.* 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: 20th 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 septarian. 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 Is.]

Includes, exclusive of item D, Greenhorn Is. 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.
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†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. 153). 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 ss., which overlie Alpena ls. The clay is underlain and overlain by ls.

Dockum group.
Triassic (Upper?): Panhandle of Texas and southeastern New Mexico.

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.

Dockum 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.
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.]

Dodge shale.
Upper Cretaceous or Miocene (?): Western Iowa.
than Nishnabotna ss. and overlies Carbt Basal fm. of Dakotan series. [Later reap by Keyes assigned this ss. to Mio.]

Probably named for Fort Dodge, as author stated the ss. 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. Frayer, 1883 (2d Pa. Geol. Surv. Rept. C, 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). Doe Run 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 druse 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. Texit. 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 ss. 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.)
Permain: Central southern Kansas and western Oklahoma.
F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 8, 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 ss. and underlain by Shimer gyp. memb. of Cave Creek fm. (In 1897 (Am. Geol., vol. 19, pp. 351-363) Cragin suggested Stony Hils 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 sana.

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. K. Miller, 1930 (Am. Jour. Set., 5th, vol. 20, p. 211). Dog Head Is. of Manitoba seems to correspond to Lander ss. (basal memb. of Bighorn fm., of Richmond age, in Wind River Mtns, Wy.)

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 lss. 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 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.]
B. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 100-101). Dolgeville shales (passage beds btw. Utica sh. and Trenton lss.) 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.


Dolores formation.

Upper Triassic and Jurassic (?): Southwestern Colorado.

W. Cross, 1890 (U. S. G. S. Telluride folio, No. 57). Dolores fm.—Reddish quartzose ss., grits, and cgl., latter usually containing granitic debris and fragments of Algonkian schists and qtzites; several thin ls. cgl., with small pebbles characterize upper part and contain a few Triassic fossils [listed]. Below the fossiliferous horizons occurs a series of reddish grits, ss., or cgl., 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.)

†Dolorean 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).

Dome conglomerate.
Pre-Cambrian: Ontario.

Dome Canyon limestone.
Middle Cambrian: Western Utah (House Range).

Domengine formation.
Eocene (middle): Southern California (Diablo Range).
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 Domljean 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 Domljean 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.

| 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 (Phil. Acad. Nat. Sci. Proc., vol. 78, pp. 290-300). 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.
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 Tembler 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
ss.; 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.


Named for development in vicinity of Domijean or Domengine ranch, in NE14 sec. 17, N. of Coalinga, Fresno Co.

Domijean sands.

See Domengine fm.

Donia beds. (In Toronto formation.)

Pleistocene: Ontario.


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.

Donal quartzites.


Donald strata.

Lower Cambrian: British Columbia.


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 fm., but did not define the new names Donegal and Nolans.

Doniphan shale. (In Lecompton limestone.)
Pennsylvanian: Southeastern Nebraska, northwestern Missouri, and northeastern Kansas.
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 Is. and overlies Spring Branch Is., all in Lecompton Is. 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. GriswoId and M. J. Munn, 1907 (U. S. G. S. Bull. 318, pp. 77+.). Donley Is. memb. of Greene fm.—Very hard and tough Is. 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) Is. 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 Is. and above Phoenix sh. Belongs in upper part of Clinton fm.]

Don River member.
Ordovician (Upper): Ontario.

Dooley rhyolite breccia.
Tertiary (Miocene?): Northeastern Oregon (Baker quadrangle).
J. G. Illin, 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 Mo.

Dorans Cove sandstone.
Mississippian: Northeastern Alabama.
J. J. Stevenson, 1903 (Geol. Soc. Am. Bull., vol. 14, p. 78). 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 Is. 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).
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).


C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 154), included this cgl. in Huronian.


Doré series.

Pre-Cambrian: Ontario.


Dornick Hills formation.

Pennsylvanian: Central southern Oklahoma (Carter County).


C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z). *Dornick Hills fm.*—Bluish and tan shales interbedded by iss. and ssns., with conspicuous Iss. cgl. S. of Ardmore. The pebbles in cgl. consist chiefly of pre-Penn. Iss. and chert such as now outcrop in Criner Hills. Basal memb. is Jolliff Iss. memb.; top memb. is Pumpkin Creek Iss. Also includes (descending) Lester Iss., Bostwick Iss. cgl., and Otterville Iss. Thickness 1,500 to 4,000 ft. Underlies Deva Iss. and overlies Springer fm.


Named for Dornick Hills, N. of Ardmore, Carter Co.

Dorothy limestone and shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.


Dorset limestone.

Or dovician and Cambrian: Southwestern Vermont (Rutland and Bennington Counties).


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 Iss. 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 (Washington 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, ss., 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 Is. 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 Is. 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 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 and R. C. Moore, 1922 (Jour. Geol. vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 177-180, charts, etc.). Dothan Is. islnt of Moran fm. of Brazos River Valley is approx.—Horse Creek Is. of Colorado River Valley, but it is not certain they are same bed. Is separated from overlying Sedwick Is. 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. Recon. 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 Chatanooga 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.
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.

Double Mountain formation.
Permian: Central northern and central Texas.
Named for Double Mtns, Stonewall Co.

Doublet 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 Is., overlying them produce so prominent an escarpment, which extends entirely across the State from Leavenworth to southern line, that they, with overlying Oread Is., 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 lss. He also applied
Weston shales to basal 40 to 75 ft. of Lawrence sh. and Iatan is. to the thin is.
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.
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.

**Douglas shale.** (In Kanawha formation.)
Pennsylvanian: Southern West Virginia.

**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 arkose 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 ¼ mi. from canyon mouth, NW ¼ SW ¼ 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).

Douglas, Bayfield, and Ashland Counties is 20,000+ ft. thick and includes (descending) Douglas County traps, s.s., 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).

thick. Overlies Treadwell sh. with apparent conformity. No fossils found in either
Treadwell sh. or Douglas Island volcanic group, but their apparent position above
Thane volcanic group indicates they are post-TriasIc 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.] Keys (Pan-Am. Geol., vol. 46, 1928) 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).

Vashon glacial epoch. Underlie Oceola clays in section exposed in N. bank of Car­
bon 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
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 Is. or of 2 Is. 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 Is. memb. of McKissick Grove fm. and overlying Brownville Is. are two, instead of one, persistent Is. The upper one is distinguished by occurrence of coal a few inches to 2 or 3 ft. beneath the Is. The lower Is. is characterized by abundance of large Trinitoids and Cryptozoan, and, except for generally lighter color, very closely resembles Tarkio Is. Both of these Is. btw. the Maple Hill and Brownville have been identified at various places in Kans. and Nebr. as Dover Is. Study of Beede’s original description of the Dover and examination in field near Dover convince writer that lower of the 2 Is. 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 Is. 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 French sh. (from a creek NW. of Onaga, Kans.) is adopted for the sh. btw. the Dover and Maple Hill Is.
R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Kans. and Nebr.) transposed the names French sh. and Table Creek sh. restricted, by applying former name to sh. overlying Dover Is. and latter name to sh. under­lying Dover Is.
G. E. Condra, 1935. (See under Jim Creek Is.)
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22). The sh. overlying Dover Is. and underlying Grandhaven Is. 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.
See under Dover Is., 1927 entry (G. E. Condra).

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 lithogenic 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 Is." for the "fence-post Is." 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 mem., and its local name "fence-post Is." 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 mem.

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. ("Mariou flint"). Included in Chase stage.


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 Holmeville 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.


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 bed" on p. 143, and farther along on same page mentions one species "from the Whitehorse and Dozier ss." 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 *Doster ("Memphis") ss. membr.* [which he mapped separately].

See under †*Memphis ss.*

R. Both, 1932 (Jour. Geol., vol. 40, No. 8, p. 703), believes Memphis ss. is a continuation of Doster Hills, which are channel deposits, and that it marks base of his Custer fm., which he assigned to Lower Triassic.


**Draco morainic.**

Pleistocene (Wisconsin stage): Northeastern Minnesota.


**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.


†*Dragoon quartzite.*

Cambrian (Middle): Southeastern Arizona (Dragoon Mountains).


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 Mnts 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 Mnts seems, in light of work in Mule Mnts, 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-Carb., 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.**


**Draney limestone.** (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

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 ool. memb.—Hard, heavy-bedded ool., 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.


\textit{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 Is. 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 \textit{Dresbach sh.}).}

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2), assigned thicknesses of 50–82 ft. to \textit{Dresbach sandrock} of Minn. and applied \textit{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 \textit{Ulrich's mas.}, 1914). \textit{Dresbach ss. overlie 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). \textit{Dresbach ss.} is named for Dresbach, Minn., where about 200 ft. of friable white and light greyish 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 \textit{Dresbach ss.} of SW, Wis. as underlying Ironon memb. of Franconia ss. and overlying Eau Claire sh. [The Ironont memb. had previously been included in Dresbach ss.]

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, p. 709). At Dresbach, Minn., the \textit{Dresbach fm.} underlies Franconia ss. (which is 102 ft. thick) and consists of (descending): (1) sss., often massive but usually sandy shales, 28 ft.; (2) sss., massive, white to yellowish or brown, with \textit{Discolomus politus} and \textit{Hyolithes primordialis} common, 19.4 ft.; (3) sss., massive, gray to white or yellowish to buff and brown, well shown in old quarry, very fossiliferous, and 18 ft. thick; (4) sss. and sandy sh. alternating, white to bluish, often cross-bedded, well exposed along river bank or in lower quarry, very fossiliferous, 22.6 ft.

E. Peterson, 1929 (Buffalo Soc. Nat. Sci. Bull., vol. 14, No. 2). \textit{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 sub-aerial deposit would help to avoid confusion.}

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 38–45, 79). \textit{Dresbach fm. should include all beds btw. base of Mount Simon ss. and base of Ironont memb. of Franconia ss.} The upper ss. of this series of beds (which is 60–86 ft. thick and has heretofore been called \textit{Dresbach ss.}) is here renamed...
Galesville memb.; the underlying 200 ft. of ss. and sb. 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 ssy., 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 gt 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 Ill. 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 189 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 ss. 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).

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 Cty.

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 Is. 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 Is. The name Dripping Spring is restricted to the lower qtzite.

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380-385). The Is. overlying Dripping Spring qtzite restricted is here named Mescal Is. 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 faltiy 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.

Droop sandstone. (In Bluefield formation.)
Mississippian; Southeastern West Virginia and southwestern Virginia (Giles County).

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 Is.” have been used in central
northern Okla. to include (descending) Dewey Is., Nellie Bly fm., and Hogshooter Is., but that usage has been discontinued.

The Drum Is. 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 Is., 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 Is. (oolitic) above and Cement City Is. (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.
Pennsylvania: Northeastern Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, pp. 73-74), used Drum group to include (descending) Dewey Is., Nellie Bly fm., and Hogshooter Is., 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, 1925) to “50 ft. of clays of Mid Tertiary age” in Mont. Derivation of name unknown.

Drury shale and sandstone member. (In Pottsville formation.)
Pennsylvania: 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 ss., 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 quartz 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 onick 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 Is. by Swallow, according to C. N. Gould (1925).

Dry shale. (In Wabaunsee group.)
Pennsylvania: 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 Is. from next higher (Grandhaven) Is. 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 Is., 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 membr. of the Gallatin. Outcrops obscure in most places. Best exposure seen is on Dry Creek [NE. corner of Threeforks quad.], where thickness is 20± 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 shale, 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 sss., 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 lss.
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 lss. and overlain by Yogo lss., which consists of gray or mottled lss. 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. sss. Correlated on basis of lithology and strat. position with Dry Creek sh. of Threeforks and Little Belt regions.
C. F. Delos, 1930 (Geol. Soc. Am. Bull., vol. 47, No. 8, pp. 1258-1342), proposed that Yogo lss. 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, 1829 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 18, No. 14, pp. 367-398, 400, 401, 403). Above the Chico sss. (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. Formably underlies Tone 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 sss., 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 Is., and underlain by “Bone bed” [p. 34 states lies few ft. above “Bone bed”), which rests on Columbus Is. Of Marcellus age.
Forms lower part of Delaware Is.
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 ml.) 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.

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 Calhoun 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 Is. 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 (Wisc. Acad. Sci. Trans., vol. 21, pp. 71–93). Dubuque Is. is basal Richmond, and older than Fernvale Is. [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.


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 lvs., 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 ml. 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 sss. 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.

Overlies Kiamaitia clays and underlies Fort Worth Is. 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 Is.)

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 Is.

†Dudley limestone.
†Dudley series.


T. A. Conrad, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 58-59), applied Dudley Is. and Dudley series to Is. exposed at Dudley, which he originally believed, from contained fossils, to be younger than Trenton Is., but which he finally concluded corresponds in age to Trenton Is.

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 sq. and some thin Is., overlying Parsons Is. and underlying Hertha Is. Top fm. of Pleasanton group in Kans. In SE. Kans. is basal memb. of Coffeyville fm. Underlies Hertha Is. 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.]


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.


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 Is. 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. Is.
Dugout clay and gravel.

Miocene and Pliocene: Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 68). Dugout clay and gravel.—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 Pilo.

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-Carb." 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. 100-145), and criticises their reference to Gaptonk 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 clgs.; the ss. are different and have none of the typical gray Is. 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 clgs. 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 ss. and shales, with one, perhaps two, thin beds of gray Is., and at base, 20 ft. of gray, granular, in places conglomeratic, ls. passing upward into fine-grained sandy ls. This basal ls. contains Chaetetes nullipora-cus 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 ss. assigned to Raymond fm. Along Dugout Creek overthrust the Gaptank has been overriden by great mass of pre-Carb. rocks.

Dukes boulder bed.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard) and southeastern Rhode Island (Block Island).


**Duley Lake group.**
Pre-Cambrian: Labrador.


**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., pl. 14, pp. 134, 142–146, 185; also U. S. G. S. Mon. 5, p. 266). Duluth gabbro 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. E. Effman, 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 Is.—Ls., 100 ft. thick, in middle of interval btwn. Fall River ss. and Neodesha Is. in Wilson Co. Probably same as thick Humboldt Is. 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., Is., and ss.


Named for Dun, Wilson Co.

**Dunbar series.**
Carboniferous (Mississippian?): Nova Scotia.


**Duncan chert.**
Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 86, 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 Is. by a process of silicification. Included in Blue Canyon fm.
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Duncan formation.

Cretaceous (?): British Columbia.


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. 318 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.


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 iss. and calc. sss., generally without fossils. Both types vary from apparent beds to small lenses. [Type loc. not stated.]


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. 68). 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.
to Dunderberg sh. of Nev.

Dunham dolomite.
Lower Cambrian: Quebec.

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 Wash­
ington Is. 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 abun­
dance 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.
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.
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.
Included in Chenung. Overlain by Gowanda ("Portland") beds and discon.
underlain by Hanover shales.
tauqua Co. is overlain by Gowanda sh. and underlain by Hanover sh.; in Cat­
taraugus Co. it is overlain by Gowanda beds and underlain by Weecoy sh. (in
part—Hanover sh.). Assigned to Chenung. Equiv. to upper part of Cayuta sh.
memb. of Chenung.
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. 389), 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 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 ls., separated by 9 to 20 ft. of sh. Separated from overlying Cottonwood Falls ls. by 25 to 30 ft. of sh. and from underlying American 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, cgl. (principally of ls. pebbles), and varying amounts of volcanic rocks. In Gabbs Valley Range and central part of Excelsior Mnts 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 fans contain lens of ls., sh., ss., and bedded cgl. Thickness of fm. 4,000-5,000 ft. Assigned to Lower Jurassic and correlated with Middle (?) Liasic 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 noncal. 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.
Hernando Counties. A mixture of materials, largely residual, from several fms., from Lower Olig. to at least as late as Pleist. Consists of sands, clays, boulders, cgl., 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 ls. 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 mer. of the Gallatin.

Dunvegan sandstone.

Upper Cretaceous: British Columbia and Alberta.


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. 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. pos. 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. Out-
cropping along bluff on N. shore of lake there is a compact fossiliferous is. that contains many casts of Molluscan shells, Crepidula being especially abundant. This is. 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 Pee Dee 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. 887, 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.


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 chert, 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. Wandle, 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 1/4 mi. of Rollingford, 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 mem. is a heavy, thick-bedded, very hard, yellowish shale, of which 75 ft. remains uneroded. Underlying part of fm. consists of about 150 ft. of sh. with a few thin-bedded, shaly, impure srs. 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 sh. Well exposed on Duskin Creek, a tributary of Pinney Creek, which flows by Spring City, Rhea Co.

Dutch Creek sandstone.
Middle Devonian: Southwestern Illinois and eastern Missouri.

Dutch Creek formation.
Pre-Cambrian: British Columbia.

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).

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. 1/4 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. WlUard, 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 Is.]. 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.


Dyer Bay dolomite lentille (of Cabot Head shale member).

Silurian (early): Ontario (Bruce Peninsula and Manitoulin Island).


†Dyeestone group.

Silurian: Tennessee.

J. M. Safford, 1858 (Geol. Reconno. Tenn., 1st Rept., pp. 149, 156–158, and map). Dyesteone and Gray Limestone Group.—Includes several distinct fms. In East Tenn. consists of ssh., calc. shales, including dyeestone, and some Is.; in middle and western Tenn. is almost entirely Is. Includes (ascending): Clinch Mtn ss., variegated shales containing iron ore, and Sneedville Is. Underlies Carbf. black sl. and overlies Nashville memb. of Central Is. and sh. group.

In 1869 (Geol. Tenn., pp. 151, 161, 302) Safford defined "Dyeestone group" as consisting of 200 ft. of variegated shales, with some thin, smooth ssh., overlying White Oak Mtn ss., and underlying Meniscus Is., 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.

Eagle limestone. (In Kanawha formation.)
Pennsylvanian: Southwestern West Virginia.
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. Beenen 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).

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 foMo, No. 55). Eagle fm.—Basal part consists of thinly laminated ss. 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 ss. 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 ml. 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 Yellow-stone-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 predominately 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.

Eagle sandstone. (In Kanawha formation.)
Pennsylvanian: Southern West Virginia.

Eagle shale. (In Kanawha formation.)
Pennsylvanian: Southern West Virginia.
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.


Eagle City beds.

Mississippian: Central northern Iowa.


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 Is. at base and the oolitic Is. 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 Cont Kons. Geol. Soc., pp. 243, 245). Eagle City Is. 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.


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 correspond-

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. Cheney, 1920 (Univ. Chicago, Contr. Walker Mus., vol. 2, No. 5). Eagle Creek fm.—Flora (listed and described) is considered Olig. [They did not give reference to publication that constitutes priority of Triassic fm., and compiler has been unable to find it.]


†Eagle Creek formation.

Upper Triassic: Northeastern Oregon (Wallowa Mountains region).


Preoccupied. Replaced by Martin Bridge fm.

Eagle Ford shale (also clay).

Upper Cretaceous (Gulf series): Texas, western Louisiana, and southeastern Oklahoma.


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 plagoclase phenocrysts. Forms country rock on both sides of Eagle Gulch.


Eagle Hill rhyolite.

Tertiary (Eocene?): Central northern Utah (Mercur district).


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. 58; 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. Cherty 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.

**Eagle Pass formation.**

**Upper Cretaceous (Gulf series)**: Southwestern Texas.


**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).]


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 (Tennille district).


**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 ss. and cgl.). Marvone'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 1938 (Jour. Geol., vol. 44, No. 4, pp. 434-489). 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 Neely lake beds.

†Eaunua limestone.

Lower Ordovician (?) and Upper Cambrian: Central Missouri (Camden, Hickory, and Dallas Counties).

H. King, 1844 (Am. Jour. Sci., 1st, vol. 47, p. 129). **Eaunua 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 Eaunua 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 Niaunua 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 Bonnetterre 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. Buhl, 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. L. 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 lola ls. by shales. [Some later reps stated this ls. is lola ls.]


Early Bird formation.

Carboniferous or pre-Carboniferous: British Columbia.


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 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. 55, 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.


†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 ss. are red and often highly argill. Same as fossiliferous Camb. or Potdam 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).

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 IBS. 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 Devil’s Bedstead a little S. of E. for 7± mi. The lower 530 ft consists largely of beds of nearly pure IBS. 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 qtzite 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 ss. and clay slates (almost argillites), with thin bands of laminated IBS. 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. 19). *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 Knopp formation 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 cgl's. 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.


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 Is.—More commonly called by Tex. geologists Caddo Is., but as that name is preoccupied by a ls. in Kans, the name Eastland has been chosen for this Tex. Is. 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 Is. memb., older name, and "Eastland" is preoccupied. (See 1921 entry under Home Creek Is. 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.)
Pennsylvania: Central Texas (Eastland County).

†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.)
Pennsylvania: Southern West Virginia.
B. 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 ½ 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. 28, 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).
Pennsylvania: Central northern Texas (Palo Pinto County).
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.
F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3334, 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. Foiles, 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 qzite [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; quartzite 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, Carbt. (?).

G. O. Smith, 1904 (U. S. G. S. Mount Stuart follo, 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. Bustin and H. S. Williams, 1914 (U. S. G. S. Eastport follo, 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 rhyolite 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 Is., 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.


†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.

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, 80-91). 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 Vlesca 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 is.

H. B. Stenzel, Jan. 1935 (Univ. Tex. Bull. 3501, p. 277). Crockett redefined to include only the 100 ft. of beds above Moseley is. The Moseley is. 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, 1882 (Geol. Wis., vol. 4, p. 110). *Eau Claire grit.*—Very coarse s.s. exposed at mouth of Eau Claire River. So coarse it has been termed cgs. 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.


**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 ml. 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.


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 N.W. 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).

Echo Bay series.
Pre-Cambrian: Northwest Territory.

Echo Island formation.
Middle Jurassic: Southwestern British Columbia (Harrison Lake region).
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 108 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.

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. Doll, 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 palaeontologic 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 weather, from western Fannin Co. NE. to point about 1½ mi. SE. of Ravenia. 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 iss. 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).


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 iss. 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 shb.]

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).

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 Pli.

D. M. Fraser, 1931 (Min. in Calif., vol. 27, No. 4, pp. 511-514). Frick's name *Eden bed* being preoccupied, he suggests it be replaced by *Mount Eden fm.*, which is here used for the lower Pli. 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.**


**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 (Summarv 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 B. C. (Marlboro Co.) along said creek to the Pee Dee, thence by Catacth, 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 body 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 argillltes 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.*


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 coarse crystalline ls. 4 ft. thick, oolite 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 Shl. [Later repts give thickness 0 to 75 ft.]

Girardeau Is. up to top of the mag. Is. near Bowling Green, and top of the brown Is. 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 Is., Noix oolite, and Channahon Is. 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 Is. with sedimentary break. In Kankakee Co., NE. Ill., it underlies, with possible break, Essex Is., which may prove to be a memb. of overlying Sexton Creek Is. (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 Kanes, which is a shallow-water phase of sedimentation near Miss. River, and is here called Noix oolite memb. The name Channahon Is. 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 Is. is 0 to 21 ft. thick and is not known N. of Oswego. It underlies Kankakee Is. with erosional uncon. It is here proposed to shift upper bdy of Edgewood fm. and basal part of overlying Sexton Creek Is. (of SW. Ill. and Mo.) 3 or 4 ft. higher than formerly, placing it at top of Is. containing Platymerella manniensis in Ill. and Mo., instead of at base of this zone, as formerly.


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 Is.—Varies from dense and micro-crystalline to coarsely crystalline, fossiliferous Is., 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 sh. 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 gneisses.

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 (Ephora) 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 phase of Mio. which has been phosphatised 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, Parachuela, 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 equv. marl, from bed of present ocean. Overlies Marks Head marl and is older than Goose Creek marl.
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 Hawthon 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, Parachuela sh., Parachuela marl, and Combabee sh., all of which are here abandoned. The Hawthorn includes Marks Head marl and upper part of underlying Alum Bluff "fm." of Vestot and Stephenson's rept on coastal plain of Ga. (Ga. Geol. Surv. Bull. 28, 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, 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.) Denvys fm. Fossils indicate Cobleskill and Niagara age. Named for exposures near Edmunds, Washington Co.

Edmunds Hill andesite.

Devonian (?): Northeastern Maine (Aroostook County).


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 flgygy or shaly ss. 0 to 75 ft. thick, in lower part of Lllydale 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 Lllydale sh., at times coming well up in this memb., and at some points near base; and often rests directly on Alderson Is. 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 Prosp 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.)

Pilocene (lower): Western Kansas (Sherman County).


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 (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 ml. 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.


eFraw 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.] Keyses (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).


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 Is.* includes the beds of upper Black River age that are younger than the upper red Moccasin memb. (Lowville) and older than Trenton Is. Although a good section of the fm. occurs 1.1 ml. S. of Eggleston, Va., the best section is along State Highway 8, 1 ml. 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 Is., 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 Is. 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.


Is a part of Stockbridge Is.

Egypt sand.

Upper Cretaceous: Missouri.


Eileen sandstone. (In Oronto group.)

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield County).


Einstein sandstone. (Also spelled Einstein.)

Pennsylvanian: Eastern Kansas.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 7). *Einatine ss.*—Thin beds of soft brown micaceous and hard gray calc. ripple-marked ss.s more or less intercalated with and passing into blue and brown sandy argill. shales. Upper part marly and fossiliferous at McPaddin's and at Ward's mill. Forms bed No. 10 (35 to 60 ft. thick) of geologic section of Miami Co. Overlain by Cave Is. and underlain by older Coal Measures strata.

In later repts called "Einstein ss." and included, together with †Cave Is., in †Cave Rock series. Probably represents whole or part of Chanute sh. memb. of Kansas City fm.

Derivation of name not stated.

Ells limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

Ekwan limestone.
Silurian: Canada (Hudson Bay region).

Ekwan River limestone.
Silurian: Canada.

El Abra limestone.
Lower Cretaceous: Mexico.
V. R. Garfias, 1915 (Econ. Geol., vol. 10, pp. 199, 290).

Elbert formation.
Upper Devonian: Southwestern Colorado.
W. Cross, 1904 (Am. Jour. ScL, 4th. vol. 18, pp. 245-282). 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 12 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, 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.

El Capitan granite.
Probably Cretaceous: Yosemite National Park, California.
El Capitan limestone.
A term applied by some geologists to Capitan Is. of Tex.

Elco gravel.
Mississippian: Southwestern Illinois (Alexander County).
L. C. Glenn, 1906 (U. S. G. S. W. S. P. 184, 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).

Eldon limestone.
Middle Cambrian: British Columbia and Alberta.

Eldonian series.

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.

Eldoradoan series.

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 Is. is introduced to replace Prospect Mtn Is. [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.

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.

†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.

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 Is.—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.) Talleman quartz. 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 Is.
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 Is.
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.
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. It 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.

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.

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.

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.

Eliot shales.—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.


Elipol phosphate.

Same as Eliot sh.}

Elisa quartz monzonite porphyry.

Age (?): Mexico.

Eliza gabbros.


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).

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.
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):

Elk conglomerates.
Cretaceous: Alberta.

Elk fire clay. (In Conemaugh formation.)
Pennsylvanian: Southern West Virginia.

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-beded ss.s 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 Cardile 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 Lambler 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 as Cragin as Lauphier beds, from exposures on Lauphier 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 ss. 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 Is. 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 Is., Tecumseh shales, and Lecompton Is., the two lss. being brought closer together to S.


Named for Elk Falls, Elk Co.

†Elkgarden formation.

Pennsylvanian: Northern West Virginia and western Maryland.


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 intermixed 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).


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 Rhynochotrema dentata zone and underlying the [so-called] Clinton [Brassfield Is.]. Characterized by
Platystrophia lynx var. mortitura, and faunally to be known as mortitura 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 is., 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 3 1/2 mi. SE. of Richmond, Ind.

Elkhorn moraine.


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 ls. contain Psautina, 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. ScL, 5th, vol. 15, pp. 50-57). Elkins is.—Greenish brown, generally composed of shaly, iron-stained flgs or thicker beds, all separated by irregular deposits of green sh.; infrequent carbonateous streaks. Thickness 450 to 500 ft. Marine fossils, also plants and tree trunks. Included in Chemung series. Separated from younger Valley Head is. of the Chemung by 650 to 750 ft. of sh. and is. 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. 38, pp. 298, 297). The name Elkins Fork shale 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 8 1/2 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., p. 60). Elk Lick (Upper Berlin) ls., 8 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 is. is placed 90 ft. above Berlin is., and latter is shown as consisting of 2 isss. separated by 18" 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 is. at Berlin is Elk Lick ls.)

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 90). Elk Lick ls.—Light-gray is., often tinged with buff. Thickness 8 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 is. 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 1, 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 ss. 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 ss. 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, 608), restricted Elk Mountain to the flaggy ss. 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 Carb.

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 Platen. 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 McKeans Counties [which U. S. G. S. classifies as Dev. or Carb.]. 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, indica-
tions 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.


Elkoan series.


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. Rett, Jr., 1931 (Unlv. 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 Micas 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. Dill says fossils are probably Pleist.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, No. 212, pp. 560, 565). Elk River fm. (upper Pli.).—Extending from the Goldwashers' cabin 1% 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. 204-270). 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.]


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 Is.—Chert-bearing lss. and dolomites, with usually a conglomeratic Is. at top. Thickness probably 1,000 ft. Uncon. may exist near top. Overlies, possibly uncon. in places, Wilberns fm. and underlies Carb.

Named for Ellenburger Hills, Burnet Co.

Ellensburg formation.
Miocene: Central Washington.

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. Ellenburg 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 cgl. 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 inter-bedded 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 (Alleghany and Garrett Counties).
ELLERSLIE FIRE CLAY. (In Allegheny formation.)
Pennsylvanian: Western Maryland (Georges Creek Basin).
Ellerslie fire clay (Lower Kittanning fire clay).—Underlies Lower Kittanning (Ellerslie) coal and overlies Mount Savage ss.; all included in Allegheny fm.

ELLETSVILLE stone.
Trade name of a ls. quarried from Spergen ls. in southern Ind.

ELLIOTT SHALE member.
Upper Devonian: Northwestern Pennsylvania and southwestern New York (Chautauqua County).
Ellisville 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 ss., 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.

ELLIOTT CITY granite.
Late Paleozoic (?): Northeastern Maryland (Baltimore County).
Ellicott City granite.—A narrow outcrop of massive biotite-quartz monzonite (very similar in appearance to Woodstock granite), which extends SW. from Elllicott City, on Patapsco River, to Orange Grove, is quarried at Elllicott City. Intrudes Wissahickon fm. Age may be as late as close of Paleozoic.

ELLIOTTVILLE conglomerate.
Name applied in some early N. Y. and Pa. repts to the cgl. at Ellicotville, 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. 1), 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.

ELLIOTT CREEK bed. (In Strawn formation.)
Pennsylvanian: Central Texas.

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 iss. or soft earthy calc. rocks of dark-gray color, with iss. 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 ss.s. of more southern localities. Underlies Dakota fm. and overlies Quadrant qtzite.

A. C. Peale, 1898 (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.


Ellison formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).


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). Port Adams or Ellisville phase of Grand Gulf group Mi. has very irregular boundaries, its southern line drawn from Tunica, La., by Columbus, Miss., by mouth of Okatoma Creek, by the Falls on Leaf River near Estaline, passing to S. of Ellisville and crossing Chickasawhay River btw. Winchester and Waynesboro. For convenience this div. will be called Port Adams or Ellisville phase. Extends into Ala.


Named for Ellisville, Jones Co., Miss., and Port 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 pre-vailing 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, 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 NE^4 NE^4 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, NW^4 NW^4 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.
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 Is, and underlying Middle Creek Is. Where these limiting ls. 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.]
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 Is., overlies Sniabar ("Hertha") Is., 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 Is. and overlying Hertha (Sniabar) Is. the Ladore sh., and apparently 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.
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.
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 Is.—Light-gray Is. 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. In overlying bed of 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 Is. Probably belongs to Canyon div.

Elm Creek limestone. (In Cherokee shale.)
Pennsylvanian: Northeastern Oklahoma (Ottawa County).
S. Weldman, 1932 (Okla. Geol. Surv. Bull. 56, pp. 25-26). "Elm Creek Is.—A 6- to 10-inch band of Is., 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 NW\frac{1}{4} SE\frac{3}{4} sec. 10, T. 28 N., R. 22 E.; along Fournille 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. 30 N., R. 21 E. Also on S. slope of a hill in NW. part sec. 15, T. 35 S., R. 8 E. (Kans.), a short distance N. of Kans. State line. Exact horizon of the Is. 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).
Elmdale formation (Oklahoma).
Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern and central Oklahoma.
C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 708). Elmdale fm.—Yellowish to bluish shales, with thin beds of alternating Is. including 2 or 3 thicker ones. Thickness 130 ft. Underlies Neva Is. and overlies Americus Is.
L. C. Wooster, 1905 (The Carb. rock system of eastern Kans.). Elmdale beds, 150 ft. thick, overlie Americus Is. and shales and underlie Crusher Hill alternating shales and Is. They include a friable Fusulin Is. 24 ft. above base; the Neva and Cottonwood Is. 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 Is. and overlies Americus Is. [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 Is. above Americus Is. and below Neva Is., 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 (?) Is. is herein called Foraker Is., thus restricting Elmdale sh. to strata btw. Foraker and Neva Is., 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 Is., of which the uppermost 2 to 3 ft. is deep buff and soft, the whole 20 ft. constituting the Red Eagle Is. memb.
See 1932 entry under Admire sh., for later definitions of boundaries.
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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 fm. (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.


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).


Elmont limestone. (In Wabaunsee group.)

Pennsylvaniaian: 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 rep. Emporia has priority over Beede's Elmont ls. [This discard Elmont ls.]


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 ls.—"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 weather 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.


Elmtree slates.


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. 28, 27–31). Elmwood beds.—Uderlies, with sharp contact, Clark Reservation ls. and grades into underlying
Elmwood is., 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 Onondago Co.; (2) Elmwood B, bluish block Is., 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.


El Paso 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 Is., but which are now divided into Montoya Is. (above) and El Paso Is. 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, 1908 (Am. Jour. Sci., 4th, vol. 23, pp. 476, 477-479), restricted El Paso Is. to lss. of Lower Ord. age, and named the lss. of Upper and Middle Ord. age the Montoya Is. He described El Paso Is. as thus restricted as gray, chiefly mag. Is., usually massive but locally thin-bedded; lower 100 ft. characteristically aren. and weathered brownish. Thickness 750 ft. in Van Horn quad. and 1,000 ft. in El Paso quad. Not sharply separated from Montoya Is. In El Paso quad. overlies Bliss ss. with apparent conformity, where that Is. 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, 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 coarse crystalline gneisses and schists to slates, granulites, ias., 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 Cuyama 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.)

†Elsstone formation.

Eocene: Southern Texas (Medina County).

R. A. Liddle, 1921 (Univ. Tex. Bull. 1860, p. 75, map, and columnar section). **Elsstone fm.**—Impure gray and yellow-gray, medium coarse-grained ias., moderately soft gneissitic ias.; 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 1¾ mi. above the bridge at Elstone.


Julia Gardner (personal communication, July 1930). The so-called "Elsstone 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). **Elsite la. lentil** was named by Liddle. It is a white, hard, massive, fossiliferous ias. 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. 280, p. 234, and Bull. 267, pp. 12, 17, 23–26). **Elvins fm.**—Shales, shaly ias., and more or less earthy dolomites. 0 to 120 ft. thick, intervening btw. platy top of underlying Bonnetteer ias. and cherty ias. of Potosi group above. In vicinity of Elvir 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 ias. and = Potosi slates and cgl. of Nason. It rests uncon. on Bonnetteer ias., the most appropriate and probably the only strictly available designation for the ias. 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 chalkless ias., 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. E. 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. E. 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.


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 Is. Rests on Reelsville Is. 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).


Ely limestone.

Pennsylvanian: Eastern Nevada (Ely region).


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 ls. 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.

†Elyssian 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).

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 lls. and chert beds lying btw. Tensleep ss. (below) and Chugwater red beds (above). Thickness 200 to 250 ft. Consists of (descending): (1) Yellowish ss. 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 ss., 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. 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.


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 l.,s. with thicker beds of qtzite. Thickness 420 ft. Underlies Lucky Cuss Is. and overlies Ajax qtzite.

**Emerald dolomite member (of Ajax limestone).**

Lower Ordovician: Central northern Utah (Tintic district).


**Emerald sandstone member (of Mancos shale).**

Upper Cretaceous: Central eastern Utah (Wasatch Plateau and Book Cliffs).


**Emigrant formation.**

Upper and Middle (?) Cambrian: Southwestern Nevada.


**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. ss. 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. In upper part of Thaynes ls. Underlies (conformably) Ankaraih ls. and conformably overlies Pinecrest fm. (lower part of Thaynes Is.). Named for Emigration Creek, E. of Salt Lake City, which it cuts across N. and NE. of Emery.

**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 graphic slate is 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. It 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.

that fm. and then usually comes in contact with pre-Camb. 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.)


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 Eimience is same as Proctor fm., 0 to 60 ft. thick, of W. flank of Ozarks.


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.

Emmet formation.

Pleistocene: Southwestern Idaho (Gem County).

V. R. D. Kirkham, 1928 (Idaho Bur. Mines and Geol. Fam. 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 Emmet, 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.


Probably named for occurrence at or near Emmittsburg or Emmittsburg 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 Tenc., 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.
Emperor limestone.
Miocene: Panama Canal Zone.

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 ml. 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 sas., 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 sh., 30 ft.; tuff, 20 ft.; yellowish sh., 400 ft. Uncon. underlie Elk River beds (Pleist.) and uncon. overlie Cret. (?) crushed gray sh.

Empire shale.
Pre-Cambrian (Belt series) : Western central Montana.
Empire limestone.
Oligocene: Panama.

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.
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 Wabanaese 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.]


B. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 223). It is impossible to determine to which of 3 or more Iss. 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 ls. = “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 mls.]

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 44 1/4 ft. of shales with two thin Iss. [Humphrey sh. of A. J. Smith 1905 rept] and separated from overlying Emporia ls. by about 64 ft. of shales with some thin Iss. and one coal bed [Olpe sh. restricted of A. J. Smith 1905 rept].


Emporia reservoir shales.
Pennsylvanian: Eastern Kansas.

L. C. Wooster, 1905 (The Carbt. rock system of eastern Kans.). Emporia reservoir shales.—Aren. shales, 77 ft. thick, carrying 6-inch coal bed at top. Overlie Emporia buff Iss. and underlie Admire shales and Iss. [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. Talaferrro, 1933 (Jour. Geol., vol. 41, No. 1, p. 33).

Encinal 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 Iss. at other horizons within Hamilton
Enocrinital limestone.
A descriptive term applied in early reports on Mississippi Valley to Burlington Is. Derived from predominance of fossil crinoids. In some early reports the Keokuk Is. was included, and in others the name was restricted to lower member of the Burlington.

Endeavor granite.
Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426-428, 1982) to a pre-Camb. granite in Wis. (area not stated).

Endee shale.
Triassic (?): Northeastern New Mexico.
C. R. Keys, 1905 (Am. Jour. Sci., 4th, vol. 20, p. 424). Endee shales, 300 ft. thick, underlie Amarillo shales, unconformably overlies Cimarron shales (= Moencopie shales), and are correlated with Shinarump shales of western New Mexico. [Derivation of name not given.]

Endicott sand series.
Series of subsurface Penn. s.s. and interbedded strata in central northern Okla. corresponding to upper part of Nelagoney fm. Thickness 30 to 200± ft.

Endicott diorite.

Enfield shale member (of Portage formation).


Enfield facies subgroup.

Engadine dolomite.
Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).
G. M. Ehlers, 1929 (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.
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 color; in places a small amount of dolomitic lime or fine-grained quartz sand silt. Thickness 60 to 100 ft. where overlain by Yountin 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.
Pennsylvaniaian: 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 Armo for 9 mi., to Crawford Co. line, the limit of field work. Is younger than Fort Scott Is., 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 Is. 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.

English Head formation.
Ordovician: Anticosti Island.

English River sandstone member (of Hannibal shale).
Mississippian: Southeastern Iowa and (?) central western Illinois (Pike County.)
H. F. Rain, 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 *Chonopeustus* fischeri. Has commonly been called *Chonopeustus* ss. Thickness at Prospect Hill, Burlington, Des Moines Co., Iowa, 22½ ft. Older than McKerney Is. memb. of Hannibal fm. and younger than Maple Mill sh. memb. of Hannibal.


Named for exposures along English River in Washington Co., Iowa.

Englishtown sand. (In Matawan group.)

Upper Cretaceous: New Jersey Coastal Plain.

H. B. Klümmer, 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 Cragn's first paper and Kingfisher and Glass Mt. 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 so-called Perm. even though it is of same age as lower part of Enid.

C. N. Gould, 1925 (Okla. Geo. 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. geo. 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., Heaviessey 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: Aluska (Iniskin Bay).


Later work resulted in dividing these rocks into 2 fms., Chinitna sh. (Upper Jurassic) and Tuxedni ss. (Middle Jurassic).
Ensenada shale.
Cretaceous: Puerto Rico.
†Enterprise green marl. (In Claiborne group.)
Eocene (middle): Southeastern Mississippi.
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.
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.
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 Krier Is. and Paddock sh. with overlying Herington Is. into a newly named fm. (Noians Is.). 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, unpagd; 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).
D. 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
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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 quartzites, 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. 396-410). *Eolian* Is.—White and gray Is., both nonmagnetized dolomites. Thickness 2,090 ft. Includes some sparly Is., clay sl., felsitic schist, talcose Is., etc. Same as Berkshire Is. and Stockbridge Is. of Mass. and Dorset Is. of Vt. (Elem. geol. of E. and C. H. Hitchcock, 1860). The name *Eolian* Is. is more appropriate for this fm. than Stockbridge Is., because only a part of fm. is developed in that town, and that is in an inferior condition to this. Named for Mount Eolns (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 Is. in Maine, and in same year (Maine Bd. Agric. 7th Ann. Rept.) he called the Is. in Maine Taconic (Eolian) Is. and Stockbridge Is.

C. H. Hitchcock, 1860, also 1867. [See 1866 entry under Dorset Is.]

J. E. Wolff, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 531-538). Eolian Is. of Vt. geol. repts includes Centre Rutland Is. and West Rutland Is. (which are of "Trenton-Chazy-Calcareous" age) and Rutland Is. (which is of Lower Camb. age).


H. M. Seely, 1910 (7th Rept. Vt. State Geol., pp. 257-313). “Eolian Is.” of Hitchcock (type loc. of which was Dorset Mtn., at that time renamed Mount Bolus) includes beds of Trenton, Black River, Chazy, and Beekmantown age.

F. A. Burt, 1929 (18th Rept. Vt. State Geol., pp. 68-84). Stockbridge Is. of Bennington area, Vt., is 1,200 ft. thick, and consists of bluish crystalline lss. and dolomites; near bottom ls., schist, and gqtzite 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 Is. of southern Vt. as containing beds of Chazy, Beekmantown, Tribes Hill, Little Falls, and Upper Camb. age. Replaced by Stockbridge Is., which has many years priority and is the name now applied to this Is. 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 Is., 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.


†Eo-lignitic.


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 gqtzite (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., 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 meridion, which lies in the fm. Is basal fm. of Gannett group. Underlies Peterson ls. and overlies Stump ss. May be Jurassic.

Epicene series.

Epperson sand.
A subsurface sand in Lee fm. (of Pottsville group) of Knox Co., SE. Ky.

Epworth dolomite.
Pre-Cambrian: Arctic Canada.

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 lattes 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, Geneseo s., Tully s., and Hamilton and Marcellus shales. Is top group of New York system. Overlies Helderberg series, which includes at top Schobartling grit and overlying Helderberg [Onondaga] s. Underlies Old Red ss.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3). Erie gr.—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 s. 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 s. and Onondaga s. [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 Mln. 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 s. and above Onondaga s. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 370.)

†Erie clay.

Pleistocene: Ontario, Ohio, New York.

W. E. Logan, 1833 (Canada Geol. Surv. Repts. 1843–63, pp. 887, 886–907). 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 [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 underlaid 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 ls., few ft. to 60 ft. thick, overlying Laneville shales and underlying Chanute shales. [Some later reps 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. 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 Haye'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.

Ermont formation.
Devonian: Southwestern Montana (Argenta, Beaverhead County).
P. J. Scden, 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.

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 Iss. of Phosphoria fm., which extend E. and S. from Wind River and Owl Creek Mts 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 Mtn, Green Mtn, 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 Freezout 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). Ervive Creek Iss. is top unit in Deer Creek Iss. 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 Iss. and included them in Deer Creek Iss.
G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11), transferred Jones Point sh. and overlying Iss. to Calhoun sh., leaving his Ervine Creek Iss. the top bed of Deer Creek Iss. 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 Iss., Jones Point sh., and Sheldon Iss. on a cyclothem basis. (See 1936 entry under Sheldon Iss.)

For Condra's latest interpretation of strat. position of this Iss. see 1937 entry under Topeka Iss.

Erving hornblende schist.

Carboniferous : Western central Massachusetts.
B. K. Emerson, 1917 (U. S. G. S. Bull. 507, pp. 60, 72-74, and map). Erving hornblende schist.—A thick mass of fissile, rather fine-grained hornblende schist, which is in middle of Quabbin 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.

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 Iss. 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).
P. L. Ransome, 1904 (U. S. G. S. P. P. 21). Escabrosa Iss.—Characteristic rocks are rather thick-bedded, nearly white to dark-gray, granular Iss. 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 nonmagneslan Is. containing practically no aren. sediments and 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 Is. and is conformably overlain by Naco Is. Named for conspicuous exposures on Escabrosa Ridge, Bisbee quad.

Escamela limestone.  
Cretaceous: Mexico (Guerrero).  

Escanaba limestone.  
Middle Ordovician: Michigan (Upper Peninsula).  
A. C. Lane, 1909 (Mich. Geol. Surv. Rept. 1908, p. 47). Escanaba Is.—Local name suggested by A. W. Grabau for Trenton Is. 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 Is. of Mich. Includes equivalents of Chazy, Birdseye, Black River, and Trenton of N. Y. So Grabau would suggest a local name like Escamela. While Escamela Is. is a more euphonious term, my impression is it would be better to use Trenton for a broad sense and introduce Escamela as applicable to some accurately defined subdivision.

Escondido formation. (Of Navarro group.)  
Upper Cretaceous (Gulf series): Southern Texas.  
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 Is. 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).  
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.  
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).
82C–84C, pl. opp. p. 82C). Gray ss. and sh., carrying Upper Dev. fishes and ferns,
discon. underlying Bonaventure cgl. (Carb.) and overlying Fleurant cgl. in Es-
cumiac Bay section, Gaspe Peninsula, on N. shore of Chaleur Bay, opp. Dal-
houise, N. B. Highest Upper Dev. in section.

Eshamy granite.
Mesozoic (?): Southeastern Alaska (Prince William Sound region).
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).
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 Pilu. (? 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.
Eskota or Greer beds.—A series (65 ft. thick in Coke Co.) of soft, evenly bedded
clayey fine-grained ss., and fine sandy shales provisionally referred to Greer stage.
As a rule the ss., and shales are dark red. Locally they are leached to a
buffish or greenish shade, and occasionally 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 Is. has been seen, and that of is 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 Is. 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 gyspum.
Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central
northern Oklahoma.
suggested by C. S. Prosser, in unpublished ms., for 30± ft. of shales overlying
Neva Is. and underlying Cottonwood Is.
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Top fm. of Wabunsee group as used in Kans. for many years, but Kans. and Nebr. Surveys have recently greatly restricted Wabunsee 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, Wabunsee 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 ss.s., 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. Mother, 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 ml. S. of Kingston, Ulster Co.]

Esopus slate.

See under Esopus grit.

Esopus grit. } (In Oriskany group.)


L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 127-130). Cauda-galli grit.—Fine-grained, calc. and argill ss.s., usually drab and brownish. Underlies Schoharie grit and overlies Oriskany ss.s.

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. Fucoiden 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 ml. 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 st., from Esopus settlement, of which the portion now known as Kingston is largely on this fm.; and Esopus Creek, along which, for some ml. above Saugerties [Ulster Co.], the slates are particularly well exposed. 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 sh. 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 cauda 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).


**Espina breccia.**


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 Supal formation).

Permian: Northern Arizona (Grand Canyon).


**Esquias formation.**

Upper Cretaceous: Honduras.


**Essex limestone.**


yellowish-brown mag. is. with small nodules and masses of chert; lower 8½ ft. yellowish-brown thin-bedded mag. is.

T. E. Savage, 1913 (Ill. Geol. Surv. Bull. 23). Essex is. underlies Sexton Creek Is. 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 Is.


Named for Essex, Kankakee Co.

Estancia basalt.

Quaternary: Mexico.


Estelle quartz diorite.

Late Jurassic (?) : Southern California (Riverside County).


Estes system.

Pre-Cambrian: Western South Dakota (Black Hills).


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).


Estill clay.

Silurian (Niagaran) : East-central Kentucky.


In 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173) Foerste assigned this clay to Clinton epoch.

Etchegoin formation (narrow sense).

Pliocene: Southern California.


W. P. Woodring, 1934 (U. S. G. S. geol. map and structure v. ; 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 fm. of region, resting upon each respectively with a distinct uncon. The next older rocks are the Coalinga beds.

R. Arnold and R. Anderson, 1908 (U. S. G. S. Bull. 337, 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 NW 1/4 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.


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.


Etholen conglomerate.

Lower Cretaceous (Comanche series): Western Texas (El Paso County).


Etna sandstone.

Pennsylvanian: Central Tennessee (Grundy County).


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).


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.

†Eucheene phase.

Miocene (probably upper): Northwestern Florida.

L. C. Johnson, 1893 (St. L. vol. 21, pp. 90-91). Eucheene 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. Foorate, 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 ss.*, consisting of 19 to 20 ft. of ss. in lower part of Bedford; separated from underlying Cleveland ss. by 5 to 14 ft. of argill. bluish-gray ss. 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.]


**Eudora shale.**

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.


Foregoing definition was used by R. C. Moore, C. O. Dunbar, G. E. Condra, and others.


†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 ss. 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 (Oregon Univ. Commonwealth Rev., vol. 7, No. 4, pp. 149-156). A considerable thickness of ss. 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.


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 is. and is regarded as inaugurating the dolomite series hereina 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 ¾ mi. NW. of Lewisburg and a little nearer the quarry.


Eureka quartzite.

Ordovician (Middle) : Northern Nevada, western Utah, and Inyo County, California.


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 Shastina Mtns, Utah, but is represented in Frisco dist., SW. Utah, by Morahouse 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 ss., some is., 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 Is., the few ft. of Upper Ord. dacitic ash. 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 Is. and underlying Pogonip Is., 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 ash., calc. beds, and lss.

†Eureka shale.
Devonian (?) : Northern Arkansas.
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 l. memb. of Boone l., overlies Clifty l., 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 Is. proposed by G. I. Adams for l., 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 equlv. of Osage shales [really a higher sh., the Scranton]. Same as Burlingame Is. [older name].
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 Is.—Dolomitic, cherty, and shaly l., with several beds of clay sl. near base. Thickness 4,000 ft. Underlies Godiva Is. and overlies Robinson qtzite. [A footnote on p. 620 says that in Tintic folio the Eureka Is. 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 Is. 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 Is., Severy shales, Howard Is., Burlingame shales, and Burliugnnie Is.
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 Pecos 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.

Eureptican.
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 Is. 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 non-effervescent 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. 3, 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).


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 ss., 400 to 500 ft.; (3) Wilkeson [coal] series, 1,260 ft., including coals 11 to 20; (4) sh. and ss. 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).


Evans Landing facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 167, etc., 1881) to a lithologic development of his Garwood 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, etc.]


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.


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 Icqnium 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 ex-
posed 3/4 mi. E. of Evansville, with approx. elev. of 1,120 ft., but is better exposed as conspicuous ledges S. of there, at locality 300 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 sb.

†Everett schist.

Ordovician: Southwestern Massachusetts and northwestern Connecticut.


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 Is. probably based on the Tert. rocks, which farther N. are elevated above the sea. For it we may provisionally adopt the name Everglades Is. It is the rock forming about the margin and underlying the basin of the Everglades of Fl.; 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 Is. 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 Is.—A narrow belt of blue slaty Is. exposed from Mitchells Ford, on Rapidan River, to SW. of Rivanna River near Charlottesville. Named for small village in Orange Co., where the Is. is exposed in a small quarry N. of Mountain Run. The Is. 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 Is. of Md., which Bassler concludes is probably Chazy. Is believed to be in fault contact with Wissahickon schist.

Eversole chert.

Middle Devonian: Central Ohio.


Named for Eversole Run, Delaware Co.
Everton limestone.

Lower Ordovician: Southern Missouri and northern Arkansas.


A. H. Purdue and E. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Everton Is.* consists of 3 subdivisions: (1) Sneeds Creek Is. lentil at base; (2) Kings River ss. memb.; and (3) a fine-grained nonmag. Is. 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 Is.* consists of 2 members: (1) a basal group of dominantly sandy beds with some interbedded Iss., and (2) an upper Is. The lower memb. is 20 to 55 ft. thick; the upper memb. 0 to 55 ft. thick. Rests uncon. on Powell Is. 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 Is. (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 Is. 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 Is., the so-called St. Peter ss. (here named Newton ss. memb. of *Everton Is.*), and the so-called Everton Is. (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.


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, 1938 (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 Iss. 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 mine dist., about 6 mi. SW. of Mtns.

Exeter diorite.

Post-Carboniferous: Southeastern New Hampshire (Rockingham County).

**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 s.s.s., pink to white. Consists of (descending): (1) Massive white s.s., 35 ft.; (2) loose-textured and readily weathered s.s.; (3) massive chalky white s.s., cross bedded and cavernous weathering, 15 ft.; (4) soft shaly s.s., 2 ft.; (5) massive evenly laminated s.s., ranging from red at base to white at top, 15 ft. Thickness of f.m. 75 ft. near Exeter P. O., where it is overlain conformably by Morrison f.m. and rests uncon. on Red Beds. [The P. O. was formerly spelled *Ester*. The town is now called Johnson.]

T. W. Stanton, 1905 (Jour. Geol., vol. 13, pp. 664–665). *Exeter ss.*— Massive white or pinkish s.s. which Mr. Lee has described as Exter ss. varies greatly in thickness. Max. observed was 80 ft. Is in places separated from overlying Morrison f.m. 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. 79–83), stated that in SE. Colo. the Exeter ss. appears as a thin lentil btw. the Morrison and the Lykins f.m.

E. P. Rothrock, 1925 (Okla. Geol. Surv. Bull. 34, p. 38). *Exeter ss.* underlies Morrison f.m. 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 f.m. (consisting of s.s.s., variegated shales, l.s.) 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 s.s.s., underlies Morrison f.m. in Cimarron Co., Okla., and rests with angular uncon. on variegated shales which were mapped as Morrison f.m. in Okla. Geol. Surv. Bull. 34, but which are probably Triassic.

N. H. Darton, 1929 (U. S. G. S. Bull. 794, p. 306). One s.s. which lies considerably below middle of Morrison f.m. 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 f.m. 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 s.s. (Exeter) and the eroded surface of the “Red Beds.”

J. T. Duce, 1929 (Kans. Geol. Soc. 4th Ann. Field Conf., p. 132), and 1933 (Jour. Geol., vol. 41, No. 1, pp. 40–43), introduced Sheep Pen Canyon f.m. for 0–68 ft. of s.s. of Triassic (?) age, in Union Co., N. Mex., which he stated overlies Sloan Canyon f.m. 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 s.s. lentil in lower part of Morrison f.m.

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 f.m.* for 0–68 ft. of s.s. of Triassic (?) age, in Union Co., N. Mex., which he stated overlies Sloan Canyon f.m. 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 s.s. lentil in lower part of Morrison f.m.

B. H. Parker, 1934 (A. A. P. G. Bull., vol. 18, No. 11, pp. 1544–1546). In Cimarron Valley, N. Mex., Morrison f.m. rests on Todito (?) f.m. (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 f.m., and in places on the still older Dockum group. The Sloan Canyon has been mistaken, by some geologists, for Morrison f.m., which has resulted in inclusion of Exeter ss. in the Morrison.

The U. S. Geol. Survey still treats *Exeter ss.* as a distinct f.m., 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.

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 Johnson.

Fabre series.
Pre-Cambrian: Quebec.
R. Harvie, Jr., 1911 (Quebec Dept. Colonization, Mines, and Fisheries, Mines Branch, pp. 9, 15).

Factoryville moraine.

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, 1898 (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 Elkarden coal or 14-foot bed. Thickness about 300 ft. Underlies Elkarden fm. and overlies Bayard fm. Exposed around Fairfax, Grant Co., W. Va.
Fairfax limestone.
Pennsylvanian: Northern West Virginia.

Fairfax.
Eocene: Western Washington (Puget Sound region).
See under Melmont.

Fairfield slate.
L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 56-60), stated that Utica Is. 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. 387, 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 Lithopolls 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.)

Fairhaven diatomaceous earth member (of Calvert formation).
Miocene: Eastern Maryland.
G. B. Shattuck, 1904 (Md. Geol. Surv. Miocene vol., p. lxxii). Fairhaven diatoma-ceous 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 s.; and 2 to 6 ft. of brownish sand. Named for Fairhaven, Anne Arundel Co.

Fairlee granite gneiss.
Cambrian: Northeastern Vermont (Orange County).
E. J. Foyle 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, McCabe 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 Foyle 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.
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, non-laminated, sandy, and contains dolomitic concretions; sun cracks locally. Lenses of ss. like underlying Garber ss. occur in basal 50 ft. of the Fairmont. The ss. above basal 50 ft. are finer grained than any ss. in Stillwater. Wellington, and Garber fm. are reddish brown to gray, thin, cross-bedded, lenticular, and rarely more than 5 ft. thick. Thin dolomitic cbs. are generally found at bases of the ss.


Fairmount 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.


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 Monticulpora molesta beds and underlain by Mount Hope or Amplexopora septa 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.]


†Fairmount slate.

Upper Cambrian: Northwestern Georgia (Gordon County).

H. K. Shearer, 1918 (Ga. Geol. Surv. Bull. 34, map opp. p. 43). [Conasauga (Fairmount) sh. 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.


Fairview diorite.

Tertiary: Central southern Colorado (Silver Cliff-Rosita Hills region).


Fairview formation. (In Maysville group.)

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


Lower fm. of Maysville group.

Named for Fairview Heights, Cincinnati, Ohio.

†Fairview formation.

Lower Cambrian: Alberta and British Columbia.


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 Is." 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 Is. locally called “Buckskin Is.” in Gold Brick dist. are underlain by 10 to 15 ft. of brownish-gray aren. shales and shaly Is., 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.


Recent (1931 and 1933) repts by H. A. Meyerhoff assign this fm. to Cret.
Falkirk dolomite.

Silurian (Cayugan): Western New York.


**Fall Creek conglomerate lentil** (of Chemung formation).


I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G, 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 coal 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 Tloga 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.**


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 Tloga 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.

**Fallia 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+). **Fallia 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 dolomite cgl. 2± ft. thick, which forms ledges in T. 15 N., R. 2 E. Tops of the shales are generally marked by dolomite cgl. The sh. increases to N. and W. of Stillwater probably 50 per cent of it is sh. Overlies Stillwater fm. Named for town of Fallia, sec. 29, T. 15 N., R. 2 E., Lincoln Co. The P. O. of Fallia is about 40 ft. above base of the ss. Contact with underlying Iconlum memb. of Wellington is shown 1½ mi. E. of Iconlum, 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.

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 is. 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 Neb. It consists of 75 ft. of ss. 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 Johns Ranch. In Feb. 1930 (U. S. Nat. Mus. Proc., vol. 78, art. 21, p. 73) Ulrich published the following as his subdivisions of Simpson fm. (descending) Bromide, Criner, Tulip Creek, Falls, McLish, Oil Creek, and Johns. 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); Johns (of Chazy age); and basal cgl. (of Beeennantown? 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.]


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 is.—Usually one massive bed, brownish mottled, soft, resinous; hardens on exposure. Thickness 3 ft. to 6 ft. 4 in. Lies 15 to 37 ft. above Aspinwall Is.
G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser.), named the beds overlying Falls City Is. and underlying Americus Is. the West Branch sh., and the beds underlying Falls City Is. the Aspinwall sh.; but in 1932 he discarded Aspinwall sh. and named the beds immediately below Falls City Is. the Hawxby sh. On p. 82 of 1927 rept. cited Condra stated type loc. of Falls City Is. to be in Lehmer quarry, sec. 32, 2 3/4 mi. S. and 1 1/4 mi. W. of Falls City, Richardson Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville Is. 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 bentonic 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).


Falls Mills sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).


Falls Mills shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).


Falmouth formation.

Pleistocene: Jamaica.

Falmouth moraine.
Pleistocene: Southeastern Massachusetts (Barnstable County).
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 Is.

Famine series.
Devonian: Quebec.

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 Is.
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.

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.

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 Is.—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 Is., 1½ to 2 ft. thick, which makes a natural riprap along river bank; (2) dark-blue, carbonaceous, clayey to sandy sh., 5 ft.; (3) Is., 4 ft., in 3 beds. Separated from overlying Preston [Emporia] Is. by 14 to 34 ft. of sh. and from underlying Buttingame Is. by 11 to 29 ft. of sh.

Fargo moraine.

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 s.s.; middle 400 ft. very lignitic, but containing marine fauna; basal 325 ft. very micaceous calc. sandy shales with a prolific ralrrofauna 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 Is. 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. 25, 155). Farley Is. bed.—Ranges from a thin layer of calc. sh. to a bed of Is. 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 (Kansa. Geol. Soc. 5th Ann. Field Conf. correlation chart), named the sh. overlying Farley Is. 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 (Kansa. Geol. Surv. Bull. 21), the Lane sh. of Hinds and Greene is younger than true Lane sh. and corresponds to upper part of Wyandotte Is. and overlying Bonner Springs sh. of Moore and Newell; and Farley Is. is upper memb. of their Wyandotte Is. This classification is followed by R. C. Moore, 1936 (Kansa. 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. 08K). *Farmington s.s. 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).*


**Farm Ridge moraine.**


**Farnham limestone.**

*Ordovician: Quebec.*


**Farrer non-coal-bearing member** (of Price River formation).

*Upper Cretaceous: Central eastern Utah (Book Cliffs).*


**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 Is.] is even more richly supplied with silicified fossils, and the rock is whiter and less distinguishable from the so-called dove-colored ss. at the top [of the Perryville]. Should any separate designation for the lower layers with the silicified fossils be desirable, the term Faulconer Is. will serve.
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**Fauconer memb.** of Perryville is a gastropod horizon, 5 to 8 ft. thick, underlying Salvina memb. of Perryville and overlying Flanagan.

**Fauconer 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 Salvina memb. and underlain by Woodburn bed, the top memb. of the Flanagan.

Named for Fauconer, Boyle Co.

**Faxon limestone.**

Pre-Cambrian: Northern New York (Adirondacks).


H. L. Algling, 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 paramphibollte 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. 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 semicrystalllne 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 ls. 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. xxxii, 17, 47, 57, 58, 63). **Fayette beds.**—Sands, ss., 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 ss. 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 ss. with some clays, which contain large amount of opaline and chaledonic materials, overlying Yegua clays and underlying Frio clays.

A. Deussen, 1324 (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, 1926 (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.


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 Eocene 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. 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] Is.; 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 misconceptions made in above rept., and described the following as correct strat. succession (downward): Pitkin ("Archimedes") Is.; 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.

Federal Hill beds. (In Patapsco formation.)
Lower Cretaceous: Northeastern Maryland.

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 Michiganme 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.
†Pelch 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 Pelch 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 Pelch Mountain” was said to correspond to lower Huronian and the “Upper Pelch Mountain” to upper Huronian.

Felix siltstone.
Miocene (middle) : Southern California (Kettleman Hills).

†fence-post limestone.
Upper Cretaceous: North central Kansas.
See under †Downs bs.

Fennell formation.

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.
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. 1-2, 297-278). 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 Chick 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. 300). **Fernando fm.**—
A variable series of cgs., 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 Pico., 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 5 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.


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.


The present generally accepted classification of Fern Glen assigns it to Osage group, but not to Burlington ls.
Fernian series.

Fernie formation.

Fernow rhyolite.
Tertiary (post-Eocene?): Central northern Utah (Tintic district).

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. (In Richmond group.)
Fernvale formation.
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 lenses, 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 vermillion-red lens. Thickness 0 to 40 ft. Uncon. overlies Leipers fm. and uncon. underlies Clifton ls. (Sulf.) Top fm. of Richmond group.

To W., in Tenn., the Arnheim (†Warren) ls. intervenes btw. Fernvale fm. and Leipers fm., and Brashfield 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 verte-
brates (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 1 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. ss., all carrying abundant fossils. Thickness 35± ft. Is basal fm. of Long Lake stage. Underlies calc. sh. of Genshaw fm. and overlies Rockport 1a., 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).


†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 Is., slates, ss., gis. and grit to hard cgl. on N. To S. rests uncon. on Skagit 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 Sill. (?) 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 Is.**—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 Klin 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 Is.**—Thin-bedded dolomitic Is., 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.

Fieldian series.
Cambrian and Ordovician (?): Canada.

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 1,800 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 Is.**—Gray to blue fossiliferous Is. 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 Is. 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 Is. (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.

Fincher sand.
A subsurface sand, lying 96 ft. below top of Marble Falls ls. in central northern Tex.

Finis shale member (of Graham formation).
Pennsylvaniaian: Central northern Texas (Brazos River region).


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.

Finlay 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.


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 ls. 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, 155, 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, NW\(\frac{1}{4}\) 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 Is. 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.


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, 1878 (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 30 to 40 ft. below Nineveh coal. Included in Greene County group [Greene tm.].

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. PhlL 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 ss. (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. Beger, 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 sh. 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 quartz; 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 Is. 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).


Fisherville coral reef. (In Waynesville limestone.)

Upper Ordovician: North-central Kentucky.


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.


Named for exposures on Fish Haven Creek, Bear Lake Co., Idaho.
Fish House clay.

**Pliocene**: Southern New Jersey.

R. D. Salisbury, 1895 (N. J. Geol. Surv. Ann. Rept. State Geol. 1894). *Age of Fish House clay* 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 3½ 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.


†Fish House beds.

**Pleistocene**: Southern New Jersey.

L. Woolman, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, pp. 201+). *Fish House beda.*—Under this name we would include (descending): (1) Orange yellow clay bed, thin; (2) *Fish House clay*, blue or black clay 3½ 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).


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, Beckmantown, and Lower Camb. fossils. See also under *Barnegat ls.*

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 30). Another extensive area of Barnegat ls. (=Wappinger ls.), of Cambrian and Ordovician 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.


Fishpot sandstone. (In Monongahela formation.)

**Pennsylvanian**: Eastern Ohio.

R. E. Lamborn, 1930 (Ohio Geol. Surv., 4th ser., Bull. 35, pp. 20, 21, 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.).

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.
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 unconf. 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 Is. Blotches of crystalline calcite are almost invariably present in the sub lithographic matrix, and often near middle there is a lens of brownish fine-grained dolomitic Is. 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 Is., 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 Is. (Upper Ord.) or by Chattanoogna sh. The Fernvale was also included in Tyner fm. by Taff. Underground in Okla. an occasional bed of ss. occurs btw. Fite and Fernvale Is. Fossils are now identifled 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.

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.
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.

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, 339-340). 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 Follas Mills Is. 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 Tallysh 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.)
Pennsylvania: Kansas and Nebraska.
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 Is. and Estill clay [members of Alger fm.] where Waco Is. cannot be distinguished from overlying Estill clay but where thick basal layer of Waco Is. can be recognized.

Named for Flades Creek, E. of Crab Orchard, Lincoln Co.

Flag Spring limestone. (In Conemaugh formation.)

Pennsylvanian: Gallia County, Ohio.


Occurs at exact horizon of Bands 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).

B. M. Spieker and J. B. Reeside, Jr., 1925 (GeoL Soc. Am. Bull., vol. 38, pp. 150-151, 448). **Flagstaff Is. memb. of Wasatch fm.**—A remarkable memb. of fresh-water Is. 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 Is., 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. Chiey 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 clgl., 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, 148, 151). **Flaming Gorge group.**—In descending order: (1) Bad-land sss. of lacustrine origin; (2) mid-group Is., marine, more or less aren.; (3) massive s., 400 to 600 ft., which to S. is represented by bad-land ss. with clay and gyp.; (4) **White Cliff Is.** marine Is. 10 to 200 ft. thick. Named for Flaming Gorge, on S. side of Green River [at mouth of Henrys Fork], Utah [in Uinta Co.].


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. ab. containing bands of chert; thickness 0 to 40 ft. Overlain by Winchester Is. and underlain by Lexington Is. 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.


W. C. Phalen, 1917 (Ky. Geol. Surv. rept. on phosphate rocks of central Ky.). Flat Gap memb. 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).


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 coarse 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 ss., 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 basalt 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).

Flat Lick sandstone. (In Pottsville group.)
Pennsylvania: 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.
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.

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. Commonly marked by light-gray bands more feldspathic than rest of rock, being made up of quartz and feldspar grains of varying size 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.
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 Devon. 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) Flattop Mt. sandstone; (2) Pocahontas coals Nos. 6, 5, 4, 3, 2, and 1, with intervening s.s.s. and shales; and (3) Pocahontas shales.


**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 sandstone — 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. Hllgard, 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 sh.

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, 1880 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 148, map, and structure section opp. p. 162). [See under tCoosa 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. Gilley 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. 179-194). 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 2,800± 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 quartzite and argillite derived from Rocky Mtns. Pebbles of Is. from same source may have been dissolved and the lime redepósited 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.


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.


G. C. Matson, 1916 (U. S. G. S. P. P. 98), divided Fleming clay of eastern Tex. into Pascagoula clay (above) and Hattlesburg clay (below).


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.

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.


Named for Fleming, Tyler Co.

Fleurant conglomerate.

Upper Devonian: Quebec (Gaspe Peninsula).


Flint moraine.


†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. 250-256) Douglass assigned these beds to upper 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.


Not used in later classifications of Kans. Geol. Survey.

Named for Flint Hills, Cowley and Butler Counties.

Flint Ridge limestone. (In Allegheny? formation.)

Pennsylvania: Central Ohio.


Named for Flint Ridge, Licking Co.

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 170), stated that Flint Ridge Is. is in upper part of Pottsville fm.

Flint Ridge flint. (In Allegheny formation.)

Pennsylvania: 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 Is.). According to E. Orton, 1878
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(Ohio Geol. Surv., vol. 3, p. 894), the Putnam Hill Is. 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, underlyng 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. 38, 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 Is. Loose dolomitic or leached Is. 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 J. 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 Is. 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 Is. 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 Johnson's 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.


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 Is. with prominent layers of flint, separated by 2 ft. of white cellular Is. Included in middle of Chase fm. Underlain by 31 ft. of yellowish, chocolate, and greenish shales and overlain by buff shaly Is.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 714). Florence flint is overlain by Fort Riley Is. 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 Is.—Massive buff Is., 5 or more ft. thick. Separated from overlying Marion flint by 22 ft. of buff shaly Is. overlain by 62 ft. of varicolored sh. with thin Is. layers, and separated from underlying Florence flint by 15 ft. of buff shaly Is.

In 1902 (Jour. Geol. vol. 10) Prosser redefined Fort Riley Is., to include at base the 15 ft. of shaly Is. and at top the 22 ft. of buff shaly Is., both of which he had excluded in his original definition. He also stated that Fort Riley Is. (40 ft. thick) rested on Florence flint and was separated from overlying Marion flint by Doyle sh.; that Florence Is. is Fort Riley main ledge; and that Florence Is. is abandoned.

In succeeding years Prosser's 1902 definition of Fort Riley Is. was adopted generally, Florence Is. fell into disuse, and Florence flint was name applied to the fm. underlying Fort Riley Is. 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 Is. to the original 5-foot massive ledge; (2) introducing Oketo sh. for underlying 5 ft. of shaly Is.; (3) applying Florence Is. to underlying 30 ft. of beds bearing the symbol of flinty Is. and apparently corresponding to Florence flint of previous repts. He called the beds immediately overlying his Fort Riley Is. the Holmesville sh., and the beds immediately underlying his Florence Is. 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 Florence 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."

Florencea 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 carbonatey 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 age. Thickness 10 to 50 feet. Materials range from coarse sand and grit to large cobbles and boulders. 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 Caloosahatchee as the "Floridian," by this name indicating the region where the fauna has its furthest, and, as far as we know, only development. What its precise equiv. among the trans-Atlantic Terms, 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 interruption to Fort Thompson, a distance along the river of 10 to 12 mi. Appears in most places as a partially indurated marl or earthy Is. 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-plioc. Venus cancella bed. Referred to basal Plioc.

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 [Plioc.] 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 (Caloosahatchee 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.


Named for Flower-pot Mound, Barber Co., Kans.

Floyd shale.

Mississippian: Northwestern Georgia, northeastern and northern central Alabama, and southern Tennessee.


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 Is. 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 ss. restricted, and as a memb. of Floyd sh. in other areas. (See C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1928.)

Named for development in Floyd Co., Ga.

Floyd limestone.

Upper Devonian: Central northern Iowa.

A. O. Thomas, 1912 (Sci., n. s., vol. 38, pp. 589-570). A new substage, tentatively called Floyd Is., is added at base of Lime Creek stage. Uncon. overlies Cedar Valley stage in Floyd Co. [The Nora Is. of Thomas, to which this Is. may correspond, has been referred by C. L. and M. A. Feenton to Cedar Valley Is.]

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 Isms. The name Floyd Knob fm. is being suggested for this fm. It exhibits several lithologic facies, the most common being Is. that is itself of differing traits from place to place. For this Is. facies the name Goes Mill Is. 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 Is. facies of Floyds Knob fm. as "Stevens Creek Is.," 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 Is., 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 Is. 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 Is. 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 Is., 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 Is., which is an excellent key fm., has often been spoken of as the "Stevens Creek Is." by Ind. workers, although the name has never been definitely proposed. For Jefferson Co., Ky., Butts erroneously referred to it as the "oolitic Is." 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 Is. and Stobo Is., by both of which names the Is. has been known.] Named for Floyds Knob, ½ 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).

F. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 295, 300). Flume dol., 400 to 1,600 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 Is. in cliffs on Roche Miette.]

**Fly Creek limestone.**
Upper Cretaceous: Central southern Montana.

J. F. Kemp and F. Billingsly, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 474, in chart). [No description or definition, but shown as=Greenhorn Is. 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.


Same as Joachim Is., older name.

Named for Foley, Lincoln Co.

**Fond du Lac sandstone.**
Pre-Cambrian (Keweenawan?): Northeastern Minnesota (St. Louis County).

N. H. Winchell, 1809 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 587). 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 cgl., red shales, and ss. W. Upham, 1861 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 6, Atlas, pl. 37, map. and text describing pl. 58), placed Fond du Lac ss., 157 ft. thick, below Hinckley ss. (381 ft. thick) and above Potsdam red qtzite. "To these ss., 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.

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

Foothills series.

Tertiary (?): Alberta.

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, 1918 (U. S. G. S. Bull. 641, pp. 21, 25). Foraker Is.—Chieffy Is., but much of rock is so soft and thin-bedded as to give no outcrop. Some soft sh. is present. The heavy Is. 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 Is. forms the rim of Elk River Canyon, and is prominent along line of bluffs in E. part of Foraker quad. It lies 18 ft. below Red Eagle Is. and is underlain by sh. A ss. which occurs 28 ± ft. below the Foraker is a good horizon marker.

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, 1925 (Nebr. Geol. Surv. Paper No. 8, p. 8), carried this name into NW. Mo. and SE. Nebr.; called it Foraker Is. fm. (45 to 50 ft. thick); defined it as underlying his Johnson sh. fm. and overlying his Hamilton sh. fm.; and divided it into (descending) : Long Creek Is., Hughes Creek sh., and Americanus Is. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)
R. C. Moore, 1930 (Kans. Geol. Surv. Bull. 22), transferred this Is. 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. Keys, 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 Blen. 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 (Neb. 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.*

Ford sandstone.
Pennsylvanian: Central southern Iowa.

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 augitlc 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 unde., 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 bedding of the gneiss. The rock is thoroughly gneissoid. It 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. 351-378). *Fordham gneiss* of Harlem quadr. (folio 83) is not different in position or significance or general character from same gneiss series of Tarrytown quadr., with which it is continuous; and writer sees no essential point of difference bt. these and the basal gneisses of West Point quadr., from which they are separated by only a belt of later ls. and schists occupying the synclinal fold of lower Croton valley. In northern Highlands interbedded ss. and qtzites and schistose graphitic beds are common, whereas in southern
localities the Iss. 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 Iss." as "associated with Fordham gneisses;" and included Fordham gneiss, the interbedded is., 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 is., qtzite schist, quartzose gneisses, and graphic 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. 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):

<table>
<thead>
<tr>
<th>Post-Grenville (very old pre-Cambrian)</th>
<th>Later igneous</th>
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<tbody>
<tr>
<td>Basic dikes</td>
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<tr>
<td>Pegmatites</td>
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<tr>
<td>Yonkers gneissoid granite</td>
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<tr>
<td>Pegmatites</td>
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<td>Ravenswood granodiorite</td>
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<tr>
<td>Injection granites and pegmatites</td>
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<tr>
<td>Fordham gneiss, in part (igneous gneiss)</td>
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<tr>
<td>Occasional basic injections</td>
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<tr>
<td>Staten Island serpentine</td>
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<tr>
<td>Stevens Point serpentine</td>
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<tr>
<td>The Hornblende schists</td>
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<tr>
<th>Later Grenville (sedimentary)</th>
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<tbody>
<tr>
<td>Manhattan schist</td>
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<tr>
<td>Inwood is.</td>
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<tr>
<td>Lowerre qtzite</td>
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<tr>
<th>Older Grenville (sedimentary)</th>
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</thead>
<tbody>
<tr>
<td>Interbedded Is. and schists</td>
<td></td>
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<tr>
<td>Fordham gneiss, in part (paragneisses)</td>
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</tbody>
</table>

Keewatln apparently not represented.

H. L. Alling, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 27-49). Fordham gneiss is a syntetic—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-Laurentian, and Fordham-Algoman.

E. B. Knopf and A. I. Jonas, 1929 (U. S. Geol. Bull. 799). Manhattan schist correlates with Wissahickon fm.; Inwood is. 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 Algoman and Baltimore gneiss as Archean.

The terms "Algoman 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, 187, etc., 1831) to a lithologic development of his Floyds Knob fm. in a part of southern Ind.

Forelle limestone.

Permian: Southeastern Wyoming and northeastern Colorado.


H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, p. 1868). Forelle Is. seems to be an extended tongue of Phosphoria fm., and consequently may be considered as Forelle Is. 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 ss.s, with several beds of cgl. Plants identified by Prof. Fontaine as "clearly Mesozoic and most probably Rhaetic." Regarded as older than Hardgrave ss.s and younger than Trail beds. [Later proved to be much younger than Hardgrave ss.s.]

J. S. Diller, 1908 (U. S. G. S. Bull. 353). Foreman fm.—A succession of sh., ss.s, 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 ss. 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.s, and in places uncon. overlies Mormon ss.s 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).


Foremost formation.

Upper Cretaceous: Southern Alberta, Canada.

D. B. Dowling, 1917 (Canada Geol. Surv. Mem. 93, p. 37). Shales and shaly silt.s, with many coa1 or carbonateous 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 coa1; basal memb. is Verdigris ss.s. 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. 4 of 24 pp. and map, Phila., 1863, map and p. 19). A belt of cgl., 88 ft. wide, exposed 500 ft. N. of old Forest mine is termed Forest cgl. Distin­guished by varied character of enclosed pebbles, among which occur Is. and ss.s; a
coarse gravelly appearance; and a tendency to disintegrate on exposure. Older than Minnesota 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.


**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.


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. 382, 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 greywacke 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).

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 ss. 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.


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).


Forked Deer limestone.

Ordovician (Lower) : Northeastern Tennessee (Morristown quadrangle).

G. M. Hall and H. C. Amlck, 1934 (Tenn. Acad. Sci. Jour., vol. 9, No. 2, pp. 158–161). Forked Deer Is.—Approx. 185’10“ of Is. and dol., including a few thin beds of sh. The Is. and dol. occur in about equal proportions and are interbedded. The sh. is mostly in thin partings. The Is. is predominantly “dovelite” 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 (States 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 quartzite 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 uncm. 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.
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.
The reddish shales forming lower half of Cinturan series (Cintura fm. of Ramsey) in SE. Ariz. Thickness 800-1 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.
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. 535-536). In his work on geol. of Ariz. Darton mentions "a thick memb. of Is. about 100 ft. below top of Supai fm." in Fort Apache Ind. Res. area, and stated that it carries Manzano fossils. This Is. is herein described as Fort Apache ls. It lies considerably above the Perm. plant-bearing beds (pink as. 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 Is., 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 occurrence 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 Is., 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 reports on Rocky Mtn region to Upper Cret. deposits now generally called *Benton sh.*

Fort Bridger series.

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.

Fort Dodge gypsum.
Permian(?): Central northern Iowa.
W J McGee, 1884 (Rept. 10th Census, vol. 10, Rept. on building stones, pp. 287, 288). *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.

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 cglss. 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.

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.
Fort Hall fm.—In descending order: (1) Yellow to grayish cherty and sandy lls. in thin beds, 600± ft.; (2) at two localities only a set of sandy and shaly gray lls. 50± ft. thick including an oolitic bed 6 to 10 ft. thick; (3) gray or yellowish siliceous dense lls. containing large pelecypods 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. s.s., 60+ ft. [Fossils listed.] Middle fm. of Thaynes group in Fort Hall Ind. Res. Underlies Fortenpet Is. conformably and overlies Ross [Ross Fork] Is. 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 lls. or yellow chalk 60 ft. thick; lower part varicolored shales and thin lls. 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 Is. 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 betw. 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 Is. 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 Is. 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 Is., "the name of the town having been changed from Fort Hays to Hays, and geologists working in Kans. having become accustomed to calling the Is. Hays Is." (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 Is. 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.
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.. Brevier 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 Little-
ton, a village in NE. part of Fulton Co. There is a sharp lithologic change (prac­
tically 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).

Herefore 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.
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.

Fort Min fm.—Consists of (descending): (1) Qtzitic ss. (called "Fairview fm.")
by author in 1908, but Fairview is prooccupied, 350 ft.; (2) coarse ss., 570 ft.;
(3) silaceous sh., 44 ft.; (4) aren. qtzitic cgl., 300 ft. Since 1908, when upper
part of this fm. was named "Fairview," the basal part of fm. has been found ex­
posed 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, Ten­
nessee, and northeastern Mississipi.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, pp. 155–156, section
opp. p. 102, and map). Fort Payne chert.—The siliceous memb. of the Sub-Carb.,
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 Is. 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 Is.
(=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 under­
lain by Chattanooga sh. In western Tenn. the Fort Payne is uncon.
underlain by New Providence fm. or Ridgetop sh., both of post-Chatta­
nooga age. According to E. O. Ulrich and C. Butts the Fort Payne con­
tains fossils of Keokuk, lower Burlington, and Fern Glen age (com­
prising Osage group), and of late Kinderhook age. (See also C. Butts,

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 Is. and bedded chert. The Is. 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, Is., and ss., from 1/4 inch to 6 in. diam. Thickness 125 to 200 ft. Overlies Alsat 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 Tetrarugoplist suggests that fm. is possibly Chazyan (Lower Ord.). Type loc. is 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).


Fort Riley limestone. (In Chase group.)

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


C. S. Prosser (1902) redefined Fort Riley Is. as explained in 1902 entry under †Florence Is. R. C. Moore (1936) restricted Fort Riley Is. as explained in 1936 entry under †Florence Is. 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.


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, 1886 (Kans. Geol. Surv. Prel. Rept., p. 25). Fort Scott Is.—Bluish-drab and brown, irregularly bedded fossiliferous Is., 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 Is., but should not include the upper heavy Is. which caps the hills on all sides of Fort Scott. Oswego Is. consists of (descending): (1) Is., 5 to 15 ft.; (2) black sh., 4 to 7 ft.; (3) Is., the “cement rock,” 5 to 15 ft. J. Bennett, 1896 (pp. 86 to 98, pl. 4 of book last cited). Oswego or Fort Scott Is. consists of (descending): (1) Is., 10 to 14 ft.; (2) clay and bituminous sh.; (3) Is. (“cement rock”), 4½ ft. [This definition of Fort Scott Is. 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.


Includes lower part of Henrietta group and upper part of Cherokee sh.

Fort Scott marble. (In Cherokee shale.)

Pennsylvanian: Eastern Kansas.


Fort Scott marble series. (In Cherokee shale.)

Pennsylvanian: Eastern Kansas.


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 Fort Scott gravel.

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 Pleistocene 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.


†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 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 bw. 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 (SE² 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 Is.; 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 Is. in beds 2 to 6 inches thick, separated by thin sh. partings, with trilobite fragments throughout entire thickness; (3) 6 ft. of Is. similar to No. 12, with large trilobite fragments at base; (4) 40 ft. of Is. 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 ss. with interbedded shales; ss. 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 ss. and shaly ss., 100 to 200 ft.; sh. 40 to 260 ft.; and at base, 20 to 50 ft. of hard, daggy, 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).


Fort Thompson formation.

Pleistocene: Southern Florida (Palm Beach and neighboring counties).


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 Oithona 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.


F. V. Hayden, 1889 (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 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. 1x). 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.

(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, 1/2.
(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, 1/2 ft.
(8) Yellowish-gray indurated clay, 2.

F. V. Hayden, 1878 (U. S. Geol. Surv. Terr. Mon. 7, pt. 2, p. lv), 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. 351-364), stated that he had never visited Fort Union locality, but that "the correlation of the upper plant beds of Fort Union with the Wasatch (my Vermillion Creek) seems the most prodigious strain."

In 1893 (U. S. G. S. Bull. 106) 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 is., "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. Culver Showed that, in that region (Econ. Geol., vol. 5, pp. 551-577, 652-660, 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 sss. and variegated sh.; (3) Lenne sss., 250 to 400 ft. of sss. with intercalated shales, which may correspond to Fox Hills sss.; (4) Bearpaw sh.; (5) Judith River fm.; (6) Claggett fm.; (7) Eagle sss.; (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 sss., 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 sss., 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.


Fort Washington.

Eocene: Southern Maryland (Prince Georges County).


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. 63, 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, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 503-528). Fort Worth ls. of Tex.-Ark. region is overlain by Denison ls. 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
Oreek 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 Is. (below). "The Duck Creek marl and limy marl are distinct from the overlying Fort Worth Is. and the underlying Duck Creek Is., 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 Is., since the faunal changes are very abrupt at end of Duck Creek Is."

Named for exposures at Fort Worth, Tarrant Co.

Fortymile series.

Fortymile group.

Paleozoic and pre-Cambrian: Central eastern Alaska (Fortymile Creek).


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, 1886) 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. Mertel, Jr., 1938 (U. S. G. S. Bull. 872). Fossil Creek volcanics.—Basic lavas, tuffs, breccias, and aggl. 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 Is. (SIL), without observed structural uncon., but in reality there is a great discon. btw. them. Middle Ord. fossils. Included in Tentativa group of Prindle.

Fossil Lake formation.

Pleistocene: Central southern Oregon.


Fountain formation.

Pennsylvanian: Eastern Colorado.

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). Fountain fm.—Series of red ss., grits, and clgs., 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 ss., 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 pupplish 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 ss. 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 cpl. layers contain many...
pebbles of hard Algonkian quartzites, while a few l.s. 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 standing 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 consid­
erably 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 l.s. 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 Is. Named for exposures on the point S. of Fourmile Creek in SW^4 sec.
30, T. 24 N., R. 10 E.

Fourmile limestone. (In Wreford limestone.)
Permiian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.
mile 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 10 1/2 mi. S. and 1/2 ml. E. of Humboldt, Nebr. Thickness
in Nebr. about 7% 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. ls 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.
replaced Fourmile ls. of Condra and Upp with new name Threemile Is., probably
because of prior use of Fourmile for a ss. in Okla.
Surv. continues to use Fourmile for the ls. for which Kans. Surv. has substituted
Three mile.

Fourmile group.
Ordovician to Devonian: New Brunswick.

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 ml. 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 Is.*—Dense Is., 1 to 1½ ft. thick, at top; in middle shaly bluish Is., 1 to 2 ft. thick, carrying Richmond fossils; at bottom Is. layer with branching bryozoans. Included in Richmond group. Overlain by Rennix Is. and underlain by 15 ft. of thin-bedded Is. and other unnamed strata of Richmond group.

Named for Fowkes ranch, about 9 ml. from Evanston, around which the fm. is well exposed.

**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.**


†**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 Batellesville or Burbank sand.

**Foxen formation.**

**Pliocene (middle):** Southern California (Santa Maria district).

W. W. Porter, II, 1933 (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 ss., generally known as “Fernando.” The Foxen is a clay sh. varying locally to diatomite. Charaterized 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 ml. 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. 158). 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), 1,500 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.—Sh., 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.)


P. B. Meek and F. V. Hayden, 1862 (Phil. 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 "Lignite 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, to 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 formalional 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 Mt Assoc. Pet. Geol., by its committee, composed of T. S. Lovering, H. A. Aurand, C. S. Livingston, 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. Beezle, Jr., of U. S. G. S., the Rocky Mt 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 ss. 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.)
  Pennsylvania: Western Pennsylvania (Lawrence County).
  J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q., pp. xxii, 320). Foy's Is., 2 ft., Foy's Knob, Wayne Twp, Lawrence Co. May be Freeport Upper Is. “The name Foy's Is., 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. Nolin, 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).

Francis formation.
  Pennsylvania: Central southern and central Oklahoma (Pontotoc, Seminole, and Okfuskee Counties).
  G. D. Morgan, 1924 (Bur. Geol. [Okl.] 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,
Franciscan fm.—Consists of (ascending) : (1) DeNay ls. memb.; (2) dark-blue and black shales 30± ft.; (3) nearly 20 ft. of ss.; (4) 250± ft. of dark and sometimes calc. shales; (5) 100± ft. of coarse brown ss. and chert cgls.; and (6) 100± ft. of sh. with few thin ss. 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 ls., 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, ss., shaly ss., shales, and argill. ls. 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 Cuhl 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).


H. R. Wanless, 1929 (Ill. Geol. Surv. Bull. 57, pp. 49, 80). 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. biw. the coal and the black laminated concretionary sh. (1 ft. thick) in lower part of Carbondale fm.

Franconian series.


Franconia breccia.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region).


LEXICON OF GEOLOGIC NAMES OF UNITED STATES


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, 8 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. W. Hall, 1901 (Int. Min. Cong., 4th sess., pp. 165-171). **Franconia (ss. and shales)** underlies St. Lawrence and overlies Dresbach ss. in SE. Minn.


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. E. 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, ss., shales and lss., many of which are glauconitic, that lie btw. the nonglauconitic Dresbach ss. 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.


W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1987-1744). Franconia fm. divided into (descending) : Bad Axe memb. (Dikelcephalus postrectus zone); Hudson memb. (Psychaspis-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 Basel greensand and cgl. memb. of Trempealeau fm.

Franconia moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.


Franey granite.

Age (?): Cape Breton Island.


Frankenfield.

Cretaceous: Jamaica.


Frankford gneiss.

Pre-Cambrian; Southeastern Pennsylvania (Philadelphia County).


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 sh.—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 alternate 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.


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.


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 gneiss, 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 Twp. 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).

Franklin group.
Carboniferous: British Columbia.

Franklin granodiorite.
Jurassic: British Columbia.

Franklin monzonite.
Oligocene: British Columbia.

Franklindale limestone lentil (of Chemung formation).
Upper Devonian: Central northern Pennsylvanian (Bradford County).

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.
†Franks conglomerate.
Pennsylvanian: Central southern Oklahoma.
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 Caneys sh. and rests on early Paleozoic strata to SW.


G. D. Morgan, 1923 (Okl. 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 Iss. cgl. 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 is.

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 Iss., 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 (Okl. 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 Is. was found to emerge from beneath the cgl.s. at a point 2± ml. 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. Is. cgl. of Arbuckle region that are (a) fossiliferous, (b) highly folded or faulted, and (c) nonarkosic. The cgl.s. near Sulphur, which have in some previous reps 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 cgl.s. of Arbuckle Mtn region.

Named for exposures in vicinity of Franks, Pontotoc Co.

Fraser River formation.

Cretaceous: British Columbia.


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.
Lane expressed opinion that Freda and Jacobsville ss. are same fm.

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. 94, vol. 10, p. 32). Frederick ls.—Has geographic extent of nearly 100 sq. mi. Greatest length perhaps 30 mi.; max. breadth, near Frederick City, 8 mi. Along W. border Frederick Valley iss. are covered by Messozoic red ss. ("Newark fm." of Russell). To E. the iss. pass gradually into shales and slates, the whole forming apparently a conformable series. The iss. 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 iss. pass into a more earthy facies and grades into dark-colored calc. shales and these into slates or sandy shales. The shales and iss. 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 iss.

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.


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 the 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, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 105-139), divided Fredericksburg into (descending) Caprina chalky iss., Comanche Peak chalk beds, and Basin or Alternating beds, the latter including 1st Caprotina horizon.

**Gryphaea** rock and Walnut clays or *Eogyrra texana* beds; and, tentatively, Paluxy sands. Overlies Trinity div. (which includes Glen Rose or Alternating beds, above, and Trinity or Basal sands) and underlies Kiamichi clays.


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. 330): 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 *Gateville fm.* to include Edwards and Comanche Peak Is., and Walnut clay, which he proposed be reduced to rank of members; and recommended abandonment of Goodland Is. He stated the Edwards, Comanche Peak, and Walnut are in part contemporaneous, 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. 1337 of book last cited above), questioned advisability of new name *Gateville fm.* and of abandoning Goodland Is., and stated that assignment of Kiamichi to Fredericksburg group is still considered a debatable question by some geologists.


**Fredericksburg gneiss.**

*Pre-Cambrinian: 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. Jones, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.,) mapped the gneiss around Fredericksburg as *Baltimore (?) gneiss.*

**Fredericksburg granite.**

*Pre-Cambrinian: 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.
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.
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).

Freeman.
See Lower Freeman sand. (Archer Co., Tex.)

Freeport coal group. (In Allegheny formation.)
Pennsylvaniaian: 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.
Lower Productive Coal Measures [Allegheny fm.] divided into (descending) Freepori coal group, Kittanning coal group, and Clarion coal group.

Freepori coal group extends from top of Upper Freepori coal to top of Upper Kittanning coal.

Freepori coal group is treated by U. S. Geol. Survey as an economic memb. in upper part of Allegheny fm., extending from top of Upper Freepori coal down to top of Upper Kittanning coal.

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia, and eastern Ohio.

Freeport limestone member (of Allegheny formation).

Freeport sandstone member (of Allegheny formation).

Freeport clay.

See Upper Freeport clay and Lower Freeport clay.

Freeport gravel.

Pleistocene: Northwestern Illinois.

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. Wy., is bed of Is. 10 ± ft. thick, which for convenience we can term Freezeout Is. Overlies Triassic "Red Beds." Same as Alcova Is. 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 Is. 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 Is., 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.

According to E. Kirk, the Fremont Is. 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.

French slate.
Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).
E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 622, 645, 649). French Is.—Largely dark brown to blackish gray phyllites, with thin beds of gneissic 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.

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 Is. be known as French Creek Is., 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 Is. was called Conneaut Is., but Conneaut Is. withdrawn as name for the Is. at request of G. H. Chadwick, who desires to apply "Conneaut" to a different unit in same region. [Table opp. p. 61 shows this Is. 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.)
Pennsylvania: Northeastern Kansas and southeastern Nebraska.
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 Is., grading laterally into ss., 10 inches; ss. or sh., gray green, bedded locally with plant remains, 6 ft. Underlies Nebraska City Is. and overlies Jim Creek Is.
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 240). French Creek sh. overlies Jim Creek and underlies Caneyville Is. 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, 1898, 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).

Frenchtown diorite.
Age (?) : Northeastern Maryland.

French shale.
Pennsylvania: Northeastern Kansas and southeastern Nebraska.
R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised chart), transposed French sh. and Table Creek sh. [restricted] by applying French to sh. overlying Dover Is. and Table Creek to sh. underlying Dover Is. [Derivation of name not stated.]
G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), called the sh. overlying Dover Is. the Friedrich-Dry sh. and the sh. underlying Dover Is. the Table Creek sh. and did not use French sh. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.
R. C. Moore, 1938 (Kans. Geol. Surv. Bull. 22, pp. 238, 240). French sh. (derived from erroneous spelling of French Creek on maps) was applied to beds btw. Dover Is. below and Jim Creek (Nebraska City) Is. above, and is abandoned. French Creek sh. comprises upper part of what was termed "French 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.

Fried's Hill series.
Age (?): West Indies.

Fried's Hill gravels and marls.
Pleistocene: Antigua.

†Frickham bed.
U. S. G. S. Bull. 191, p. 167. (Error for Trickham bed.)

Friedrich shale. (In Wabanaese group.)
Pennsylvanian: Eastern Kansas and southeastern Nebraska.
sh. underlies Jim Creek Is. and overlies Grandhaven Is.
here proposed to include clayey and sandy beds that overlie Grandhaven Is. and
underlie Jim Creek Is. The unweathered sh. is chiefly bluish gray, but it
commonly weathers yellowish or brownish. Locally there is sh. 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).
p. 574). Friendsville black sh.—Marine fauna (Cambridge?). Underlies Albright
Is. 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).
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 Capítan ls., and that Frijole ls. was its top bed. This inter-
pretation of position of Frijole ls. is also that of R. E. King, 1931 (Univ. Tex.
Bull. 3342, 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
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 sh.; (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, 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.]
J. A. Udden, C. L. Baker, and E. Boese, 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 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 Is. 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 Kenedy, 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 Mocene.
E. T. Dumble, 1920 (Univ. Tex. Bull. 1929). 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.).
E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, No. 4, July-Aug., pp. 424-438). 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 Is. 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 Mts, and on eastward-facing slopes of these mts 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 by 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 as 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.

Frisbee limestone.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.


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).


In 1911 Reeds named top fm. of Hunton Is. of Taff the Bois d’Arc Is.

Frog Mountain sandstone.

Middle Devonian (Onondaga): Northern and central Alabama and northwestern Georgia.

Froth 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, 1895. (U. S. G. S. 16th Ann. Rept, pt. 3, pl. 20 and 21 and p. 555). Froth Mtn ss. is all of Onondaga age. The name Froth Mtn ss. is therefore here restricted to the ss. in Ala. that are of Onondaga age, the new name Clear Branch ss. is introduced for the ss. in Ala. that are of Oriskany age, and the new name Bagard ss. is introduced for the ss. in Ala. that are of Hamilton age. The restricted Froth Mtn ss. is present in Froth 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 (Am. Jour. ScL, 5th, vol. 14, p. 365-380). All Dev. ss. of Ala. have been heretofore called Froth Mtn ss., but the 300 ft. of Dev. ss. at Froth Mtn, the type loc., is all of Onondaga age. The name Froth Mtn ss. is therefore here restricted to the ss. in Ala. that are of Onondaga age, the new name Clear Branch ss. is introduced for the ss. in Ala. that are of Oriskany age, and the new name Bagard ss. is introduced for the ss. in Ala. that are of Hamilton age. The restricted Froth Mtn ss. is present in Froth 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 Froth Mtn Chert, the type loc., but E. O. Ulrich found that Froth Mtn ss. at that locality consists of 150 ± ft. of coarse red ss., with Spirifer macrothyris and Amphigenia curta (7) at top, underlain by 200 ft. of sandy, calc., mag., and cherty beds with rounded quartz grains scattered through mag. Is. and quartz grains increasing toward bottom; fossiliferous chert-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 Is. of Beckmantown age, probably Newala Is. The Froth 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.


Frontenac.

Name applied to a glacial lake, of Pleist. age, in Ontario Basin.

Frontenac formation.

Paleozoic (pre-Ordovician?): Southeastern Quebec (Mount Megantic area).


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 solenacea. Underlies Hilliard fm.

A. C. Veatch, 1897 (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 2,800 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, Bolus, Teumlie, Whitehead, and Triable 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.


W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pl. 13, p. 188). Frostburg fm.—Lss., ss., and shales, the lss. in several bands and at different horizons; most important lss. 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).


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 Schorharie layers [Schorharie grit] and overlies Oriskany ss.

A paleontologic name. Replaced by Esopus grit.
Fulda sandstone.
Permian: Central northern Texas.
Named for prominent development near little station of Fulda, Baylor Co.

Fullerton formation.
Pleistocene (Aftonian): Southern, central, and northern Nebraska.
A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 328, 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. ml. 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. Craig, 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 (Scl. 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.
Named for Fulton, formerly a suburb of Cincinnati, but now forming part of First Ward.

Fulton shale member (of Monongahela formation).
Pennsylvania: West Virginia, western Pennsylvania, and eastern Ohio.
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. Pohs, 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.


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 Is. is new name for middle part of Speiser sh. as defined by Condra in 1927. In Nebr. it consists of (descending): (1) Gray Is., 1 ft. or more; (2) greenish argill. sh., 2 ft. or more; (3) gray Is., 1 ft. or more; (4) massive aren. Is. that weathers yellowish, 1 1/2 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.

Furnace limestone.

Upper Cambrian (?), Ordovician (?), and Mississippian (?): Southern California (San Bernardino Mountains).


A. O. Woodford and T. F. Harris, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, p. 270). Fossils collected close to top of Furnace Is. are pronounced by G. H. Girty to be probably Carb., 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.


Furnaceville iron ore.

Silurian: Central and western New York.


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 Is. intervenes betw. Sodus sh. and the ore.
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

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 Is., Furnaceville ore, Bear Creek ore, and Maplewood sh. The iron ore underlying true Wolcott Is. is here named Verona iron ore. The true Furnaceville ore is a much older bed. Hartnagel miscorrelated Wolcott Is. with the much older Reynolds Is. The iron ore overlying Wolcott Is. is here named Wolcott Furnace ore.


W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 324, 325), included Furnaceville ore in Reynolds Is., of which it is said to be basal 4 ft.

The iron ore underlying true Wolcott Is. is here named Verona iron ore.

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.
Silurian: Central and western New York and western Ontario.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept, pt. 4, p. 530). Fuson fm.—Very fine-grained ss. 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 Is. 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.


Named for exposures in Fusselman Canyon, Franklin Mtns, N. of El Paso, Tex.

Gabbs formation.
Upper Triassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).


Gabilian limestone.
Pre-Jurassic (?): Western California (San Francisco Bay region).

G. F. Becker, 1888 (U. S. G. S. Mon. 13, pp. 128, 181). Gabilian Is.—In Gabilian Range [spelled Gabiian by U. S. Geographic Board], some 60 mi. S. of Bay of San Francisco, the lowest sed. fm. encountered is in part Is., which at points in 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 Is." for what he a few sentences farther along called "oolitic Is. of the Gabourl" exposed at Ste. Genevieve, Mo. According to C. R. Keyes (Pan-Am. Geol., vol. 44, pp. 149-150, 1925) the Gabourl is. of Nicollet is Spergen is., and he would revive Nicollet's name. The only known uses of "Gabourl" in literature are Nicollet's casual use and Keyes' proposed revival of the term.

Gabriola formation.
Upper Cretaceous: British Columbia.

Gaffney marble.
Cambrian (probably Lower) : Southern North Carolina and northernwestern 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.

Gagné Brook series.
Ordovician (?) : Quebec.

†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 bdwy twixt. 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 McLeans-
boro fm. Lies strat. higher than Brushy Creek ss. and also about 100 ft. higher than an unexposed Is. that is correlated with Shoal Creek Is. Crops out about 1/2 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 sand.—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 Is. 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 Is., very friable, forming part of "cliff Is." of Ohio and Ind. repts, and is called by Dr. Owen, in his rept on Lead region, the "upper mag. Is." From its position and lithological characters it appears that this Is., 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 Is.; 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 la." 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 Is. diminishes in thickness eastwardly from these points, and becomes a very subordinate memb. of the series, losing, at same time, its metaliferous 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 Is. above. From all the evidence, therefore, the lead-bearing or Galena is. 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 la. is placed beneath so-called Hudson River group and above Trenton Is.]

J. Hall, 1858 (Iowa Geol. Surv. Rept. 1855-57, vol. 1, pt. 1, pp. 42, 56, 57, 58, 60). Galena la.—This rock, which succeeds Trenton Is. 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 grey 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. Is.;" but this term, as originally applied, included also Niagara la., causing the two to be confused for a long time; and in order to avoid the difficulty arising therefrom the name Galena la. 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 la. On p. 350, also by Whitney, is statement that Galena Is. 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 Is. of Hall is Platteville Is. 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 Is., 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 is. 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-beded 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 Blver 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 1982 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 91, 97) R. C. Moore (1) revived Dennis is.; (2) divided it into (descending) Winterset is. memb. ("same as Winterset as previously recognized in Kansas and Mo."); Stark sh. memb., and Canville is. memb.; and (3) stated; So-called Galesburg sh. of Kansas City is mainly Stark sh. Moore also assembled Bethany Falls is. and underlying beds into a fm. which he named Swope is. (q. v.), and assembled Dennis, Galesburg, and his Swope is. into his Bronson group.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21), stated that Stark sh. and Canville is. 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 is.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 92+). In Linn Co., where Canville is. disappears, Stark sh. rests on Galesburg sh., and lower 1 to 8 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 is. 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 is.

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 is.

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 Dreabach fm. be defined to include the ss. 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 Dreabach 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 U. S. Geol. Survey at present uses Dreabach 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 serpentinite. 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, 87, 90). Galisteo sand group.—Variegated sands and sas., 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. Is. 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 Galisteo Creek, although they pass under the Santa Fe mts., and northern limit is concealed from view. Overlies Placer Mtn group. Are doubtless middle Tert.

Galisteo is commonly accepted spelling of this name.

Galileo 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 “Galileo 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, 1938 (Geol. Soc Am. Bull., vol. 47, No. 4, pp. 508, 517-521). Galiuro ls.—Name here applied to Penn. part of Ransome’s Tornado Is., which is discarded, the Miss. rocks included under that name being Escabrosa Is. In certain ways the Galiuro ls. is different from Naco Is., the Penn. of extreme SE. Ariz. The beds composing it are individualized lithologically, as compared with the monotonous lead-gray Is. 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 Is. 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. cals. and quartzites. 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 ls. that might be called “Marginalina beds.” The overlying strata are white, yellow, brown, and pink Is., often silicified, and with frequent inclusions of cherty nodules. Upper part of Galiuro ls. consists of thinner-beded pink and brown hard, compact ls., 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) Pebble ls. (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. sas.), 30 ft.; (3) Mottled ls., 280 ft. (massive-beded, the lower 20 to 25 ft. being laminated, light-gray or brownish); (4) Obolclla shales, 280 ft. (more calc. than aren.; soft shaly beds with few thin Is. bands, dark greenish in lower part, lighter in upper part); (5) Trilobite ls., 120± ft. (thin-beded 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 ls., more massively bedded than those of underlying Flathead fm., and forms first prominent Is. bluff that rises above the Archean areas. Lowest bed is massive mottled black and gray Is. 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 Is. and top of Flathead qtzite were named Gros Ventre fm. The Gallatin Is. as now generally accepted is overlain by Jefferson Is. 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).


Gallegos sandstone.

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


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 Coloradoan 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, p. 312), applied Gallitzin Is. to a concretionary Is. described by W. G. Piatt 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.


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 ss. traceable throughout Gallup-Zuñi Basin. Upper and in places lower ss. 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 ss. 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 220 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).

Pennsylvaniaian: Southwestern Illinois (Perry County).


*Galum* ls. memb.—Earthy yellow nodular ls.; fossils rare or absent. Thickness 3 ft. Top lies 2 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.


*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.


*Gamachian series*, of Cincinnatian system, follows Richmondlan 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 Charleston 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 Richmondlan 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 [Silt] and name is superfluous."


*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 Silt. [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).

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 900 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).


Ganges formation.
Cretaceous: British Columbia.


Gannett group.
Cretaceous(?): Southeastern Idaho and southwestern Wyoming.


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).


†Gant bed.
Silurian (Niagaran): West-central Tennessee.

A. F. Poerste, 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 lss. 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, 1871, 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. 688W, 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 Rly 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 ¼ 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).
P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). Uddenitea zone is basal part of Wolfcamp, and there is uncon. at its base.
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 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 Schaeferina,
which first appears at base of this memb.; (2) the Gray Is. memb., a rather thick-
bedded, scarp-forming ls. about 50 ft. thick, containing few fossils; (3) Uddenitea
memb., consisting of sh. with a few thin ls. beds, and varying in thickness up to
800 ft. The Uddenitea 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 cgl.,
ranging from 10 ft. thick W. of Iron Mtn to 450 ft. near Lenox. The Gaptank
fm. is 1,500 ft. thick in vicinity of Gap Tank. Its basal bed is the Chaetetes
ls., 50 ft. thick, characterized by large masses of Chaetetes milloporaceae. [Gives
detailed sections and fossil lists of Gaptank and Wolfcamp fms.] Cgl. 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 Is., 40 to 75 ft. thick, separated by ss. and shales. The 5th Is. is top bed of fm.
P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pl. 103), treated Uddenitea-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.

788–790). Garber ss.—A series of red clay shales, and red sandy shales, and red
ss. 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.

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 280 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 deflned 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.

paper, serious objection can be made to what amounts to redefinition of fms. estab-
lished 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 flags, or Lower Fucoidal group.—Thick mass (100 to 250 ft.) of sb. and flags, 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 ss. 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: (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 ss. 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. 360.)

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.


Garden limestone.


Garden City limestone.

Lower Ordovician (Beekmantown): Northeastern Utah and southeastern Idaho.


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. Wimarth). 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.

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. 188). 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, 1906 (Sci., n. s., vol. 24, pp. 487-489). 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.

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. interf. Top is mapped at base of lowest exposed cherty beds of Pine Canyon Is. 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.  

Garfield formation.  

Garfield formation.  
Pre-Cambrian: Southwestern South Dakota (Lawrence County).  

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, 1880 (2d Pa. Geol. Surv. Rept. I, 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 ml. 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 Devon. (Chemung) age in NW. Pa.

Garley Canyon sandstone member (of Mancos shale).

Upper Cretaceous: Central eastern Utah (Book Cliffs and Wasatch Plateau).

E. M. Spleker 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 reps 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 cglts.; some thin lss. are present, one near middle of Mingus memb. Thickness of fm. 400 to 500 ft. The Thuer 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): Goei ls., Plummer, 1929; Santo Is., Plummer, 1929; and Barton Creek Is., Plummer, 1929, preoccupied and discarded.] Type loc. Garner, Parker Co.

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. 881, figs. 2, 3). Garnet Range fm.—Chiefly qtzites of different colors and types, but including some argillites 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 ml. E. of Bonner eastward to 1 ml. 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.

Pennsylvania: Eastern Kansas.


N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 70). Moore's restricted Landing 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, insasmuch as the term has been used for several different units and has never had wide acceptance.

Named for Garnett, Anderson Co.
Garman 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.** —

Colo. 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 66 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 ls., 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.


G. C. Matson, 1906 (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 ss., 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.


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 faggy 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 Neoshn 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 la. 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 ss.s.

Gary moraine (also morainic system).
Pleistocene (Wisconsin stage): South Dakota, North Dakota, Minnesota, Iowa.
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. ss.s. and separating ss.s. of earlier repts.
A. Winslow, 1894 (Mo. Geol. Surv. vol. 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 ss.s. 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. Buchler, 1904; E. M. Shepard, 1904; E. R. Buckley, 1905; H. A. Buchler, 1907; and C. [R.] Keyes, 1914.]
H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, 267). *Gasconade ls.*—Chert-bearing dolomitic iss. and ss.s., 450 to 650 ft. thick. Underlies Roubidoux fm. and overlies Elvins fm. Is = 3d and 4th Mag. iss. and 3d ss., also = Le Sueur Is. 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, 1905; E. R. Buckley, 1909; R. S. Bassler, 1911; E. O. Ulrich, 1911; G. W. Crane, 1912; H. A. Buchler, 1912; C. L. Dake, 1912; E. B. Branson, 1918; M. E. Wilson, 1922; H. A. Buchler, 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).
Gaspe series.
Devonian and Mississippian: Quebec.
Gaspe series.—Is Middle and Upper Sil., Dev., and Lower Carbf. Includes Gaspe is., Gaspe ss., and Bonaventure fm.

Subsequent writers assigned Gaspe Is. and Gaspe ss. to Dev. and Bonaventure fm. to late Miss.

Gaspe sandstone.
Devonian: Quebec.
C. H. Kindle (1936) stated fossils of lower memb. of Gaspe ss. are probably Middle Dev. (See under Malbaic cgl.)

Gaspe limestone.
Devonian: Quebec.
J. M. Clarke, 1908 (N. Y. State Mus. Mem. 6, p. 26). Gaspe Is. of Quebec are Dev.

Gasper formation.
Gasper oolite.
Mississippian: Kentucky, southwestern Virginia, Tennessee, and northern Alabama.
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 Girlkin 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 Girlkin fm.]

Gaspereau formation.
Carboniferous: Nova Scotia.

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 non-magnesian. Thickness 6 to 20 ft. In literature has been called Lower Niagara Is., 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 Is., but faunule differs entirely from that of surrounding Lockport Is. 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 Is. Passes laterally, with a jagged margin of interlocking layers, into coralline and crinoidal beds of Lockport Is., 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. Mississ-quoi 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 Twp.s. 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, 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 lamelata.* 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 Hamilton, Ont. Absent in Lakeport well [Madison Co.].

Gates formation.
Cretaceous: British Columbia.

Gatesburg formation.
Upper Cambrian: Central Pennsylvania (Blair to Center Counties).
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 Is., Comanche Peak Is., 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).
*Gateway fm.*—Chiefly thin-bedded siliceous metargillite; some dol. at base. [Younger than Purcell lava and St Yu fm.]
*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 Kinta fm. Lower memb. (125 ft.) consists of dol., ss., Is., 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.

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. 179).

Gauvin andesite.
Age (?): New Brunswick.

Gavilan.
See *Gabilan Is*.

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. 
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, Martha’s Vineyard, etc.).


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. F. 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).


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 Meeteece 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).


The Chief Consolidated and Gemini ls. of Crane compose Bluebell dol.

Genesee group.

Upper Devonian: New York, Pennsylvania, Maryland, northern West Virginia, and across western Virginia.


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 *Rhine-street 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 *Geneseo 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 *Geneseo*, and it is here proposed to restrict *Geneseo* 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 ls., 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 *Geneseo* 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 (l. 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, l. e., for the sh. above Tully ls. and below Genundewa ls.


The U. S. Geol. Survey in March 1936, at request of W. H. Bradley (who had in preparation a rept. (Bull. 819-A) on structure and gas possibilities in Steuben and adjacent counties in south-central N. Y.), adopted *Geneseo 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).


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*Geneseo* Valley limestone and shales.
Genesee shale. (In Genesee group.)

J. S. Diller (U. S. G. S. Bull. 353, 1908) mapped the Triassic rocks of Genesee Valley region as Searangering st. and Hossektua Is. Name probably derived from occurrence in Genesee Valley, E. of Genesee, Plumas Co.

Genesee shale. (In Genesee group.)


G. H. Chadwick, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 118). Genesee black sh.—The name “Genesee” is in duplicate use for the group (including the West River) and for the part beneath Genundewa Is., 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. 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 Is. and underlying Genundewa Is., because use of Geneseo 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 report on structure and gas possibilities in Steuben and adjacent counties in south-central N. Y.), adopted Geneseo sh. for basal fm. of Genese group, and redefined Geneseo by including in it, at top, Genundewa Is. lentil. The Genundewa was included in Genesseo 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 Is. separated by black sh.”

Genesee limestone.

Middle Devonian: Central and southeastern Indiana (Shelby to Jennings Counties).


E. M. Kindle, 1913 (Jour. Geol., vol. 21, p. 313). Fauna of Geneva Is. indicates it is of either Schoharie or Onondaga age, probably Schoharie.


E. R. Cummings, 1922 (Hdb. Ind. Geol., pt. 1, Sep. Pub. 21, p. 466). Geneva Is. 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.

†Geneseo 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 napp of Camb. qtzite repeated by an overturn. 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.


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.


Genshaw formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).


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 Is. in midst of Geneseo sh. had for many years been called Styliola Is. (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 Geneseo. In 1897 rept cited above Clarke referred to it as Genundewa or Styliola Is. In 1903 (N. Y. State Mus. Hdb. 19, chart) Clarke used the following title: Geneseo sh. incl. Genundewa Is., while D. D. Luther (N. Y. State Mus. Bull. 69, p. 1001) referred to it as Styliola or Genundewa Is.]

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, pp. 199-214). The Genundewa or Styliola Is. of Geneseo 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 Is. or Styliola Is.—Dark-gray soft shaly Is. 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 Geneseo 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 Geneseo group, which is divided into (descending): Standish flags and shales, West River sh., Genundewa or Styliola Is., and Geneseo sh. restricted [which Chadwick proposed (1920) be replaced by Geneseo shale].


See further explanation under Geneseo 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 Geneseo group, and redefined Geneseo by including in it, at top, Genundewa Is. 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 Is. 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.


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).


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. is., 40 or more ft. thick, characterized by *Kingena wacoenaia*. 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.


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, 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.


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 quadr.], 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 Corilis 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 8 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 Geor. al., included only the slates of Georgia and their supposed equivalents elsewhere. This usage was followed in the main by other geologists. The underlying ls. and ss. 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 †Georgiaan series.

†Georgia group.

See under Georgia al.

†Georgian epoch (or series).

Discarded name for Lower Cambrian (Waucoban epoch or series). See U. S. G. S. Bull. 709, pp. 94-96, 100.

Gering formation.

Miocene: Western Nebraska.

N. H. Darton, 1898 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 733, 747-755). Gering fm.—Coarse sands, soft ss., 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 drils 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 volcanica.—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.


Named for Germer Basin, on S. side of Salmon River, nearly opposite mouth of Bayhorse Creek.

**Gerome andesite.**

Tertiary: Northeastern Washington (Stevens County).


**Gerona marble.**

Late Jurassic (?): Cuba.


**Gerona marble.**

Pennsylvanian (?): Southwestern Oklahoma (Wichita Mountains).


**Gerster formation.**

Permian: Western Utah (Gold Hill district).


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 (pi. 64) as Peaceable sand (probably from Peaceable Creek, Hughes Co.), but Guertie adopted in text as more appropriate name. Assigned to Quat. (?).]


Named for Guertie, Hughes Co. The spelling of name of this town was in December 1924 changed by U. S. Geographic Board to Gerty.

**Geting member.**

Cretaceous: British Columbia.

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 ss. 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 ss., with minor amounts of white ss., green and yellow ss., black carbonaceous sh., and dark impure Is. Much of fm. has been metamorphosed, by intrusive diabase, to dark purple or black argillite or to white porcelainite. Near middle Is Heldersburg memb. and at top the Arendtsville fangl. memb. (consisting of quartzose cgl.) and a contemp. Is. 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.


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 Is. The salt beds are therefore now included in the Wellington.

Ghost River formation.

Devonian (?) : Alberta (Front Range).


Giants Range granite.

Pre-Cambrian (pre-Huronian and post-Knife Lake): Northeastern Minnesota (Vermillon and Mesabi districts).


C. K. Leith, 1903 (U. S. G. S. Mon. 43, pp. 24, 188-188, 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 ml. 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. F. 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. 787). Gibson coal memb.—Light-gray to white, lenticular sh., 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.

Gila conglomerate.
Pleistocene and Pliocene: Arizona and southwestern New Mexico.

G. K. Gilbert, 1875 (U. S. Geog. and Geol. Surv. 100th Met., 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, Gila, 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 dominating over the cgl. Thickness 1,000 to 1,600± ft.

Gillan 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 ss. 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.

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 sh.—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.

Gilbert Peak erosion surface.
Tertiary (Oligocene or Miocene): Northeastern Utah and southeastern Wyoming (Uinta Mountains).
W. H. Bradley, 1938 (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.


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 mesastriaul and other Ithaca fossils are common in the ass. 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" mesastriaul zone at Jefferton, 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." mesastriaul 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 1 mile 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 23/4 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 Mfr. 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, Owfuskee 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 11), but P. 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.**


**Gillespie formation.** (In Trinity group.)

Lower Cretaceous (Comanche series): Central Texas.


Apparently named for Gillespie Co.

**Gillette moraine.**


**Gilliam thin-bedded member** (of Capitan limestone).

Permian: Western Texas (Marathon region, Brewster County).


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.

Gillies intrusive.
Jurassic (?) : British Columbia.


Gilman quartzite.
Lower Cambrian : Quebec.


Gilmanton monzodiorite.

Gilmanton sandstone member (of Greene formation).
Permian : Southwestern Pennsylvania (Greene and Washington Counties), northern West Virginia, and eastern Ohio.


Gilmore limestone. (In Greene formation.)
Permian : Northern West Virginia.


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 ml. 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 Is., fossiliferous throughout but more so near the base (Streptorhynochus zone), 18 ft.; (3) massive greenish Is. interbedded with green sh. (Rhodocrinus zone), 8 ft.; (4) soft blue shaly Is. (Camarotoechia zone), 3 ft. [In his 1933 paper he called this Rhynchopora zone]; (5) brecciated Is., 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 Is., gray, lithographic, banded, carrying a brown Is. memb. in base and a brown shaly Is. 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 Is., 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.]


L. R. Laudon, 1935 (p. 247 of rept last cited). Moor^ 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.

Gilmour Gulch formation.

Tertiary (?), probably pre-upper Miocene: Central Nevada (northern Nye County).


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., 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 faucids. 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.


No. 3, pp. 195-199) 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.


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 Is.—A described by B. F. Shumard [on a later page of this vol.] is a fossiliferous compact bluish-gray brittle Is. 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 argill. mag. Is., the lower part more argill., with several thin beds of bluish gray crystalline Is.

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 Is. 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 1900, 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 Is. was many years ago shortened to Girardeau Is. (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).


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. ss. are absent, and Renault and Paint Creek Is. 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 miscorrelatlon 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 Is. (with Platy­crinis ponticulatus) 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 Is. 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 ep.ch.

Glacial period.
Terms applied in early repts (and still used in popular articles) to Pleisto­cene epoch.

Glacial.
Pre-Cambrian: General.
See under Petodian.

Glacier division.
Pre-Cambrian: British Columbia.

Glacier Peak volcanics.
A term that has been applied in a formalional 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. F. 160, 1930.]

Glade limestone.
Lower Ordovician: Central and western Tennessee.
J. M. Safford, 1869 (Geol. Tenn., pp. 258-267). Glade Is.—Light blue or dove-colored thin-bedded or flaggy Is.; fossiliferous. Thickness 115 to 120 ft. Preeminently the bed of the great "Cedar Glades" of Central Basin. Underlies Carter's Creek Is. and overlies Ridley Is. Included in Trenton or Lebanon [Stones River] group.

Nongeographic term. Replaced by Lebanon Is. 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, 1934 (Bulla. 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.)

Pennsylvania: 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.


Glady Fork sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.


Glamorgan gabbro.

Pre-Cambrian: Ontario.


Glance conglomerate.

Lower Cretaceous (Comanche series): Southeastern Arizona (Bisbee region).


Glassboro gravel.

Pleistocene: Southeastern Pennsylvania and adjacent parts of New Jersey.


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. Craigie, 1897 (Am. Geol., vol. 19, pp. 353, 355). Glass Mtn fm.—Includes all beds, 180 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).


This name being preoccupied, and the rocks being the southern extension of Captain Is. (an older and well-established name), the U. S. Geol. Survey designates these rocks in Glass Mtns the Capitan Is. (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., 1837, p. 72) to Cret. rocks in Miss.

**Glauconitic division.**


**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.


**Glenburnie member (of Chaumont formation).**

Middle Ordovician (Black River): Ohtario (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 is. 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 Is.

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).


Glen Canyon group.
Jurassic (?): Southern and eastern Utah, northern Arizona, southwestern Colorado, and northwestern New Mexico.


Glencoe marble.
Trade name for a marble quarried from Kimmswick Is. at Glencoe, Mo., according to J. Bridge (letter dated July 10, 1936).

Glendale granite.
Pre-Cambrian (?): Central northern Colorado (Boulder County).

B. 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 Lefthaud Canyon in vicinity of Glendale and Rowena [Boulder Co.].

Glendale shale.
Mississippian (early): Southeastern Tennessee (Chattanooga quadrangle).


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. Beice 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 Bulloch 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 crinoideal 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 poulsenii*. 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 formalional 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 ls. at Glenerie are named *Glenerie ls.* from town [in Ulster Co.]. Underlie *Esopus grt* 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, 389).

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). *Glencyprie fm.*—Gray and buff, finely laminated ss., 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 ss., the lower part of which are of Ord. age. 

J. Henderson, 1909 (Colo. Geol. Surv. 1st Rept, 1908, pp. 140-184, fig. 27). [Shows *Glencyprie ss.* of Manitou region as conformable with overlying Fountain cgl. of that area, and ss.—basal part of Fountain cgl. of Boulder region.]
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 Is. memb.]

Named for Glenkirk, Wayne Co.

Glenn formation.
Pennsylvanian: Central southern Oklahoma.
J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 28). Glenn fm.—Blue sh., with thin brown ss., and occasional thin lms. Thickness 1,000 to 3,000 ft. Overlies Caney sh. and may include highest Carbf. rocks exposed in Tishomingo quad.


G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331-357). 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. 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 Is., 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).


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 1,560 ft.

Glenn Creek shale member (of Jefferson limestone).
Middle Devonian: Northwestern Montana.
C. F. Deles, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 42 and passim). Glenn Creek sh. memb.—Underlies Coopers Lake Is. and overlies White Ridge Is.; all members of Jefferson Is. Thickest (86 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 fossilite 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.  
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).  
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 1835 (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).  

Glenrock limestone.  
Pennsylvanian: Southeastern Nebraska and northeastern Kansas.  
G. E. Condra, 1935. (See under Howes Is.)  
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.


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. 182). Glens Falls lss. proposed for basal Trenton lss., 17 ft thick in Flat Creek ravine at Sprakers, 2½ ml. E. of Canajoharie ravine. Consists of thin layers of very fossiliferous lss. with sh. intercalations near top and a 2-inch cgl. layer at base, separating it from Tribes Hill Is. Contains ripple marks and other signs of shallow-water conditions. Fauna of both the Is. 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 Jacksonsburg Is., but Jacksonsburg 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 Is.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 39). Glens Falls Is. is well developed in Mohawk and upper Hudson valleys.


The present N. Y. State Survey assigns Glens Falls Is. to Trenton group. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1981.)

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 [Winnebago Co., Iowa], lying btw. St. Peter ss. below and Platteville Is. 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 Is. 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 Is.; 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 Is. 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 repts a thickness of 50 ft. for the Glenwood.

F. W. Sardeson, 1933 (Pan-Am. Geol., vol. 80, 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 is.”

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 Is., as did Kay (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, pp. 256-258) 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 Is. Kay stated Glenwood memb. is overlain by Pecatonica Is. On pp. 333 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).


Replaced by Tornado Is. (Penn. and Miss.) and Martin Is. (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).


D. Hager and A. E. Robitaille, 1919 (Geol. rept. on oil possibilities in eastern N. Mex.). Glorieta 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.


Glaciator sa. is coarse, gray, massive, 300 to 500 ft. thick, underlies San Andreas Is., overlies Yeso fm., and is of Perm. age.

As there is no fm. btw. San Andres Is. 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 Is., 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.]


Goathaunt member (of Siyeh limestone).

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


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 Anona 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 1 1/4 mil. 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 Is. 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, 1889 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 624). Godiva Is.—As distinguished from underlying Eureka Is. is essentially a pure Is., 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 Is., Gardner dol., Victoria quartzite, Pinyon Penk Is., and Bluebell dol., which range in age from lower Miss. to Lower Ord.

Godiva limestone. (Also spelled Goldiva.)

Eocene: Utah.

Goen limestone. (In Millsap Lake formation.)
Pennsylvaniaian: Central northern Texas (Palo Pinto County).
F. B. Plummer. 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). Goen Is., 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 Is., all members of Mineral Wells fm.
F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 2534, pp. 16-24). The Is. 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 ¼ mi. by road NE. of Goen Cemetery entrance, is here named Goen Is. It lies in upper part of Grindstone Creek memb. of Millsap Lake fm., 50 ft. above Santo Is.

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. 33, pp. 19-29, on part of Saline, Williamson, Pope, and Johnson Counties, SE. Ill.). Golconda fm.—Shales and Is., 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 Is., 30 to 40 ft.; sh. and Is., 80 ft.; dark, argill., coarsely crystalline or fragmental fossiliferous Is. called Pterocarpaceae capitata 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 qz-tzite.—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. Relieved to be unconv. 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. 29). [See description under Piasa Is. Position within McLeansboro fm. not defined. It appears to be the 5 ft. of gray concretionary ls., containing Fusulinida, 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.
Named for development on N. and S. shores of Golden Gate.

Golden Ray limestone.
Middle Cambrian: Central northern Utah (Tintic district).
These rocks were later subdivided into 3 fms., named (descending) Herkimmer 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 reports, 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. Schultze, 1920 (U. S. G. S. Bull. 792, pp. 23, 32, 33, pl. 1). Massive yellowish ss., 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 sh., quartzite, 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 thick-
ness 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 Is. memb., 30 ± ft. thick; (2) schist with several thin beds of qtzite, nearly 200 ft.; (3) Morning Glory Is. memb. 15 ft.; (4) siliceous schists, 140 ft.; (5) Pine Nut Is. 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 iss., 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 Is. containing the gold ores of Mercur dist., central northern Utah, which occur in Great Blue Is. (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. 68601). 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. 465). 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.


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. (Pliist.) 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) Labahia, 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 (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 whittish 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 ('xposures near Gonic, Strafford Co., N. H.

**Gonzales limestone member (of Graham formation).**

Pennsylvaniaian: Central northern Texas (Brazos River region).

C. S. Boss, 1921 (U. S. G. S. Bull. 726G, p. 307). **Gonzales Is. memb. of Cisco fm.—**Coarse-grained dark-gray Is. containing large numbers of Campylophyllum. Thickness 0 to 4 ft. Lies 96 ft. above Home Creek Is. and 80± ft. below Bunker Is. Strat. position corresponds closely to that of Jacksboro Is. 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 Lucasa 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 Is. is now treated as a memb. of Graham fm.

**Gonzales shale.**

Pennsylvaniaian: 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 basalt part of Cisco in Palo Pinto Co., and as underlying Gonzales Is. lentil, 0 to 5 ft. thick.


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).**

Pennsylvaniaian: 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. 210± ft. of sh. and ss. occur above Jacksboro Is. This portion of Graham fm. of Brazos River valley is named Gonzales Creek memb., for a creek in Eastland Co. [1]. Where Jacksboro Is. is absent the Gonzales Creek memb. rests on underlying Finis sh. It underlies Bunker Is. memb. of Graham fm., and is composed of poorly beded, lenticular dark-brown ss., sandy shales, red clays, gypsiferous black clays, 2 Is. lentils, and a coal bed. The Is. are lenticular and the shales variable. One Is. lentill occurs 30 ft. below Bunker Is. and the other 80 ft. below the Bunker.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 112), stated that Home Creek Is. of Jack Co. includes Jacksboro Is.

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): Bunker Is., 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).

W. H. Twenhofel, G. O. Rasch, 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 ss.s, alternating with thicker beds of nonlaminated glauconitic ss.s, 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 Plioc. (?) 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 southwestern Oklahoma, and southwestern Arkansas.
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 oolite-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, 1881) in type section at Goodland, Choctaw Co., Okla. Although Tal'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.]


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 Kiamichi.

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.


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 Ozytopsoides 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.


Goodnight formation.

Pliocene: Panhandle of Texas.


J. W. Gilley, 1900 (Am. Mus. Nat. Hist. Bull. 18, p. 332). Goodnight beds of Cummins are identical with Clarendon beds, and former name as a distinct horizon should be abandoned.

Mapped as Ogallala fm. (Plío.) on 1932 geol. map of Tex.

Named for Goodnight, Armstrong Co.
Goodrich quartzite.

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


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 Is., 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.


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.


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. Is., and, locally, near top 50 to 75 ft. of dolomitic and sandy sh. Thickness 2,450± ft. Underlies Sultan Is. (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 Good-
springs 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 LIs., 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.


**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; 1/2 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.


**Goose Bay formation.**

Jurassic (?): British Columbia.


†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 Yenman’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 Terr. division, where it was succeeded by Pee Dee phase, which extended over depressed areas as far N. as Sparrow Swamp. In eastern Terr. 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).


**Goose Lake slate.**

Pre-Cambrian: Northwestern Michigan.

See 1907 entry under Weewe sl.

**Goose Neck sand.**

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

**Goose Pond limestone.**


**Goose Run sand.**


**Gordon sandstone.** (In Strawn formation.) Pennsylvania: 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).


**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 Is. (Penn.) in central Tex.
Gordon Mountain limestone.
Upper or Middle Cambrian: Northwestern Montana.
C. F. Delts, 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.


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. 339, 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., qzites, and intraformational flat-pebble cglts. of dol. and ls. pieces, and black dolomitic sh.; in lower part thick beds of ss. The upper Gorge (or No. 2) 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 slubby 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 cglts. and not basal cglts. as in the Mill River. The middle part of Gorge fm. is the Missisquoi of Koth, 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 Genesee 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 Is. 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, garneliferous schist, with beds of quartz and la. 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 (Virginia district).
F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 19, 23; map). Goshen schist (Ord. f.)—Highly schistose, elastic, 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 Virginia dist.
A. I. Jonas, 1928 (Va. Geol. Surv. prelim. ed. of geol. map of Va.). [Under the block of pre-Camb. extrusive rocks younger than Glenarm series and designated "aporbyolite" is statement: "In Virginia 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 Is. 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, 1950; 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.

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).

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 Valvuliniera 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 Valvuliniera 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.


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 Is. (local). Upper part is plastic, lower part is nonplastic.

Gourdhead Run limestone. (In Conemaugh formation.)
Pennsylvanian: Southwestern Pennsylvania (Allegheny County).
G. B. Richardson, 1932 (U. S. G. S. Bull. 829, p. 17). The Gourdhead Run Is. 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 Is. and 50 to 60 ft. below fossiliferous Brush Creek horizon, and therefore occurs in interval (usually) occupied by Mahoning ss. memb. This Is. 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.


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.


Gouverneur limestone.

Pre-Cambrian (Grenville series): Northwestern New York (St. Lawrence and Jefferson Counties).


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, 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 Canadea 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 Is.*, but which are contemp. [?]. Overlain by Dev. Wapsipinicon Is.

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, 1900; 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 (LeClaire 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 Is. (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.


**Graford formation (redefined).** (In Canyon group.)

Pennsylvanian : Central and central northern Texas.

F. B. Plummer, 1919 (A. A. F. 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 Is.*, one of most persistent, and can be recognized by greater height of its scarp than the other Is. members of the fm. The lss. are very fossiliferous, but shells are poorly preserved. Underlies Ranger fm. and overlies Palo Pinto Is.

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 Is. and underlies Seaman Ranch sh. memb. of Brad fm. In Colorado River Valley it underlies Cedarton sh. memb. of Brad fm. Includes Adams Branch Is. memb. at top (replaces Graford Is.) and Rochelle cgl at base. Thickness 170 to 450 ft. [Adams Branch Is. replaces Graford Is. 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 Is. is arbitrarily taken as top memb. of Graford fm. in Wise Co. It is an older Is. than Adams Branch Is., 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 Is. of Drake, because “the top of the Graford fm. as defined at type loc. apparently falls within the Merriman (Clear Creek) Is. equiv. and not at the Adams Branch Is. as given in the original description.” Also (pp. 105, 109) he transferred Capps Is. from Graford fm. to top of Strawn group, and included Devils Den Is. in Graford fm. This definition of Graford fm. was adopted by U. S. Geol. Survey in 1935.

Graford fm. was named by Plummer and Moore, and was made to include all strata from top of Palo Pinto Is. up to top of the Is. that caps the escarpment W. of Graford. This escarpment-forming Is., at time the fm. was named, was thought to be = typical Adams Branch Is. to S. Later work by Cheney, Armstrong, and others has shown that true Adams Branch Is. in Palo Pinto Co. lies much lower in section than uppermost Is. of Graford fm., and that this uppermost Is. is = Merriman Is. of Reeves. The Graford fm. of Palo Pinto Co. consists of Merriman Is. at top and 400± ft. of sh. containing lentils of sand, a lentil of coal, and a few thin layers of Is., and Is. divided into following members (downward): (1) Merriman Is., 20 to 75 ft., formerly mapped by Plummer and Moore as Adams Branch Is.; (2) Wolf Mtn sh.; (3) Wiles Is., 3 to 8 ft.; (4) Posideon sh., 50± ft. Underlies Brad fm. and overlies Palo Pinto Is. The Brad fm. is divided into Ranger Is. (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 Is. (preoccupied) in Brazos River region, because this Is. is one of several Is. in this part of the column. They therefore adopted the new name Winchell memb. for the group of Is. 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 Is.-bearing part of Placid sh. memb. of Plummer and Moore in Colorado River region, and Merriman Is. memb. (4 ft. thick) of Reeves in Brazos River region. Their rept has been transmitted and will soon be published by Tex. Geol. Survey.

tGraford limestone member (of Graford formation).
Pennsylvanian: Central and central northern Texas.
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 Is. of Reeves and overlies Palo Pinto Is. The Brad fm. is divided into Ranger Is. (above) and Seaman Ranch memb. (below).

Grafton quartzite.
Pre-Cambrian: Eastern Massachusetts and northern Rhode Island.
B. K. Emerson, 1898 (T. S. G. S. Mon. 29, p. 18). [Grafton qzite 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 qzite.—Generally a fine-grained massive saccharoidal qzite of great purity. Varies from white to pale flesh color. In places shows thin laminations 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 qzite 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" qzite is same as Westboro qzite, which has priority; "Grafton" is therefore abandoned.


Grafton sandstone. (In Conemaugh formation.)
Pennsylvanian: West Virginia and western Maryland.
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 Is. and is separated from underlying Federal Hill coal by Birmingham red bed and other strata. Lower Grafton ss. overlies the sh. above Ames Is. and lies a short distance below Federal Hill coal.

Grafton formation.

Pennsylvanian: Southwestern Pennsylvania (Punxsutawney quadrangle).


Is a part of Conemaugh fm.

Grafton member. (In Conemaugh formation.)


Graham jasper. (In Niobrara formation.)

Upper Cretaceous: Northwestern Kansas.


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. overlies Home Creek Is. memb. of Caddo Creek fm. Distinguished from underlying beds by its very elastic character and thinner Iss., and from overlying beds by its prolific and characteristic fauna. Divided into following members (descending): Wayland sh., Gunsight Is., South Bend sh., Burgin Is., Gonzales Creek sh., Jacksboro Is., 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 Is. and Finis sh. of Brazos River region.

F. B. Plummer and F. H. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3334, pp. 61-62). Graham fm. was named by Plummer and Moore and made to include all strata from top of Home Creek Is. 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): Burger Is., 6 ft.; Gonzales Creek sh., 116 ft.; Eastland Is. (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 Is. memb. The Graham fm. of Colorado River region includes all beds below Bellerophon Is. of Drake and above Home Creek Is. The Speck Mtn Is. 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 l._—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).


Graham shale. (In Bluefield formation.)

**Mississippian:** Southeastern West Virginia and southwestern Virginia (Tazewell and Giles Counties).


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 greenish gray. In bottom flags are many impressions of supposed seaweed _Sprotophyton cauda-pallii._ Thickness varies from 1,200 ft. in Clinch Basin to 400 ft. in Powell Basin. Of Dev. age. Overlies Chattanooga sh. and underlies _Newman l._ 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 l._ "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, 1801 (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.


Named for Grainger Co., Tenn.

Grapemian limestone.

Orдовician 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. (Chevy and Beckmantown) fossils in upper part. Lower part may be Upper Camb. Type loc. Grampian Hills, Frisco dist.

Grampus gneiss.


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, 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 breccia and aggs.; from rocks made up wholly of volcanic debris to such as contain abundant fragments of granitic gneissoid rocks. Exposed 1 ⅓ 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, 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 Is.—Impure ls., 4 ft. thick, near top of Niagara; used for building purposes. Overlain by 20 ft. of mag. Is. (top of Niagara) and underlain by 14 ft. of gray crystalline Is. of the Niagara.
Derivation of name not stated.

Grand Bank series.
Pre-Cambrian: Newfoundland.

Grand Canyon series.

†Grand Canyon schist.
Pre-Cambrian: Northern Arizona.
J. W. Powell, 1878 (Geology of eastern portion of Uinta Mts.). Grand Canyon schists.—Hornblende and micaceous schists and slates, with beds and dikes of granite. Thickness unknown. Found at bottom of Grand Canyon. Uncon. underlies Grand Canyon group [Unkar group].

Replaced by Vishnu schist.

†Grand Canyon group.
Pre-Cambrian: Northern Arizona.
C. D. Walcott, 1883 (Am. Jour. Sci., 3d, vol. 28, 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).

Grande Grève limestones.
Lower Devonian: Quebec (Gaspé Peninsula).
H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 208, footnote). The term Grande Grève fn., suggested by writer some time ago, has recently been accepted by Prof. J. M. Clarke and Mr. Schuchert, whilst they suggest the terms St. Albans 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 Iss. on Gaspé 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 ls., 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 Is. 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 fine conglomerate, 3 to 5 ft. thick, unconformably 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 schist.—Amphibolite, hornblende schists, etc. [Mapped at and around Twp of Grand Forks, B. C.]

R. A. Daly, 1913 (Canada Dept. Int. Rept Chief Ast. 1010, 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. Walles, 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 occasionally 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. 150, 188, 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, 1880 (Agric. and Geol. Miss., pp. 3, 108, 147–154). Grand Gulf group (also Grand Gulf stage, or Southern Lignite).—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 as. 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.


G. E. Condra, late in 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), applied Grandhaven (?) to 1 ft. of gray, nodular, aren. Is., 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, 1938 (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 ls. 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, 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. ml.

Named for exposures at and around Grand Island, Hall Co.

Grand Lake member.

Middle Devonian: Northeastern Michigan (Presque Isle and Alpena Counties).

Grand Lake formation.
Pre-Pennsylvanian: New Brunswick.

Grand Ledge moraine.

†Grand Portage amygdaloid.
Pre-Cambrian (Keweenawan): Northern Michigan.
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).
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.

†Grand Prairie formation.
Lower Cretaceous (Comanche series): Eastern Texas.
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.

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 as. of Wood Co. probably belongs to same level as Sylvanla as.

Grand Rapids group.
Mississippian: Michigan (Lower Peninsula).
A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, p. 10). Grand Rapids group consists of 305± ft. of iss, underlain or replaced by shales and dol. with gyp. Lower
part called Michigan salt group by Winchell. Overlies Marshall ss. and underlies Parma ss.


Named for exposures at Grand Rapids, where Bayport ls. is quarried.

Grand Rapids sandstone.

Lower Cretaceous: Alberta.


†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., underlaying 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 ls.

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.


Named for exposures in vicinity of Grand Tower, Jackson Co., Ill.

Grand View dolomite.

Upper Devonian: Southern central Idaho (Custer County).


Graneros shale. (Of Colorado group.)
Upper Cretaceous: Eastern Colorado and Wyoming, southeastern Montana, South Dakota, Nebraska, Kansas, northeastern New Mexico.

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).

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 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.
Granton trap.
Upper Triassic: Northern New Jersey (northwest of Jersey City).
N. H. Darton, 1898 (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.
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 clg. of E. part of county. Consist of (descending): (1) 3 to 18 ft. of coarse ss. and clg. ; (2) fucoid layer 7 to 12 ft. thick; (3) 15 to 21 ft. of compact, argill. drab ss.; (4) 60 ft. of shaly drab ss. and shales. Overlain by Licking shales and underlain by Racoon 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 fissiliferous ss. in upper part; clgs. absent or limited to few thin beds. Thickness 588 ft. Includes (descending): Borne memb., 0 to 10 ft.; Black Hand memb. 50 to 100 ft.; Racoon 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.
J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816). Grape Creek fm., 130 ft. thick, underlies Talpa fm. and overlies Bend Mtn fm. [in which bed No. 12 seems to be included]. Grape Creek fm. is distinguished from Bend Mtn beds by paucity of worm and Springapora remains, the introduction of Mollusca and Molluscoldea, and, most noticeably, by nature of bedding of rocks.

Named for Grape Creek, Coleman Co.

Grapevine sandstone. (In Kanawha formation.)
Pennsylvanian: Southern West Virginia.

Type loc. is at mouth of Grapevine Creek, Mingo Co.
Grapevine conglomerates.

Graphic lavas.
Pre-Cambrian: Central northern New Mexico (Magdalena Mountains).

†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 underlaid by quartzite. [Occurs in Kelly mining dist., Socorro Co.]

Grassmere stage.

Grasston moraine.
Pleistocene (Wisconsin stage): Central eastern Minnesota (Kanabec, Pine, and Mille Lacs Counties).

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. Underlies 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. H. 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.


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. menh. 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).

Grassy Knob chert.
Lower Devonian: Southwestern Illinois (Jackson and Union Counties).
T. E. Savage, 1925 (Am. Jour. Sci., 5th vol. 10, pp. 130-144). Grassy Knob chert (of Oriskany age) uncon. overlies Bailey Is. (of New Scotland age) and conformably underlies Little Saline Is. (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 Is. in layers 3 to 8 inches thick grading downward into bands of chert containing particles of glauconite. Not previously recognized in III., 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.

Named for fact it caps Grassy Mtn, Malheur Co.

Graters shales. (In Brunswick formation.)
Upper Triassic: Southeastern Pennsylvania (Montgomery County) and western New Jersey.


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. Found much like Herritage. 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 Grazt. Of early Utica age.


Named for Grazt, 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. It 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.

Gravia series.

Jurassic or Cretaceous and Upper Triassic: Southeastern Alaska (Gravina Island).


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.
Gray Band. (Also spelled Grey Band.)

Descriptive term applied in early N. Y. repts to the thin gray ss. later named Thoroid 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 1897 (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, Carb. lls., ss., 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. Maxwell, 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. Jepson, 1936 (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. 188, 1935.)

†Gray Cliff sandstone.
See †Gray Cliff group.

†Gray Cliff limestone.
Mississippian: Southeastern Arizona.
See under Modoc Is.

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. Is., 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 fn. [Graydon ss.] where it occurs as a cgl. filling old river channels, differentiates btw. this and Graydon proper. The fn. 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 Is. 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).

†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. 666K, p. 130). [The strat. section of rocks exposed in T. 27 N., R. 7 E., Osage Co., shows a thin Is., called Grayhorse Is., lying 85 ft. below Foraker Is. and 57 ft. below a micaceous ss. This Is. was named by C. F. Bowen in Bull. 686L, but Heald's chapter in Bull. 688K was released before Bowen's rept in Bull. 686L.]

C. F. Bowen, 1918 (U. S. G. S. Bull. 686L, p. 138). Grayhorse Is.—Dark brownish-gray crystalline conglomeratic Is., 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 subquadrate, 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 Forker Is. and younger than Stonebreaker Is. 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 Is.)

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.

Grayson marl.—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, 260-271, 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.


Graysonton formation.

Cambrian (Middle and Lower): Southwestern Virginia.

Graysonton fm.—Complex mass of red and green shales and interbedded ls., the ls. generally siliceous, showing gradual transition from the siliceous green sh. to a solid is., 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.

Sec 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 Is. deposit consists 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, 1855 (Geol. Pa., vol. 2, pt. 1, pp. 503-507). Great Is. bed.—A series of alternating calc. and argill. strata 60 to 70 ft. thick. Is older than Unlontown
coal, younger than Redstone coal, and includes, about in middle, the Sewickley coal. The Is. overlying the Sewickley coal is 22± ft. thick, and the Is. underlying it 25± ft. thick. [As thus defined "Great Is." apparently included Uniontown Is. at top, Benwood Is., and Fishpot Is.]

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). Great Is.—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), applied the names Great Pittsburgh Is. and Pittsburgh Is. group (pp. 88, 100) to Is. extending from top of Uniontown Is. to base of Redstone Is.

The descriptive term "Great Is." as used in Pa. repts for many years included the Benwood and Uniontown Is. members of Monongahela fm.

†Great conglomerate.
Pennsylvania: Appalachian region.

J. P. Lesley, 1856 (Manual of coal, pp. 91-105). The Great Cgl., No. XII (Milestone 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.


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, p. 91). Great Bend Is.—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).

Great Blue Is. — Defined — Consists of a lower and an upper Is. separated by shaly beds, 85 ft. thick, herein named Long Trail memb. The lower Is. is 500± ft. thick, according to 4 measurements by writer, instead of 1,000 ft. as reported by Spurr. The upper Is. is blue-gray Is. like the lower Is. and contains sporadic chert layers, some sandy Is., and a very subordinate quantity of black sh. In places the upper 200 to 300 ft. of upper Is. memb. consists of interbedded Is. and sh. Estimated thickness of upper is 3,000± ft. The upper black sh. of Spurr and the overlying limy shales and interbedded Is., aggregating 1,140 ft., are here separated from the “Great Blue” Is. and named Manning Canyon sh. The “Great Blue” Is. rests on Humbug fm. (“Lower Interlaced series” of Spurr).

The term “Great Blue Is.,” 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.

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.

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

Great Smoky conglomerate.

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

Greece Ranch horizon.
Oligocene: Southwestern Washington (southwestern Lewis County).

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 Barbata 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.]


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.


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.


†Greenbrier series.

Mississippian: Pennsylvania and northern West Virginia.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K._). 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 Is. In Pocahontas Co., W. Va., along Greenbrier River, the conditions are a mean btw. the extremes of Is. and sh., so that the locality would be a fitting one from which to name the series. Underlies Potts­ville cgl. and overlies Pocono as. Includes (descending) Upper Mauch Chunk shales (including Sharon group of coal beds) 82± ft.; Mountain Is. (exposed in Loyalhanna Gap); Lower Mauch Chunk shales 90 ft., and Siliceous [Loyalhanna] Is. 50± ft.

Includes Mauch Chunk sh. and Loyalhanna Is.

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.


I. C. White, 1882 (The Virginias, vol. 3, pp. 102-103). Mountain or Greenbrier Is.—Underlies Greenbriar or Mauch Chunk sh. and overlies Vespertine or Pocono of Pa. At base the "Siliceous Is.," 105 ft. thick, is tentatively included, although in writer's opinion it really belongs to Vespertine.
In some subsequent repts the †Siliceous (Loyalhanna) Is. was treated as a distinct fm., and in other repts it was included in either Greenbrier Is. or Pocono ss. It is now treated by U. S. Geol. Survey as a distinct fm. in Pa. and as a memb. of Greenbrier Is. 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-St. Genevieve age.

Named for exposures on Greenbrier River, Pocahontas Co., W. Va.

†Greenbrier shales.

Mississippian: West Virginia.


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.

Greenbush bed.

Middle Ordovician: Central southern Pennsylvania (Franklin County).


Green Cove beds.

Eocene: Western Wyoming (Wind River Basin).

H. E. Wood, 2d, 1914 (Am. Mus. Nat Hist. Bull, vol. 67, art. 5, pp. 245-249). Greencastle bed.—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 Is. member of Conemaugh fm.

Greendale limestone. (In Cynthiana formation.)

Middle Ordovician (Trenton): Central northern Kentucky.

A. F. Forster, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 19, 211). Greendale bed.—Name suggested by J. M. Nickles for argill. iss. 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 Is.]

Cynthiana fm. into (descending) Nicholas Is., Greendale, and Perryville, and
repeated this classification in 1910 (Denison, vol. 16). In 1914 (Cincinnati Soc.
or Ortohynchula 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 Is. further eastward."

and Forestry of Ky., ser. 5, Bull. 2), divided Cynthiana fm. into Point Pleasant Is.
above and Greendale is. below (the Perryville being excluded from Cynthiana).

Surv. Camb. and Ord. vol., p. 51), and A. F. Foerste, 1924 (Canada Dept. Mines
into (descending) Rogers Gap, Gratz, Bromley, and Greendale.

 Probably named for Greendale, Fayette Co.

Greene formation. (Of Dunkard group.)
Permain: 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 Wash­
ington Is. 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.
Permain 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 Is. 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 Is. or Waterline 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. Is. scarcely to be distinguished in chemical composition from the heavy beds of
Niagara Is. 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, 1888 (Sci., n. s., vol. 8, p. 800). I propose to call the so-called "bull­
head" Is. of vicinity of Buffalo, N. Y., the Greenfield Is. from town in [SW.] Ohio
near which this bed both attains strong development and afforded the first fossils
described from it.
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 Is. 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.


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 memh. of Bass Island fm. (Lower Monroe).

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 19, p. 192). The only exposure of Greenfield dol. known in Ky. is along bank of Ohio River at Vanceburg [Lewis Co.].


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 sgs. 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, acmite-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 Is., as explained under Little Falls dol. The name was introduced, but not fully defined, by J. M. Clarke in 1803 (N. Y. State Mus. Hdb. 19, pp. 9, 12, and table 2). In tables he showed Greenfield Is. 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 Is. (Greenfield Is.). He probably named the fm. for Greenfield, Saratoga Co.
Greenfield dolomite. (In Whitehorse sandstone.)
Permian: Southwestern Oklahoma (Blaine and Custer Counties).

For many years the ls. capping the hills immediately W. of Greenfield in Ts. 14-15 N., R. 11-12 W., has been called "Day Creek dolite," but this correlation is incorrect, since Day Creek dolite 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.


R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40H1). 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 dolite." [See under Day Creek dolite.]

G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 40, 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.


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.


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 ls. 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.

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 stove 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, 1846 (1st Ann. Rept. Vt. State Geol., pp. 60-61). [Green Mt. gneiss is listed as next to oldest fm. in Vt., lying below mica sl. and above "gneiss proper."]

C. B. Adams, 1846 (2d Ann. Rept. Vt. State Geol.), mentioned "the gneissoid mica sl. or Green Mt. gneiss.

A. D. Hager, 1861 (Rept. Geol. Vt., vol. 2, pl. 18, geol. map of Plymouth, SW. Vt.), mapped Green Mt. gneiss.

J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 4, p. 370). The so-called "Green Mt. series" has been pronounced on lithological evidence to be pre-Sil. and Huronian.


C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, p. 464). The Green Mt. 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 Mt. gneiss for the Huronian is improper and inappropriate.


C. H. Richardson et al., 1914 (9th Rept. Vt. State Geol., pp. 305-313), assigned Green Mt. gneiss to Algonkian; also in 11th Rept. Vt. State Geol.


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 Mt. beds.]
Green Point series.
Ordovician (lowest) : Newfoundland.

Green Pond conglomerate.
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 com-
monly 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 Potsham 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. ss. Occurs at
Green Pond, Copperas, Kanouse, and Bearfoot Mtns. Lithologically resembles
One' da cgl. Overlain by 200 ft. of red sh. of Medina age.
cgl.—Buff reddish qtzites underlain by coarse red cglss. 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. 114 to 150) 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 Shawan-
gunk 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 Mountain group.
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, how-
ever, 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 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 clf. (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. 605 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 (=Wasatch 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 fm.s. 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) Lancy 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 Lancy 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).


Greensburg or Flat Rock stone.—Light grayish-buff close-grained, compact mag. Is., 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 Ashtabula group and overlying a group of diabases, diabase amygdaloids, and lustre-mottled melaphyres, including a number of cgl. beds. Includes Marvine’s beds 81 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 reps 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.


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 Is. and overlies Union Is.; all members of Greenbrier series [Is.]. 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.


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. Surry. 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 subhorrnblende rock, generally very decomposable. Included in Western Primary system.

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.
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 fm. the Greenwich sh. of Washington Co., N. Y., and Rutland Co., Vt., the Vermont fm. of Mass. and Vt., and probably some areas of Beekmantown. The Greenwich sh. is not defined.

Named for exposures at Greenwich, Washington Co., N. Y.

Greenwood sandstone.
Pennsylvanian: Western Arkansas coal field and central-eastern Oklahoma.

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 siderite sh. Thickness varies somewhat; minimum perhaps 50 ft. Where metamorphosed it is magnetic and creates a magnetic line that marks top of Goodrich fm. Where over lain 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.

†Greer formation.
Permian: Southwestern Oklahoma, Panhandle of Texas, and central northern Texas.
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
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 Mts 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 and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 46-51). Greggs'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.

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.
The Neva Is. 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 per­
sistent. 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 wide­
spread in western Kans. and eastern Colo. It is underlaid by Roca sh. and over­
lain by Eskridge sh. It contains more Is. 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, 1962). It is here divided into following
members (descending): Neva Is., Salem Point sh., Burr Is., Legion sh., and
Sallyards Is., 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 6 members is 40 ft. or more.

G. E. Condra, 1935 (Neb. Geol. Surv. Paper No. 8). **Grenola fm.** divided into (de­
sceding) Neva Is., Salem Point sh., Burr Is., Legion sh., and Sallyards is. Overlies
Roca sh. fm. and underlies Eskridge sh. fm. The Kans. Geol. Surv. correlates
Legion sh. and Sallyards is. with Roca sh. fm.

sh., overlies Roca sh. (top part of Elmdale sh. of old classification), and corresponds
to Neva Is. of old classification. In revised classification it is divided into (descend­
ing) Neva Is. (restricted), Salem Point sh., and Burr Is. [Moore also transferred
these rocks to Penn. This change in Perm.-Penn. bdy has not been considered by
U. S. Geol. Surv. 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 ls. 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.

ville 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. 390, 1906, 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 †Grey Band.

Greybull sandstone member (of Cloverly formation).
Lower (?) Cretaceous: Central northern Wyoming (Bighorn and Elk Basins) and central southern Montana (Stillwater-Yellowstone-Counties region).

P. 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.]


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, 1861, pp. 28-28.) 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 Cloveiy fm.

Greyhorse limestone. (In Wabaunsee group.)
Pennsylvanian: Southeastern Nebraska and northwestern Missouri.
G. E. Condra, 1935 (Neb. 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.]

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.

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).

Gries Ranch horizon.
Tertiary: Western Washington.
W. L. Ebinger, 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 cgs., ass., and shales, with local volcanic tuffs and aggs. 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. Bul. 52, pp. 616-629). **Grimes ss.**—Thin ss., 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. Bul. 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. 18, 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. 389). **Grimes ss.** underlies Gardeau sh. (=West Hill) and overlies Hatch sh. All included in Portage 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. Bul. 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 Williams coal (Bell?).
Grindstone grit
A name applied in some early reports to Berea ss. of Ohio, and in other reports to basal 20 ft. of Berea ss.

Grindstone Creek member (of Millsap Lake formation).
Pennsylvanian: North-central Texas (Brazos River region).

top memb. of Millsap Lake fm. Used by G. Scott and J. M. Armstrong in ms.
on geol. of Parker Co. Overlies Brannon Is. memb. [Type loc. not stated.]
Grindstone Creek memb.—Upper memb. of Millsap Lake fm. Was named by G.
Includes all strata btw. top of Brannon Bridge ls. (top bed of underlying Lazy
Bend memb.) and base of Thumber coal (basal bed of overlying Garner fm.).
The iss. of this memb. are here named Goen Is. (the younger) and Santo Is. (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-Cainozoic (Belt series): Northwestern Montana (Glacier National
Park) and southeastern British Columbia.

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 1,500 ft. thick. Also well exposed on Appekunny and Robertson Mtns.
Conformably overlies by Siyeh Is. 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.
Griswolds Gap conglomerate.
Mississippian: Northeastern Pennsylvania.

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 weathered whithish.
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, Susque
hanna Co.

of Pocono ss. At Campbell's Ledge, Lackawanna Co., it is 130 ft. thick.
B. Willard, 1938 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 565-007), 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).

older than Montgomery Is., 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 Is. The last is of special interest in
being Sil., the oldest fossiliferous rock yet discovered in Calif. [The Is. is Mont­
gomery Is., 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-beded qtzite overlain by lentils of [Montgomery] Is.
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 Sill. 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.


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 prevalingly porphyritic habit, aggregating 175 to nearly 300 ft. As mapped the Grizzly Peak andesite rests on rhyolite tuff and is overlain by Slestan 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 of this rock meteoric 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.)
W. W. Robey, 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,
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.
Greenish and gray calc. shales, with gray, striped conglomeratic and oolitic
iss., separating overlying Gallatin Is. (as restricted by Hague and his associates)
from underlying Flathead qtzte. Contains Middle Camb. fossils. [Gives typical
detailed section (which foots 798 ft.) on W. slope of Doubletop Peak, in Gros
Ventre Range, where overlying Gallatin Is. and underlying Flathead qtzite are
both present.]

Groton granite.
Devonian: Northeastern Vermont (Caledonia County).
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).
564-565). Grove Is.—The main quarry rock at Le Gore quarry [Frederick Co.].
Formerly erroneously called Beekmantown Is. Rests conformably on Frederick Is.
Is probably of Chazy or later age. [Derivation of name not stated in this pub-
lication, but authors stated orally that this Is. was named for Grove quarry and
Grove Station, on B. & O. R. R., where it is well exposed in syncline above Fred-
erick Is.]
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).
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 con-
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 grunerite of Marquette range, with quartz and iron oxides as associates. Thickness 600± ft. Immediately overlies Mansfield fm. and is uncon. overlain by Upper Huronian mica schists and quartzites. [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. 304-306 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 Is. (afterwards named Capitan Is.), underlain by 2,000 to 2,500 ft. of yellow quartzose ss., underlain by 500 or more ft. of thin-bedded black Is., the ss. and basal Is. being afterward named Delaware Mtn fm. The basal Is. (now known as Bone Spring Is.) 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 Is. had yielded only a few fossils.]


Adopted as group term to include, originally, Capitan Is. 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 Is. The Delaware Mtn fm. of Delaware Mtns is now known to include in its upper part the time equiv. of Capitan Is. 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.


Guanajuato conglomerate.

Tertiary: Mexico.


A. Wandke and J. Martinez, 1928 (Econ. Geol., vol. 23, p. 9).

Guanica coral reefs.

Tertiary: Puerto Rico.

Guantanamo shale.
  Oligocene or Miocene: Cuba.

Guaracara limestone.
  Miocene: Trinidad.

Guadarraya intrusion.
  Age (?): Mexico.
  J. E. Spurr and G. H. Garrey, 1908 (Econ. Geol., vol. 3, p. 694).

Guaso limestone.
  Eocene: Cuba.

Guayabal limestone.
  Cretaceous: Puerto Rico.

Guayabal formation.
  Eocene: Mexico.

Guayama series.
  Cretaceous: Puerto Rico.

Guaynabo formation.
  Cretaceous: Puerto Rico.

Gubik sand.
  Pleistocene: Northern Alaska.
  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 ls. 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 Is. holding Pentamerus galcatua and numerous other silurian species which characterize the Is. 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 [i.e., 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, 1850.]

J. D. Dana, 1857 (Canadian Nat. and Geol., vol. 1, p. 411), included Galt Is. in Onondaga period, but placed it under the Guelph salt group.


**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, have 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 Is.

J. Hall, 1865 (Am. Jour. Sci., 2d, vol. 30, pp. 353-355), included Galt or Guelph Is. of Canada in Niagara group, stating that as it includes an entirely different set of fossils from Niagara Is. 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 Is. at Galt to be "clearly above the great Niagara Is. of the falls," but he included it in his Niagara group.]


H. Ries, 1899 (N. Y. State Geol. 17th Ann. Rept.). The upper memb. of this fm. [Niagara Is., now called Lockport dol.] is known as *Guelph Is.*, but it is not extensive with lower memb. It forms a lenticular bed about 20 mi. long and extends from Rochester westward.


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 Niagaraan 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. 128) excluded Guelph dol. from Lockport dol. but included it in Niagara.

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.


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. 204). 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 Niagara 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.


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 quartz at
base. Thickness of fm. 75 to 200 ft. Contains Miss. fossils. Uncon. underlies 
Harrville fm. and rests uncon. on Algonkian Whalen group and also on intrusive 
granites of Algonkian (?) age. [Mapped around town of Guernsey.]

†Guertie sand.  
See Guertie sand, the approved spelling of the geographic name.

†Gueydan formation.  
Tertiary (lower Miocene or Oligocene) : Southern Texas coastal plain.  
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 Gueycan ranch and survey, in SE. part 
of McMullen Co., Tex.  
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 Elissor has 
identified about 80 typical Vicksburg species of Foraminifera from lower Olig. 
subsurface strata of Tex. The Olig. beds above this Vicksburg zone carry fauna 
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 Mi 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.  
Guilford sl. in early days was later known as Leyden phylite.

Guilmette formation.  
Middle Devonian: Western Utah (Gold Hill district).  
Guilmette fm.—Chiefly dol. but contains a number of thick ls. beds and several 
lenticular brownish ss. 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 
800 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.

Güînes limestone.  
Oligocene or Miocene: Cuba.  

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.
†Tertiary: Gulf Coastal Plain.
See under †Atlantic group.

†Gullette Bluff beds. (In Wilcox group.)
Eocene (lower): Southwestern Alabama.

Named for exposures at Gullette Bluff, Wilcox Co.

Gunflint iron-formation.

Pre-Cambrian (middle Huronian): Northeastern Minnesota (Gunflint Lake region and Vermilion district).

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, grunerite, and magnetite rocks, all apparently representing altered forms of some original ferruginous rocks. Thickness probably 300 to 1,000 ft. Overlain by Rove sl. Rests on rocks of different character and of varying age, from Ely greenstone to W. to Ozishke 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. 369) and 1911 (U. S. G. S. Mon. 32), assigned this fm. to upper Huronian, of Algonkian system.
C. K. Leith, R. J. Lund, and A. Leith, 1915 (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 fissiliferous 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 Jurassic 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 cgs. or on older fms. Underlies Dakota fm."


W. Cross, 1896 (U. S. G. S. Telluride folio, No. 57). Lower memb. of Gunnison fm. is here named *La Plata ss.* and upper memb. is named *McCullum ss.* Latter is same as Gunnison fm. restricted of Parington. Thickness 600-900 ft.

According to A. A. Baker, C. H. Dana, and J. B. Reeside, Jr. (U. S. G. S. P. P. 183, 1930), 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 qzite and schist of Coal Creek. Jefferson Co., eastern Colo., and to be much older than Front Range granite group of Colo. Includes Irving greenstone, Doubis 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.

Guin Peak formation.
Carboniferous (?): Central Washington (Snohomish County).

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 7, pp. 34-50). *Guin Peak fm.*—Metamorphosed qzites, slates, schists, interbedded volcanic flows, crystalline Is., and conglomeratic qzite. 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 Carbo.; therefore provisionally assigned to that period. Named for Guin Peak region.

Gunpowder granite.
Pre-Cambrian: Northeastern Maryland (Baltimore County).


†Gunsight formation. (In Cisco group.)
Pennsylvaniaian: Central northern Texas.


Named for Gunsight, Stephens Co.

Gunsight limestone member (of Graham formation).
Pennsylvaniaian: Central and central northern Texas.


F. B. Plummer and R. C. Moore, 1922 (Jour. Geol. Bull. 2132, pp. 126, 127-137, charts, etc.). *Gunsight Is.*—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 Is. layers separated by 20 to 60 ft. of yellow sh. Overlies South Bend sh. and underlies Wayland sh. [In sections given in this rep. the upper Is. is 1 to 20 ft. thick, the lower Is. 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. Sc., 4th, vol. 22, p. 505). The igneous rocks of Belknap massif are in contact with migaeous gneisses along W. side. 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. 28).

Gunter ss.—Fine to coarse-grained ss., in places siliceous, in places quartzite, 0 to 18 ft. thick; the 3d ss. of Swallow. Uncon. overlies Proctor Is. and underlies Gasconade Is. 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 ss. 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.

M. J. McInnes, 1919 (Sci. n. s., vol. 50, p. 591).

Gurnee formation. (In Pottsville formation.)

Pennsylvanian: Central northern Pennsylvania (Tioga County).


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. 28, 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 Mt. group. Younger than Quanah gyp. and older than McCauley 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. has 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 McCauley beds of Fisher Co.


Guthrie Creek member (of Harrodsburg limestone).

Mississippian: Southern Indiana.

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 Is.—Middle memb. of Decorah fm. At type section (in bluff of Miss. River just ft. of town of Guttenberg, Clayton Co., Iowa) it consists of 15½ ft. of brownish fine-textured Is. Northward from this locality this Is. 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 Is. 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. 650-671, 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. 298 he showed his Guttenberg memb. as composing all of his restricted Decorah present near Platteville, Wis.

Guyandot sandstones. (In Sewell formation.)

Pennsylvaniaian: Southern West Virginia.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio. No. 77). Guyandot Is. 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 Harreys cgl. lentil. Well exposed along Guyandot River from Pineville [W. Va.] to Gilbert [Mingo Co.].


Guye formation.

Miocene: Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 130). Guye fm.—Shales, ss., grits, s., and cgl., with a little Is. 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.


Guysborough formation.

Cambrian: Nova Scotia and Canada.


Guizman formation.

Cretaceous: Puerto Rico.

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 ln., 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.

Gwynnup 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).


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 Is.—Chiefly light-gray Is., 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.


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 Is. which weather 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 Feunt 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,
Hackberry shale. (In Cimarron group.)
Permian: Central southern Kansas and northwestern Oklahoma.


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 Grove, Cerro Gordo Co. 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 Is.; occasional marine fossils in lower part; thickness 30 to 290 ft. Underlies Hackett ss. and overlies Tophet Is.; 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-Amer. 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 Is. and composing basal fm. of Nevadan series (late Devonian) 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 Devonian 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 ss. 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 Pli., 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. Ailing, 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.


Hague quartzite.

See under Hague gneiss.

Hague gas sand.

See under Sheffield gas sand.

Haida member. (Of Queen Charlotte series.)

Cretaceous: British Columbia.


Haiku volcanics.

Pleistocene (late): Hawaii (Oahu Island).


Halley shale.

Upper Cretaceous: Central Wyoming.

S. W. Williston, 1905 (Sci., n. s., vol. 22, p. 504). Halley 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 Halley, in E. part of Fremont Co.]

Probably lower part of Frontier fm.

Haileyburnian.

Pre-Cambrian: Ontario.

Haileybur.v formation.
Ordovician: Ontario.

Haines graufile.
Post-Triassic and pre-Tertiary: Northeastern Oregon (Baker quadrangle).

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 380 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 Is., 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.

In NE. and central eastern Okla. the basal part of Morrow fm. is called Hale ss. memb.

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 thee 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.
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.

Halgalto tongue (of Cutler formation). Also Halgalto 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). Halgalto tongue of Cutler fm.—Red srs. 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 Halgalto 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.

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.

Apparently named for development in Halifax Twp, Brattleboro and Wil­mington quads.

Hall series.
Triassic: British Columbia.

Hall.

Hall Canyon formation.
Pleistocene (lower): Southwestern California (Ventura Basin).
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 Carboniferous belt) Hall City Is. On a later page reference is made to Hall City mines, to which one of the Carboniferous limestones extends.]

Hallett sand.
A subsurface sand, of Pennsylvanian age and 40 ft. thick, in central northern Oklahoma. 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 reports, for marine beds forming upper part of Lykins formation of Front Range, Colo., according to J. B. Reeside, Jr.

†Halymenites sandstone.
Upper Cretaceous: Northwestern New Mexico (San Juan County).

†Hambergian series (also †Hamburgian).

Hambre sandstone. (In Monterey group.)
Miocene (middle): Western California (San Francisco region).

Hamburg limestone.
Upper Cambrian: Eastern Nevada (Eureka region).

†Hamburg shale.
Upper Cambrian: Eastern Nevada (Eureka region).

Replaced by Dunderberg sh., the name Hamburg being retained for the Is.

†Hamburg beds.
†Hamburg clays.
Upper Cretaceous: Western South Carolina.
E. Sloan, 1904 (S. C. Geol. Surv., ser. 4, Bull. 1, pp. 68, 72-73). 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 W. L. Stephenson to be of Upper Cret. age and same as †Middendorf fm. of eastern S. C. (See Ga. Geol. Surv. Bull. 10, 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, Alken Co., S. C.

†Hamburg oolite. (In Kinderhook group.)

Mississippian: Southwestern Illinois (Calhoun County).


Precoccluded. Appears to be same as Glen Park Is. 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 Twp., Marathon Co. It consists chiefly of sl. and sh., but gray-wacke 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 Huronien.

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 †Hamburgian.

†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 coarse 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 Is.—Hard, dense gray or nearly black fossiliferous ferruginous Is., 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.


Hamiton 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 lgs. 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 Is. (where that Is. 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 Leorhynchus fauna; that Cardiff memb. (light-colored) to E. (which he showed is in part contemp. with Oatka Creek memb.) is also characterized by a Leorhynchus 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 Leorhynchus 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 Leorhynchus 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 Leorhynchus zone of Cleland, while still higher (in his Ledyard memb. of Ludlowville sh.) occurs the Third Leorhynchus 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.]


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) Oaka sh., Houchens Creek Is., 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., 1938 (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 antcline 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. 987-9.) Derivation of name not stated.

Hammond fire clay. (In Kanawha formation.)
Pennsylvanian: Northeastern West Virginia.

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. L. 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 ss. 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.
Hampton shale.


M. R. Campbell, 1899 (U. S. G. S. Bristol folio, No. 59, p. 3). (Name proposed by A. Keith.) *Hampton sh.*—Over Unicoi sh. 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 sh. (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. geocogetic 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 Ladson's, 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 Marlton 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 (Southeastern New Hampshire).

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 Wassenville Is. of Washington Co., the Legrand beds of Marshall Co., and the Chapin, Maynas 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 Chaplin 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 Chaplin memb. [pp. 419-431]. In SE. Iowa Hampton fm. is divided into North Hill memb. below and Wassonville memb. above. [p. 386.] Hampton fm. has been proposed for the Kinderhook Is. series exposed in north-central Iowa btw. Sheffield fm. below and Alden ls. above. [p. 387.]


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 epidotlized 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 Is. 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 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. 2893). 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.

A. Keith, 1896 (U. S. G. S. Morristown folio, No. 27, p. 2). *Hancock la.*—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 lss. 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 lss., very sandy at top and bottom, 180 to 275 ft. thick, underlining 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 Hel-derberg 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).


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.
G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). Hanford fm.—Fossiliferous green and red sh. with manganiferous iss., 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 Etchemian series. [Derivation of name not stated.]

Hanging Rock sandstone.
Pennsylvanian: Central western Indiana (Vermillion County).
Named for the Hanging Rock, on Big Vermillion River, Vermillion Co.

Hanging Rock sandstone.
Pennsylvanian: Southeastern Illinois (Wabash and Edwards Counties).
A. H. Worthen, 1876 (IU. Geol. Surv. voL 6, pp. 61-60), described 2 ss. 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 ml. NE. of town of Mount Carmel, Wabash Co.

†Hanging Rock limestone. (In Allegheny formation.)
Pennsylvanian: Southeastern Ohio.
Later repts state that it is same as Vanport Is. 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 ss. are white, gray and brown, massive to thin-beded and cross-beded; the cgl. and conglomeratic ss. 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).
Lexicon of Geologic Names of United States

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 Is. and overlies Louisiana Is. All included in Kinderhook group.

This continued for many years to be definition of 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 Is. forming top part of Lake Valley ls. in Central Mining dist. or Santa Rita-Hanover-Fierrro 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 fma. 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, 103, 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.


Named for exposures in town of Hanover, Chautauqua Co.

Hanoverian series.
Name proposed by C. [R. J. 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.


R. C. Moore, 1930 (Kans. Geol. Surv. Bull. 22, pp. 211-212). Happy Hollow Is. 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 Is. as a fm. in his redefined Wabaunsee group.]
Haragan shale.
Lower Devonian (Helderberg): Central southern Oklahoma.

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.

Harbor Hill moraine.
Pleistocene (Wisconsin stage): Southeastern New York (Long Island).
A. C. Vench, 1903 (Jour. Geol., vol. 11, pp. 762–776), and 1908 (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 Is., 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 Is., although it is probable that in places there is a certain thickness of sh. btw. Iatan Is. 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, 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 Is. 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).

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, 135, 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 graduation into overlying sh. is treated as a memb. of Chattanooga sh. Uncon. overlies Pegram Is. 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 argillaceous 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 Is.

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 Is.] 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 Is. and overlies Golconda fm. Named for Hardinsburg, Breckinridge Co., Ky., which is built on this ss.
Hardin School limestone. (In Wichita group.)
Permiian: 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 nonperslent hard gray Is. 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.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 48, pl. 6). Hardman ("Furnace") fire clay underlies Little Montell coal and overlies Piney Mt. coal in Georges Creek Basin, Md.

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 gneisoid granite and graniteite and Hardwick granite-gneiss (pp. 317-318); Hardwick granite (on map, where it is described as dark thick-beded 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 an extending northward into N. H.]


Hardwick granite.
Devonian: Northeastern Vermont (Caledonia County).


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). Hardstown 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 cel. to qtzite; slaty phase often present in upper part. Thickness 1 to 30 ft. Grades into overlying Wallkill blue Is. [Kittatinny Is.]. Overlies Franklin white Is. Exposed at brook section in Hardstownville and on hill 1 mi. S. of Hardstownville.

H. B. Kümml and S. Weller, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 149-150). Hardiston qtzite.—Was described and named Hardiston 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, how­
ever, and is here proposed. Consists of (descending): (1) Sandy shales (transi­
tion 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 Is. Rests on pre-Camb. crystallines.


Hare Indian River shale.
Devonian: Mackenzie.

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, 1933 (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 is. 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.
Belongs to upper part of Pottsville group.
Named for Harlan Co., Ky.

Harlem gneiss.
Pre-Cambrian: Southeastern New York.
R. P. Stevens, 1887 (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. Cummings 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.

B. 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).

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, as., 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).
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 as. 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.
More or less mottled but prevalingly dull-red or brownish-red argill. and aren. shales and sas., 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.

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.

†Harper's 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.—Cherty 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 ss. which grade in places to egs.: of middle beds composed of an alternation of fossiliferous buff and yellow-brown ss., irregularly bedded calc. ss., 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-beded, 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 cliffs, 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 Is. or Harpeth and Tennessee River group.—Fossiliferous Is. which to W. uncon. separates the black sl. from underlying blue Is. of Nashville group containing Spirifer lyna and its associates. Along Tenn. River consists of (ascending): (1) Thin-bedded fine-grained impure blue Is., 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 Is. containing crinoidal beds, some of lower strata with bright-green points, middle strata banded by reddish layers, which are generally fine-grained, impure, cherty Is. common on the Glades, and upper portion sometimes-affording bluish layers of siliceous Is.; all often of marly nature, easily disintegrating and forming the angular gravel of the Glades.

Includes Pegram, Camden, Harriman, Quail, 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 (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.]


Harricanaaw series.

Pre-Cambrian: Quebec.


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., Quail Is. 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 Is. and lenses of qtzite. Thickness 5,000 ft. Overlain by Tert. intrusives and underlain by Elephant Is. (Penn.). Type loc., Harrington-Hickory mine, SE. of Frisco dist.

Harrington River formation.

Carboniferous: Canada.


Harris moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Chisago and Sherburne Counties).

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=s 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 Is.

Harrisburg gypsiferous member (of Kaibab limestone).
Permian: southwestern Utah and northwestern Arizona.

Harrisburg gypsiferous memb. of Kaibab Is.—Gray, thin-bedded ls. (some of it containing many small angular fragments of chert) and gray, red, and yellow sh., some gyp. Thickness 187 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 ml. E. of St. George, Washington Co., Utah.

Harrisburg Run sand.

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.


C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107). Harrison diorite may be later than Precambriic, 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.

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 Is. 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 Is. 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, 1930 (Geol Mag., vol. 87, p. 487 and map). Harrison Lake fm.—Aggs. and lavas, 9,200 ft. thick, yielding Cylindroteuthia themia. 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. 298). Harrodsburg Is.—Lsg., 60 to 90 ft. thick, with some sh. interbedded; formerly known as Ecrinital Is. Overlies Knobstone group and underlies Bedford oolitic Is. [Spergen Is.].

Correlation with Warsaw Is. (older name) established. (See C. Butts, 1915, Ky. Geol. Surv., 4th ser., 3d Rept., pt. 2.)
P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 310-311), suggested redefining Harrodsburg Is. 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 Is. 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.

Harrogate formation.
Middle Devonian: British Columbia.

Harshberger limestone. (In Conemaugh formation.)
Pennsylvanian: Southwestern Pennsylvania (Somerset County).
F. and W. C. Platt, 1877' (2d Pa. GeoL Surv. Rept. Hg, pp. 222, 223, and pl. 13). Harshberger is., 5 ft. thick, is quarried by Mr. Harshberger. At Forwardstown, Somerset Co., Pa., it lies 8½ ft. below lower is. bed of Berlin is. 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 [Okl.] Bull. 2, pp. 137-140). Hart is. memb.—A series of alternating lss., shales, and ss. 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 is.—Blue shelly is. 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 is.—Ls. which passes under river at Hartford. Separated from underlying Strawn is. by 60 ft. of sandy sh. and from overlying Wyckoff is. 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. Gondra, 1935 (Neb. Geol. Surv. Paper No. 8, p. 11). Hartford (Curzon) is. ls. 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 is. that weathers brown. Where 2 or more beds of is. 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 Dasher ls.

This name was discarded by U. S. Geol. Survey in 1912, because then stated to be same as Topeka ls. (See Kans.-Neb. chart compiled by M. G. Wilmarth, 1936. Also see 1937 entry under Topeka ls.)

Named for exposures at Hartford, Lyon Co., Kans.
Hartford clay.

Hartgrove limestone member (of Talpa formation).
Peronian: 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 Is., lying 1,000 ft. above Coleman Junction Is. Is here named Hartgrove mem., 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 4.6 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.

Same as Hoosac schist, the older name.
Named for development in Hartland.

Hartland shale member (of Greenhorn limestone).
Upper Cretaceous: Western Kansas.

Named for exposures along Arkansas River from a short distance W. of Hartland, Kearny Co., to Kendall, Hamilton Co. The name was formerly classified by U. S. Geol. Survey as Archean (?), but “Archean system” having been discarded the fm. is now classified as pre-Camb.

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 Is.—Gray mottled Is. in thin beds, with shaly partings; some oolite toward top. Thickness 650 ft. Conformably underlies Bowman Is. 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).


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 ss. To S. and SE. of Willis 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 Tuscaloosa Is, above and Landerdale 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 ls. and overlies Tuscaloosa ls. Consists of massive ss., underlain by variable ls. and interchangeable calc. argill. shales (in one place mostly ls., in another place mostly shales), in places 150 ft. thick; at base variable ss. [As thus defined his Hartselle ss. group included the ss. 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) Hartsell ss. memb., 100 to 200 ft.; (4) sh., 50 ft.; (5) ls., 100 ft. Rests on Fort Payne chert. [As thus defined Hartsell 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 Tuscaloosa 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 Hartselie, Morgan Co.

Hartshorne sandstone.

Pennsylvanian (Allegheny): Eastern Oklahoma and western Arkansas coal field.


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.

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.

ls., 4 to 35 ft. thick, is "Hartsville bed" of Price.

ville beds included in Jeffersonville ls. (Dev.).

Named for Hartsville, Bartholomew Co.

Hartville formation.
Pennsylvanian and Mississippian: Southeastern Wyoming (Hartville up­
lift).

Hartville fm.—Massive gray ls., some beds containing chert nodules, with occasional
beds of white, gray, buff, and red ss., compose most of fm. In lower part red sh.
and gray ls.; at base 50 ft. of red quartz streaked with white. Total thickness
650 ft. Conformably underlies Opechee 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 re­
sults of a detailed lithologic, faunal, and correlation study of HartvUle fm.,
which they divided into 6 unnamed units, the upper one of which they concluded
is probably Penn.; 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.

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 Hart­
well, 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.

Dol., 80 ft. thick, composing next to top fm. of Niagara series. Overlain by
Monticello dol. of Niagara series, and underlain by Colesburg dol. of Niagara
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.


B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). Harvard cgl. underlies Worcester cgl. (phyllite) and overlies Worcester qtzite [Oakdale qtzite].


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 ss., but of several kinds of ss. The interstitial matter is fine clay ss. 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.


Harveyville shale. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. R Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). Harveyville sh., middle memb. of Preston ("Emporia") Is. 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 Is. and overlies Reading Is. [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 Is. and underlying Elmont Is. 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.

Haskell sand.

Haskew gypsum member (of Blaine formation).
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., H. 19 W.
S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434-437). Haskew memb., not previously recognised, should be accepted.

Haskell sand.
See Haskell sand.

Haslam formation.
Upper Cretaceous: Vancouver Island, British Columbia.

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 Lbn 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.
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, 1831) 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.
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.
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.


Hatchetligebee 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). Hatchetligebee series.—All strata btw. base of Buhrstone [Tallahatta fm.] and uppermost of Wood's Bluff fossiliferous beds [called Wood's Buff or Bashí 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 Lignite [Wilcox group]. Overlies Wood's Buff or Bashí 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 Hatchetligebee Bluff, on Tombigbee River, in NE. part of Washington Co., Ala.

Hat Creek beds.
Oligocene (middle) : Wyoming.

Hathaway formation.
Upper Pliocene or lower Quaternary (mapped as Pliocene) : Southern California (San Bernardino Mountains).
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.


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 phytoalgae remains—almost lignitic. This is the Hattiesburg phase or fm. Extends into Ala. and has been traced across 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 ½ 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.

Haun's Bridge group.

Upper Devonian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T., 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] clg. 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.
See also Habana fm.

Havasupai sandstones.
Permian: Northern Arizona (Grand Canyon).
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 (Neb. Geol. Surv. Bull. 6, 2d ser., p. 32). Havens­ville sh.—Middle memb. of Wreford Is. 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 Is. and underlies Schroyer Is. [R. C. Moore (1936) replaced Fourmile Is. with Three-mile Is., but Nebr. Geol. Survey continues to use Fourmile Is.]

Hawaiiloa volcanics.
Pleistocene (late): Hawaii (Oahu Island).

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. 206, 1913) that Niobrara terrane in above definition is a bed much higher in section than so-called Niobrara chalk of Iowa as recognised 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.

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, 1904 (U. S. G. S. Mount Stuart folio. No. 106). Hawkins fm. (Carb.?) makes up rugged peak known as Hawkins Mtn, Mount Stuart quad. Is younger than Easton schist. Assigned to Carb. (?)

Hawkins limestone.

Cambrian: Southwestern New Mexico (Grant County).

C. [R.] Keyes, 1915 (Iowa Acad. Sc. Proc., vol. 22, pp. 257-259; Conspectus of geol. fras. of N. Mex., pp. 4, 9). Hawkins las.—Important calc. beds of Mid Cambrian age intercalated in basal section of quartzites 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 Albian 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 ml. 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. Agee, 1934 (Am. Jour. Sc., 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. 364-373.

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 ml. long and 3 ml. 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, 328). Hawthorne beds.—Beds of phosphatic rock, more or less broken up and inclosed in a younger matrix, overlying Vicksburg Is. at "Devil's Millhopper," near Gainesville, Gn., 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, 1906] 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 Hawxby shale, the approved spelling.

Hawxby shale.

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.


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.)


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 Eaton 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).


_Hay Creek_ coal fm.—In Hay Creek coal field, Crook Co., Wyo., consists of (descending): (1) Massive ss., ochre 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 ss. 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 Doton 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).


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.


**Hayfield shale.**

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).


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 ss., which for distinction we will rename Hayfield sh. (and is.).""] He also mentioned the thin Cussewago (Hayfield) is. beneath the Hayfield sh.]}
K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 292), 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 ss. and shales, locally associated with coal, and probably extending 10 ml. nearly E. and W., with width of about 1 ml. Contain Tert. fossils and are probably of upper Mio. age. In one place casually alluded to them as 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. 689Y, 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.]
Haymond formation.  

Pennsylvanian (Pottsville): Western Texas (Marathon region, Brewster County).  


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 uncertain. It appears to be exact lithologic counter-part of the Tesnus. It may be overthrust on the 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, 1933 (Nebr. Geol. Surv. Paper No. 2), used Plummer Is., in Iowa, for the beds formerly called Haynies Is., and stated (p. 5): The "Haynies Is." memb. of the Deer Creek, according to Condra and Moore, is the Plummer Is. of Okla.  

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 186). Haynies memb. seems exactly to correspond to upper bed of Plummer Is. as originally defined, and it is possible Rock Bluff Is., Larsh sh., and Haynies Is. together are=original Plummer Is. [On p. 187 he stated:] Because sh. btw. Ervine Creek Is. and Rock Bluff Is. in Kans. appears to be exactly=Larsh sh., Haynies Is., and Mission Creek sh. of Nebr. It is here called Larsh-Mission Creek sh. memb. of Deer Creek Is. It is 2 1/2 to 7 ft. thick. [He omitted Haynies Is. from this 1936 classification for Kans.]  

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Also see 1937 entry under Topeka Is. for Condra's latest views.  

†Hays limestone member (of Niobrara formation).  

Upper Cretaceous: Western Kansas and eastern Colorado.  

See explanation under Fort Hays Is.  

Haystack rhyolite.  

Devonian (?): Northeastern Maine (Aroostook County).  


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).
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.
memb. is provisionally considered = Ferguson gyp. memb.
Named for Haystack Creek, Greer Co.

Hayward sandstone member.
Permian: Central northern Oklahoma.
786–790). 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 Falmont sh.
mem. of Hennessey sh. Named for exposures at Hayward, Garfield Co.

Hazel slate. (In Chilhowee group.)
Cumberland (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.
Red ss., 500 ft. thick, in Diablo Mtns. Uncon. overlies schists and underlies heavy-
bodied to flaggy cherty or siliceous lss. of various colors, which are supposed to
be Algokian 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). Hazelton (Por-
phyrite) 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 greenschist, 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.
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. Edy 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.

†Hazel 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). Hazel 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).


Headquarters schist.

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

E. Blackwelder, 1928 (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 metaqtzite, metamoldomite, 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).


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.


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 (Jour. Geol., vol. 43, pp. 1016–1032). Heath fm.—Black, petrolierous 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 Duren 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.


Hebron gneiss.


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 flesile 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. 34, 1904, p. 63; and P. P. 106, 1918, both by W. C. Alden.)

Hecla sandstone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.


W. Stout, 1918 (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.

Hectozolc.
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).
trachyte.—The mass constituting Hedgehog Mtn, Aroostook Co.*

On 1933 geol. map of Maine, by A. Keith, the trachyte of NE. Me. appears
be included in Dev.

Hedges shale. (Of Pocono group.)
Mississippian: Northeastern West Virginia.
*Hedges sh.—Dark-gray to black carbonaceous sh. containing thin seams of anthra­
cite 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.
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.*

Heebner sh. of Bull. 1 Nebr. Geol. Surv. is Galesburg sh. memb.
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.]*

*Hefty fm.—Chiefly heavy-bedded red or reddish-gray ss. and qtzite 776 ft. thick.
Underlies, with some abruptness, MacDonald fm. and conformably overlies Altyn
fm.*

Heidlersburg member (of Gettyburg shale).
Upper Triassic: Southeastern Pennsylvania.
and ss. with some green, gray, and black shales, interbedded with which are many
harder gray to white ss. Numerous intrusions of diabase have altered some strata
to hard white porcellanite and to white, open-textured sandrock of light weight.
A little of the altered sh. is dark-purple 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.


Named for Banning Heights, Riverside Co., which it floors.

Heiskell shale.

Lower Ordovician (Chazyian): Southwestern Virginia and northeastern Tennessee.


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 ss. of Conrad, 1839, was defined as resting on Helderberg lss., as underlying the "gray brachlopodous ss." (which is overlain by black s.), 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 reports. In their Helderbergian they included at top 250 ft. of beds (called "Kings- ton 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 ss. 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 ss. "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.


Helena limestone.

Pre-Cambrian (Belt series): Western central Montana (Belt Mountains).


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.

Helena 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, 125, 155–166, 199). *Hellam qtzite* is name adopted by Frazer in his York Co. rept. (C) 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.


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. 53, pp. 829–835). *Hell Creek beds.*—Fossil-bearing, fresh-water deposits of alternating sss. and clays 500 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.
The Hell Creek member of the Lance Formation, as here defined, is typically exposed on Hell Creek, Garfield Co., Mont., and includes "Hell Creek beds" plus "lignite beds" of Brown (1907), occupying the interval between the Fox Hills member below and the yellow Tullock member of the Lance above. It is overlain by either Ludlow lignite member of the Lance or the contemporaneous Cannonball marine member of the Lance, and rests on Fox Hills member. It consists of somber, badland clays, probably accumulated in topset swamps of a great delta, and fluvial silt and sand, the latter being more numerous and conspicuous toward SW. Remains of a few small mammals have been found in the beds. 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 calcareous in contrast with the brown member of Fox Hills and older rocks, which are relatively free from lime. In Cedar Creek anticline, Mont., the Hell Creek member overlies Colgate member of Fox Hills member; at mouth of Cannonball River, N. Dak., it rests on Fox Hills member. [Diagram on p. 484 shows no unconformity above or below Hell Creek member.]

These rocks are now called Hell Creek Formation by the U. S. Geol. Survey, and classified as Upper Cretaceous, as explained under Lance Formation, 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. 37-54). *Heller dacite.* Vesicular glassy dacite containing numerous inclusions (sometimes large boulders) of pumiceous material, frequently of later andesite, and occasionally of coarse silicic granite. Composes Heller Butte, near town of Tonopah. It 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 contemporaneous with Esmeralda Formation (upper Miocene).

**Hellgate Formation.**

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deles, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 679, figs. 2, 5). *Hellgate Formation.* Type section (on N. side of Mount Sentinel, the S. wall of Hellgate Canyon) consists of (descending): (1) Massive, gray-red siliceous quartzite, weathering variegated gray, buff, and lavender, 365 ft.; (2) massive gray and red gray fine to coarse-grained finely banded pure quartzite and sandy quartzite, ripple marked, 280 ft.; (3) massive thick-bedded pink-gray quartzitic silt, weathering buff, 1,160 ft.; (4) massive, gray, fine-grained, siliceous quartzite, ripple-marked, weathering buff, 300 ft.; (5) massive red-gray coarse-grained quartzite, with sandy beds up to 3 ft. in thickness, weathering buff and dull lavender, 95 ft. Conformably underlies McNamara Formation and unconformably overlies Miller Peak Formation; 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 porphyroplastic 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-Cambrian. "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."
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 contemporaneous 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, 295–296, 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 is. 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 Ajbik gSlate 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. 184) changed name to Hemlock greenstone, and stated that it is of Algomanian type.

Hemphill shale member.

Mississippian: Northwestern Pennsylvania.


Hemphill beds.

Pliocene (lower): Texas Panhandle (Hemphill County).

L. C. Reed and O. M. Longnecker, Jn., 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.
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).


F. G. Wells, 1935 (Geol Soc. Am. Proc. 19, 34, 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 quadr. 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.


Hendricks series.

Hendricks member.

Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).


Hendricks sandstone.

Upper Devonian: Northern West Virginia.


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.

Henley shale member. (In Cuyahoga formation.)
Mississippian: Southern Ohio.

Named for Henley, Scioto Co.

Hennessey shale.
Permian: Central Oklahoma.
P. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786-789). 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.
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 Blen.) and 1935 (58th Blen.) 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.
Henry 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.
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 ls., 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, cgs., and shales, with carbonaceous shales and lignitic coals. Thickness 000 ft. Underlies Sulphur Creek group and overlies Flaming Gorge group. Type loc. ls 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. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1986 (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 (?) sh.*

Hensell sand. (In Travis Peak formation.)
Lower Cretaceous (Comanche series): Central Texas.

Named for Mr. Hensell's place, at Travis Peak post office, Burnet Co.

Henshaw formation.
Pennsylvanian: Northwestern Kentucky (Shawnetown quadrangle).

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 cgl. 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.

Herat shale member (of Ochre Mountain limestone).
Mississippian (upper): Western Utah (Gold Hill district).
Herat sh. memb. of Ochre Mt is.—Thin and poorly exposed horizon of black sh.
interbedded with ss., lying 1,700± ft. above base of western facies of Ochre Mt is.
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).
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 Whltwell 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).
sh. memb. of Monterey fm., underlies Quercan ss. in San Pablo region. [Derivation
name not stated.]

Replaced by Hercules sh. memb.

Hercules shale member (of Briones sandstone).
Miocene (upper): Western California (San Francisco region).
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.
W. W. Atwood, 1911 (U. S. G. S. Bull. 497, pp. 25, 39, etc.). Herendeen la.—
Aren. ls., 800 ft. thick, light-gray, locally cross-bedded. Exposed from Herendeen
Bay to Port Moller. Underlies Chignik fm. (Upper Cret.) and overlies Stanluko-
vich sh. Contains Lower Cret. fauna.

Herington limestone. (In Sumner group.)
Permian: Eastern Kansas, central northern Oklahoma, and southeastern
Nebraska.
Variable ls., including, in upper part, soft, goodiferous, baggy 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 Marlon stage.
“Marlon fm.” abandoned and Herington la. elevated to rank of a fm. in Sumner
group. Overlies Enterprise sh., probably with slight uncon., and underlies Welling-
ton 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 Is.; greatly restricted Wellington fm.; applied Paddock sh. to beds immediately underlying Herington Is.; and treated Herington as top memb. of his Nolan ls. (new). These changes have not yet been considered by U. S. Geol. Survey for its publications.


Herkimer sandstone.
Silurian: Central New York.
G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327-368). Herkimer sh.—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 ml. 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).

Herman Creek lava.
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 (andesite 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).
R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14, geol. ser. 11, p. 22). The Calclferous 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. 28, 28, 64+). Hermit sh.—Deep brick-red sandy shales and fine-grained friable ss., 287 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 prevalingly 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 Base 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 Is. and gray or bluish sh. in lower third, and heavier-bedded siliceous subgranular Is., more or less strongly phosphatic, in middle and upper parts. Thickness 40 to 70 ft. Of early Trenton age. Uncon. overlies Carter's Is. and underlies Bigby Is.

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* (Carb.), 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 Is.; middle part is many bands of massive dark-gray Is., often highly fossiliferous, alternating with sss. and cgs.; lower part is greenish-gray sss. and shales, the latter sometimes nearly black. Thickness 1,800 ft. Underlies Rico fm. and overlies Dev. Is. 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* Is. 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 Is.

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. P. 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. 86 well, which first produced from this sand.

Hernshaw sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

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, 1906 (Sci., n. s., vol. 24, pp. 487-489). **Herod gravel** (glacial) occurs at nearly all points from Long Island to Boston.


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.


**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 Is. cap rock of Herrin No. 6 coal, which I shall call the **Herrin Is.**, since it is so commonly associated with Herrin coal, is an impure, earthy dark-gray, dirty-looking Is. that breaks with a solinitery fracture. Where exposed along streams it spills off in angular fragments showing little structure. Contains fossils.


**Herschel quartzite.**
Mesozoic (Lower Cretaceous?): Southeastern Arizona (Tombstone district).


F. L. Rausome, 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.

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, 1903 (U. S. G. S. Bull. 211, pp. 34, 35). Hertha ls. is here introduced for the ls. 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 bille 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.].


For many succeeding years the definition of Hertha ls. was for the ls. overlying Dudley sh. and underlying Ladore sh.

B. 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 ls. 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. Critter 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 Is. 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 tntu bedded, but also contain several layers 5 to 10 ft. thick; a good part of is. is oolitic; some sss. and shales, mostly in lower 400 ft.; is. cgl. 10 to 40 ft. thick at base. Color of shales and is. 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 Captank 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 is., prevalently 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 is. 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, 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 is. memb. of Leonard fm.

Hesse quartzite. (In Chilhowee group.)


A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). Hesse sk.—Fine white massive is., 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.
Lexicon of Geologic Names of United States

Heumader shale. (In Oread limestone.)
Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.
R. C. Moore, 1938 (Kans. Geol. Surv. Bull. 22, pp. 48, 167-188). The few ft. of sh. that lies btw. base of Kereford Is., 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. = Tribs 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] Tribs 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 dsc. 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.

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 fusoidal 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 Vermillion 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 ss. 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, Twp s 12 N., Rs. 100 and 101 W., Moffat Co., Colo.


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 Lignite 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 Lignite.]

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. 1x1, 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.

Hickey 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.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 69, 71-72). Plattsburg is divided into 3 members (descending): Spring Hill is. memb., Hickory Creek sh. memb., and Merriam is. memb. The Hickory Creek memb. consists of 1± ft. of black carbonateous 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 is. 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).


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 is. 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 is., with interbedded layers of thin dark-colored is. similar to that in the Gardner, and at least one bed of dense carbonateous sh. Fossils abundant.

G. G. Olmstead, 1921 (Econ. Geol., vol. 16, pp. 443, 452, 453). The Upper Pine Canyon is. in Ophir dist. is locally known as Hidden Treasure is. It consists of 290 ft. of rather pure is. showing many fossils and some chert nodules. The Lower Pine Canyon is. is locally known as Chicago. It consists of 390 ft. of rather dark-gray blocky is., 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 is. 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 is. throughout.

**Higham grit.**

Triassic (?): Southeastern Idaho.


G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 8, pp. 32, 41). Higham grit memb.—Coarse white to pinkish gritty or conglomeratic is., the component particles of which are coarse and subangular. Locally is almost qtzite. Thickness 500± ft. Basal memb. of Nugget is. in Fort Hall Ind. Res. Underlies Deadman is. memb. of Nugget and conformably overlies Ankareh is. [later named Timothy is.]. 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 is. to upper part (“main is. memb.”) of Nugget is. as recognized by him in previous repts; (3) introduced Timothy is. to replace Ankareh is. as used by him in previous repts on SE. Idaho; and (4) reported the Higham as resting uncon. on Timothy is. This is present generally accepted definition of Higham grit.
**High Bluff blue sands.**

Upper Cretaceous (Gulf series): Southwestern Arkansas.


*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.


**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.**


**Highbridge limestone.**

Lower and Middle Ordovician: Central Kentucky.


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. 8, 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.


In 1907 (N. Y. State Mus. Bull. 107) Hartnagel gave thickness of *High Falls sh.* at Cornwall as 118 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. F. Berkey, 1911 (N. Y. State Mus. Bull. 149), described *High Falls sh.* as consisting of 67 to 100 ft. of greenish to red argill. to sandy sh., "exposures often brilliant red."

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 ss. 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 Blannewater 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 ¼ to ⅛ 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 or 2 ft. 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 Parrandesides 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."

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, 855-869), described the rocks of Highgate Springs region, but did not definitely name them.
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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 lls. and serpentinous beds, the whole abundantly interjected with sheets, stringers, and dikes, of igneous rocks of many varieties and different dates. Assigned to pre-Cambrie.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, pp. 22, 28). The pre-Camb. Highlands gneiss, Inwood Is., 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 Kerrlck morainic system (including Cromwell and Wright moraines).

Highland formation.

Upper Paleozoic (?): British Columbia.


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 marbles. 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. 31-42). 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 contemporaneous 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 quadr.). 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. 1047, 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 dolomite beds. Thickness 3,000 ft. Conformably overlies Chisholm chs. and conformably underlies Mendha ls. Named for Highland Peak, in Highland Range, in whose W. slope the ls. is best shown. Composes main part of Bristol-Highland Range from S. edge of Highland quadr. 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 chs. 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 lss. and cgs. lying either on granite or on a thin rhyolite flow, the cgs. characterized by pebbles of extremely hard Algonkian quartzite, granite, and gneiss. No fossils; but bed. 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.

J. M. Clarke, 1885 (N. Y. State Geol. Rept. for 1884, p. 22 and map; also U. S. G. S. Bull. 18). 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) ss. 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 ss. and the beds above it the Prattsburg ss. and sh.; and described High Point ss. as follows: Consists of 100 ft. of light-gray ss., 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.; ss. 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 ss. 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. 309, 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’s 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. 23rd 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).

L. 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 sf.
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.


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, 1898 (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 pyrites 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.


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.
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.
A. C. Veatch, 1907 (U. S. G. S. P. P. 56). Hilliard fm.—Gray to black sandy shales and shaly ss., 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).

Hill Quarry beds.
Upper Ordovician: Southwestern Ohio and north-central Kentucky.
B. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 370-387). Hill Quarry beda.—Alternating beda 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 beda (topmost fra. 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, 9 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. Schilhaba, 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 Niagara 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 Niagara dolomites. The other exposures are of ss. resting on either the Greenfield or the Niagara 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.
Hillsborough series.
Carboniferous: New Brunswick.

Hillsdale limestone. (In Greenbrier limestone.)
Mississippian: Southeastern West Virginia and southwestern Virginia.

Hilton shale member (of Portage formation).
Upper Devonian: Southwestern Virginia and northeastern Tennessee.

Hinche formation.
Pliocene: Haiti.

Hinchman sandstone.
Upper Jurassic: Northern California (Taylorsville region).
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.

Named for exposures at Curtice Cliff, in lower part of Hinchman Ravine, Plumas Co. As.

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. 333-337). Hinckley sandrock (Potadom?), 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.].
N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 16). Hinckley ss.—White ss. and cgl., varying to red, interbedded with much red sh. Thickness 1,000 ft.
N. H. Winchell, 1901 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 8, 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.]

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 ss. 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 ss. The *Hinckley ss.* is a thick coarse red to brown ss., which often contains much partly 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 be 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 ss. 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 ss. 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 ss., 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 as at least 1839 (2d Rept. Geol. Surv. Ind., pp. 8, 10) but not in stratigraphic sense.

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 Is. memb. of Batesville ss.**—Dark-gray Is. interbedded with some ss. Thickness 1\(\frac{1}{2}\) to 50 ft. In all previous repts on northern Ark. has been included in underlying Boone Is., 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 Is. and is oldest fm. in Berkshire Hills and Connecticut Valley. [See also B. K. Emerson, U. S. G. S. Bull. 597, 1917.]


**Hinsdale limestone.**

Pre-Cambrian: Western Massachusetts.

B. K. Emerson in 1892 used Hinsdale Is. 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 Is.**—Coarse white to pink, highly crystalline Is. with coccolite or chondrodite so abundantly and evenly scattered through mass that it deserves name coccolite Is. or chondrodite Is. 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 Is.

**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.
Hinsdale sandstone.

Upper Devonian: Southwestern New York (Cattaraugus County) and northwestern Pennsylvania.


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 ml. 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 sandstone.—Sst., 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 sst."]

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 division.—Consists of (descending): (1) Sponge bed. of slaty structure, 15 to 20 ft.; (2) sandy calc. shales or slaty 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 lss. 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 formation.—Heterogeneous mass of variegated shales, sst. of varying character, and impure lss., ranging in thickness from 1,050 to 1,100 ft. Lowest bed is heavy sst., 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 Roger.
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.


Hinton group.

A name that has been applied in some repts to Hinton fm. (Miss.).

†Hinton limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.


Hinton (Upper) limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.


Hinton sandstone.

Mississippian: Southern West Virginia.


†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 Is.**

Hitka formation.

Cambrian: British Columbia and Alberta.


Hitz limestone member (of Saluda limestone).

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

A. F. Poerste, 1903 (Am. Geol., vol. 31, p. 347). In repts of bed. 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 Is. because originally included in Saluda. In Jefferson Co., Ky., is 5 ft. thick and almost pure blue Is. According to E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 433), the Hitz Is. belongs to Whitewater fm. and not to Saluda. (See under **Saluda Is.** 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.


Hiwassee sl.—In this region the fm. consists almost entirely of bluish-gray or bluish-black slts, which weathers to greenish, yellowish gray, and yellow. The slates are interstratified at intervals with lenticular layers of blue or dove-colored Is. 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 cgs. 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).


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 Is. [in strat. table]. Hobo Gulch lime-sh. [in text heading].—Shaly Is., including characteristic Is. flags. Corresponds in position to Pilgrim Is. Consists of (descending): 35 ft. of “crinkled Is.” (banded cherty Is.); 100 ft. of nearly black Is.; 18 ft. of sh., with no marked characteristics, that may—Park sh. Overlies Starmount Is. and underlies Cemetery Is. 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.


Hochelangan 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). Hochelangan 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 Hochelangan 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.

Includes Cuyahoga fm. and lower part of Black Hand fm.

Hockley Mound sand member (of Willis sand).
Tertiary? (Pliocene?): Southeastern Texas and southern Louisiana.

Hodges shale member (of Bloomington formation).
Middle Cambrian: Northeastern Utah and southeastern Idaho.
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).

Hoffman limestone. (In Conemaugh formation.)
Pennsylvaniaian: Western Maryland ( Allegany and Garrett Counties) and northern West Virginia.
C. K. Swartz, 1922 (Md. Geol Surv. vol. 11, p. 67, pl. 6). Hoffman Is., 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.)
Pennsylvaniaian: Western Maryland ( Allegany and Garrett Counties).

†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 Hillard fm.). These sss. are probably in Adaville fm.
Hogback schist.
Pre-Cambrian: Central southern Maine (Waldo County).

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 1936 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.


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 memb. of Mineral Wells fm. [This ss. lies within East Mtn sh. as originally defined.]

Hogshooter limestone.
Pennsylvanian: Northeastern, central northern and central Oklahoma.


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 108 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 ss. 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.


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 ml. 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-Tembleor Mio. or Olig.; (3) gray ss. with a few sandy and cgl. lenses, 1000 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-Templeor 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. Stainton, 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 Niagara time.
and that it appears not to have been laid down over extensive area, because many wells pass from Niagara Is. directly into Maquoketa sh. See also under Hoing ss., 1935 entry.

Hoko formation.
Pliocene (?): Northwestern Washington.


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 ss. with a few sh. intercalations; the ss. dark gray on fresh fracture and contains black specks and mudstone pebbles; all weathers dark red and changes laterally to massive cross-bedded ss. Top memb. of Moenkople 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 gypiferous shales of the Moenkople.

Holden group.
Pennsylvania: Northwestern Missouri.

Is lower part of Pleasanton fm. Named for exposures at Holden, Johnson Co.

Holdenville shale.
Pennsylvania: 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 iss. and ss., 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 thickness 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. Luga, 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 mem. — 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. is., mud-cracked and ripple-marked, 75 ft. Overlies Sisyh 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.


G. C. Martin, 1928 (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 as. occupies same position in series as Sylvania is.

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).


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 ml. 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, 1938 (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 Cambrian section in Utah. (Derivation of name not stated.)

Hollis quartzite.
Pre-Cambrian: Eastern Alabama (Lee County).

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 it is lithologically similar to Niagaran of northern Miss. Valley. Differently lithologically from the uncon. overlying Ediger is. In 4 wells overlies a coarsely crystalline pink and white crinoidal is., 10 ft. thick, resembling Chimney hill of Okla. Was named by F. A. Bush, unpublished paper delivered before Tulsa Strat. Soc. in 1933, in which Ediger is. 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 is. lentil. Southward from outcrop this red series thins within a short distance, and is represented in La. by lse. form part of Glen Rose is. 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 is. lentil and are overlain by DeQueen is.

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 prevalingly sands, coarse-grained, cross-bedded, white to yellow, red, or purple; micas; 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. El. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 43). Holmesville sh.—Basal memb. of Doyle fm. Type loc. 1½ ml. W. and ¾ ml. N. of Holmesville, Gage Co., Nebr., where it consists of (descending) : (1) Gray, red and gray, argill. sh., 10 or 11 ft.; (2) blocky is., 1 ft.; (3) gray sh., 7 ft. The is. persists for a considerable distance into Kans. Thickness 20½ ft. in
Holmesville moraine.


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 Is." The name does not appear in columnar section or in text of this folio, but marble beds in Chickamauga Is. 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 it is mapped under name of Holston marble. Is 600 to 850 ft. thick near Clinch Mtn. and thins in all directions from that area. The position of the marble beds in the Is. varies much from place to place. Usually there is considerable thickness of blue and gray Is. 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 Is.

Later repts define Holston marble as underlying Athens sh. and uncon. overlying Lenoir Is. Ulrich (1929) stated that in places in E. Tenn. and SW. Va. his newly proposed Whitesburg Is. 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 Is., 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.


Holton moraine.

Pleistocene (Wisconsin stage): Northwestern Minnesota.

Holtsclaw sandstone.  (In Osage group.)

Mississippian: Western and northern Kentucky and southern Indiana.


E. R. Cumings, 1922. [See under Rosewood sh.]


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. 466-470, 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 massive. 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 migmaitite. 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 (Mich. Geol. Surv. Rept. 1891 and 1892, pp. 63-66). Holyoke fm.—Qtzite with cgl. at base. Uncon. underlies Negauance 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.


Holyoke diabase.  (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.


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 Huronian): 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).
Pennsylvania: Central and central northern Texas.
C. S. Ross, 1921 (U. S. G. S. Bull. 7263, 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 pre-occupied. 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, 30; 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 Is. 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).
Pennsylvania: Central southern Oklahoma (Pontotoc County).
G. D. Morgan, 1924 (Bur. Geol. [Okl.] 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 Is.; constituting a reef of Chaetetes in NE. part of Stonewall quad. To S. Fusulinas appear in the Is., become abundant, and the Is. finally changes to almost a pure Fusulina Is. Is in lower part of Holdenville fm., 17 to 70 ft. below Sasakwa Is. memb.
Homestake limestone.
Carboniferous: Southwestern Utah (Iron Springs region).

Homestake formation.
Pre-Cambrian: Southwestern South Dakota (Lawrence County).

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 ls., 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). Jedmont (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.

†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. (Perm.), 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.


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.


Honaker 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 limestone.

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 Is. 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 Is. and Yeso as originally defined and heretofore used.)

Honerline limestone.

Miners' local name for an ore-bearing Is., 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., pp. 60-68, 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 pear Fair Grounds, but no division can be made. Montrose ss. is a term I have freely employed in my township repts., uncertain how much of the section in hilltops round 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.]


B. Willard, 1938 (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).


H. D. Mieer, 1926 (Okla. geol. map), followed Taft's original definitions of Arbuckle ls. and Reagan ss. and included this ls. in Arbuckle ls.

B. 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 egl., probably intraformational, (the *Ptyohaspis* zone), which is absent ¼ mi. E. of Honey Creek. The lower part consists of 60 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 Iss. Trilobites of *Pterocephalus* zone are abundant in lower 20 ft., and *Eororbites* zone next above; also a layer with crinoid fragments near base and another or two in upper third. In this section the Honey Creek ls. 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 Iss. that form basal part of Arbuckle ls. as defined by Taft in Wichita Mtns, Okla., but in Arbuckle Mtns, Okla., older Iss. come in below the Honey Creek. The latter is 124 ft. thick at type loc. It does not include the 60 ft. of calc. Iss. which Taft 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.


**Honolulu volcanic series.**

Pleistocene (middle? and late) and Recent (?): Hawaii (Oahu Island).

H. T. Stearns, 1933 (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:


Basalts and pyroclastics of Koko fissure:

Kaupo basalt. Koko volcanics. (Overlie Kalama volcanics.)

Kaohkiaipu volcanics. Koko volcanics. (Overlie Kalama volcanics.)

Tuff. basalt.

Kalama volcanics. Manana tuff.

Contemporaneous "pyro-explosion deposits. Locally called "black sand.""

Do not occur near Honolulu.

Recession of sea to present level.

Late and middle (?) Pleist. lavas and pyroclastics. (Probably all post-middle Pleist.)

Lavas and pyroclastics of Waipio (60±-foot) stand of the sea and Waimanalo (+25-foot) stand of the sea:

Punchbowl volcanics:

basalt.

tuff.

Castle volcanics. Kamanuiki basalt.

Black Point basalt. (Overlies Diamond Head tuff.)

Mauumae volcanics.

Kaimukl volcanics. (Rest on Diamond Head tuff.)

Diamond Head tuff.

Training School volcanics.

Maunawill 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 Lale (+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.

Altamaniu tuff.

Haiku volcanics:

basalt.

tuff.

Kalihi volcanics.

Rocky Hill volcanics.

Mokulea basalt.

Mokapu basalt.

Hawaiian 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. 584). *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, 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 ml. 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).


**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, 1898 (U. S. G. S. Holyoke folio, No. 50; also C. 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.)

Hoosier shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.


G. E. Condra, 1935. (See under Bader la.)

Hoover division.

Upper Cambrian or Lower Ordovician: Central Texas.


Is a part of Ellenburger Is.

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. ss. 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 Is. 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 Summer group.)

Permian: Central Kansas.


Named for Hope, Dickinson Co.
Hopewell sandstone.
Carboniferous: Canada.
H. M. Aral, 1900 (Canada Rec. Sci., vol. 8, p. 102).

Hopewell formation.
Pleistocene: Jamaica.

Hopkinton dolomite.
Silurian (Niagaran): Eastern Iowa.
T. E. Savage, 1906 (Iowa Geol. Surv. vol. 18), included in Hopkinton "stage" the "Cerionites and crinoid beds," overlying the *Pentamerus oblongus* beds.

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. S. 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. fosalla. 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 West Wrentham, ½ mi. S. of West Wrentham village, just N. of Rhode Island bdy. Overlapped by Wamussutta fm. (Carbt.).

**Hordes Creek limestone lentil (of Admiral formation).**
Permian: Central Texas (Colorado River region).

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 *Scowet*, 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.
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 12 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).


E. H. Sellards, 1933 (Univ. Tex. Bull. 3222, 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.

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. 318). "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, ss., 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. ss., 200 to 300 ft. thick. No fossils. Assigned to Tert. (Mio. ?). Thickness of fm. 1,000 to 2,800 ft. Graded 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 1930) of the Overton as Cret. and Tert. (f); and, because of physical relationships of the Horse Spring to the Overton, the age designation of the Horse Spring was changed to Tert. (f).

†Horsetail Creek beds.

Named for Horsetail Creek, Logan and Weld Counties.

Horsethief sandstone. (Of Montana group.)
Upper Cretaceous: Northwestern Montana and southern British Columbia.

Type loc. is Horsethief Ridge, Blackfoot quad.
Horsethief formation.
Pre-Cambrian: British Columbia.

Horsethief Creek formation.
Pre-Cambrian: British Columbia.

Horseshotch 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.]
[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 Carb. and Millstone grit fm. of Canada, Canada Geol. Surv., 1873).

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 Paleozoica. [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 sl.

Hoskindini tongue (of Cutler formation). Also Hoskindini 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). Hoskindini tongue of Cutler fm.—Red ass. 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 Hoskinnini [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, 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 N line of Spring Creek Twp, Warren Co. Probably same as Wrightsville cgl.

K. E. Caster, 1934 (Bulls. Am. Pal. vol. 21. No. 71. p. 93). Relation of Hoamer 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, 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 ls. 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, ss., 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.

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.


Hota Conglomerate. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble. 1914 (U. S. G. S. Bull. 549). Hota Conglomerate.—Arkose 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 (Algoman). Conformably overlain by Bass Is. Named for Hota 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 Springs fm., 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 deposits.

Hot Springs sandstone.

Pennsylvanian: Southwestern Arkansas (Hot Springs quadrangle).

A. H. Purdue, 1910 (Jour. Geol. vol. 18, pp. 282-283). Hot Springs Sandstone.—Gray quartzite sandstone 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. 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.


R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), transferred Houchen Creek Is. and Stine sh. to Admire sh., and introduced Oaks sh. for the bed overlying Houchen Creek Is. 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 Is.)

Houghton conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.


Belongs to Central Mine group.

Named for occurrence in Houghton mine, Houghton Co.
Houghton moraines.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).


Hounsfleld bentonite.

Middle Ordovician (Black River): Central New York (Jefferson County).

G. M. Kay, 1930 (Sci. n. s., vol. 72, p. 365). *Hounsfleld bentonite.*—Type section in small quarry just N. of Dexter-Brownville road, 2 mi. E. of town of Dexter, Jefferson Co.; Hounsfleld Twp is 1 mi. S. of the locality. In the quarry it occurs as a bed of gray white homogeneous clay, reaching ½ in. in thickness, lying [uncon. in 1931 rept.] above Leray Is. and [uncon.] below Watertown Is., in Chaumont fm., of Ord. (upper Black River) age. In Ont. the Hounsfleld occurs within the intermediate Glenburnie memb. of Chaumont fm. near Kingston and in Cobonk Is. 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 Hounsfleld 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. Hounsfleld bentonite and overlying Watertown Is. and underlying Leray Is. at its type loc., and on p. 374 he applied *Hounsfleld bentonite* in N. Y., Ont., Ky., Tenn., Mo., and Iowa columns of his correlation chart.

House Mountain shales.

Upper Ordovician: Central western Virginia.


Appears to correspond to Martinsburg sh.

Houston marl.

Upper Cretaceous: Northeastern Mississippi (Chickasaw County).

E. W. Hilgard, 1880 (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 Tibo) 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 Is. 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 Issie fms.

Houten sandstone.

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 Is. proposed by G. I. Adams in field notes, for ls., 3 to 8 ft. thick, overlying Sever 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 underly.ing Scranton sh. memb., and overlying Sever 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.

Howard arkose.
Tertiary (Miocene?): Central Washington (Snohomish County).
†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 ot 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.
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

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.

Same as Putnam Hill ls. memb.
Named for Howenstein, Stark Co.

Howson andesite.
Pliocene (?): Central Washington (Snoqualmie quadrangle).
Thickness 250 ft. Assigned to Pli. (?). Probably not older than Pli. 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 ss., 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 Iss., one of which is a prolific Fusulina cylindrica horizon. Thickness of memb. 4,000 ft. To SE. it becomes less calc. and Iss. grade into shales and shales into ss. and cglss. 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 Taft'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 cglss.
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.
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 Is. memb.
C. W. Tomlinson, 1934. (See 1934 entry under Confederate Is. 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.]


**Hucalote rhyolite.**

*Age (?): Mexico.*


**Huautla basalt.**

Oligocene: Mexico.


**Hubbardston granite.**

Late Carboniferous or post-Carboniferous: Central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 507, pp. 231–236 and map). *Hubbardston granite.*—Chiefly coarse white ragged, highly feldspathic granite of pegmatitic texture, though never distinctly perphyritic 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. 380, 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).*


†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 Onelda cgl. and overlying Tren­ton Is.
†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 st. group.—Slates, shales, and grits with interstratified lens, 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. 90-98). Hudson st. series (also Hudson River st. series).—Includes all rocks btw. top of Frankfort st. 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 Lorraine[e] shales underlies Gray ss. [Oswego ss.] and Shawangunk grit and overlies Utica st. [As thus defined is all of Upper Ord. age, and later than Utica st., which is also Upper Ord.]

L. Vanuxem, 1842 (Geol. N. Y., pt. 3). Hudson River group.—Includes shales and ss. of Pulaski and Frankfort st. and ss. Overlies Utica st. 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 st. 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 contempt. deposits. The name in all senses has been discarded by most geologists.

Hudson trilobite beds.

Upper Cambrian: Western Wisconsin.

L. C. Wooster, 1878 (Ws. 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.


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 st. and sh. along Hudson River which has been called respectively Hudson st. and Hudson sh. The Hudson schist, Hudson st., 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).


Above definition was repeated and somewhat amplified by Twenhofel, Raasch, and Thwaites in Geol. Soc. Am. Bldg., vol. 46, No. 11, Nov. 30, 1935, pp. 1701, etc. See under Mazomanie ss.

Hudson Bridge limestone. (In Palo Pinto formation.)

Pennsylvaniaian: North-central Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 21). Hudson Bridge Is.—Hard, crystalline Is., dark brown to gray, with local pink splotches and occasionally large masses of chert in top bed. Thickness 7± ft. Outcrops about 3 m. 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 Quebecian.

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. 22-38). Hueco fm.—Mainly massive gray fossiliferous nonmag. Is., 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 Is. called Hueco Is. in early repts on Franklin and Hueco Mtns into Helms fm. (Miss.) at base, Magdalena Is. (Penn.), and an uncon-
lying series of beds, of Perm. (?) age, to which some geologists restricted the name *Hueco Is.*, 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 Is. 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.


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).


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.


R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), transferred Houchen Creek lss. and underlying Stine sh. to Admire sh., and introduced Oaks sh. for the bed overlying Houchen Creek lss. 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 lss. were included in Hughes Creek sh. of previous repts.

G. E. Condra, 1935. (See under *Long Creek lss.*)

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.


Probably named for occurrence on South Fork of Hughes River.
Lexicon of Geologic Names of United States

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.

Hulah sandstone member (of Nelagoney formation).
Pennsylvanian: Central northern Oklahoma (Osage County).
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).
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.
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.

Probably named for Hull, Sioux Co.
Hull conglomerate.
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.

Humber member.
Upper Ordovician: Toronto, Canada.
See quotation under Dundas fm. Type loc. not stated.

Humber Arm series.
Middle and Upper Ordovician: Newfoundland.

Humber River.
Ordovician: Ontario.

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 ssc., 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 Shoeshone 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.

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 la. is probably same as the thick Humboldt la. 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 Is. 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. Schmit, 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 1,600 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, 28-29). Humbug fm.—In Stockton and Fairfield quads, Utah, consists of interbedded ls. and lenticular ss. and quartzite 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 quartz 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. 2140-2151, 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. 2140-2151, 1915) to 224 ft. of calc. ss. with a few intercalated beds of aren. is., 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.

R. C. Moore, 1936 (Kans. Geol. Surv. Paper 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.


Humphrey Creek shale. (In Wabaunsee group.)


Hundred sandstone. (In Washington formation.)

Permian: Northern West Virginia.


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.


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 3/4 mi. S. of Belcher School, where the ss. is 15 ft. thick.
Hunt shale. (In Bluestone formation.)
Mississippian: Southeastern West Virginia.

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).

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, 307, 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.

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.
R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 17). Huntingdon fm.—Ss., cgl., sh., and thin coal beds. [Mapped at and to N. of Huntingdon, B. C., and in Wash.]
Huntington series.
Triassic (?): Northeastern Oregon (Blue Mountains).


Huntington dolomite.

Silurian (Niagaran): Northeastern Indiana.

E. M. Kindle, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept., p. 408). Huntington Is.—Light-gray or cream-colored granular dolomite Is. 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 Is. The same Is. 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 Is. 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. (Is.). 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 NE4 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 Is., 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 Is. 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. thicken from Monon northwestward, but how much we are not prepared to say. Fossils listed. Rests on Linton Creek Is., probably conformably. Grades upward into New Corydon Is. It is practically certain it extends beneath the drift to Chicago dist.

Named for Huntington, Huntington Co.


Hunton limestone.

Silurian and Devonian: Southeastern Oklahoma.

J. A. Taft, 1902 (U. S. G. S. Atoka folio, No. 79). Hunton Is.—Nearly pure white Is. and lime 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 Is. 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. Taft, 1903 (U. S. G. S. Tishomingo folio, No. 98). Hunton Is. 0 to 200 ft. thick, is divisible into 3 members (descending): (1) Crystalline and in part cherty bluish to white Is. with occasional thin marly strata, in places overlain by several ft. of very cherty Is.; (2) 100 ft. of white or cream-colored and occasionally pinkish rather soft Is. interstratified with more friable marly lime and, rarely, calc. clay, with a few ft. of marly white Is. at top; (3) whitish massive crystalline Is., which in places includes a bed of oolite at or near base and thin-bedded compact Is. at top; thickness few ft. to 25± ft. Upper mem. 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.

here divided into 4 fms. in Arbuckle Mtns (descending): (1) Bols d'Arc ls., 0 to
90 ft., of Beearft (Oriskany) age, according to C. Schuchert (1922) and E. O.
Ulrich (1927); (2) Haragan sh., 0 to 166' ft., of New Scotland age; (3) Henry­
house sh., 0 to 223 ft., of Niagara age; and (4) Chimneyhill ls., 0 to 53 ft., of
Alexandrian age. Overlies Sylvan sh. with uncon. The Bols d'Arc ls. corre­
ponds to upper Hunton of Taff; the Haragan and Henryhouse correspond to
middle Hunton of Taff; and the Chimneyhill corresponds to lower Hunton of Taff.

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 38 pp.). St. Louis or Huntsville.—A subdivision of the Sub-Carb. in
Tennessee River Valley. More calc. than beds below. Is= upper Siliceous of
Safford and St. Louis group of western geologists. Overlies Lauderdale (Koook)
and underlies several hundred ft. of Sub-Carb. Is. [Huntsville used in table only.]

The Mississippian rocks in vicinity of Huntsville, Ala., consist of (descend­
ing) 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).

group.—Consists of (descending): (1) Fine bluish gritstones (Pt. aux Barques),
14 ft.; (2) shales, Is., and flagstones, 18 ft. [180 in Am. Jour. ScL, 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 Is. and shales. Thickness of
Huron group 224 ft. Assigned to Portage epoch.

group as 600 to 700 ft.

thick, belong to Marshall group.

Includes Coldwater sh., Berea ss., and Antrim sh.

Mostly 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 Is. and underlies Dev. bluish or greenish Erie sh.
Extends from lake shore at mouth of Huron River S. to mouth of Scioto.

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
grey). 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 con­
cretions in lower part and as resting on black shales of Portage age). The rela­
tions 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).

†Huron group.
Mississippian: Indiana.

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-Carb. 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.

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. 59, 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 Puckunnmite 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.
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 Is. and overlying Middle Creek Is., all members of Swope fm. It is a black sh. a few ft. thick. In Kans. it is coexistent with Middle Creek Is.


See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

**Hutchison salt bed.** (In Sumner group.)

_Permian_: Central Kansas.


**Hutchison limestones.**

A term applied by C. [R.] Keyes to 25 ft. of Dev. Is. in Iowa that belongs to top of Cedar Valley Is. (See Pan-Am. Geol., vol. 56, pp. 318, 348, 1931. It occupies same interval as that to which name _Lucas Is._ had already been applied, and thickness corresponds to that of latter Is.)

_Hutchinson group._

_Tertiary_: Yukon Territory.


**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 80 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 Virgillina 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 Is. in SE. part of Virgillina dist. its place is apparently taken by Goschen 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 "apophyolite" is statement: "In Virgillina area called Hyco quartz porphyry and tuffaceous facies is called Goschen 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).


Hyde Manor limestone.

Middle Ordovician (Trenton): Southwestern Vermont (Rutland County).


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).


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 ls. 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 ss. separated by a sb. 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 sandings 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. Schwennesen, E. W. Krampert, and C. II. Henley [unpublished reps.], 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. The other ss. have been named and mapped by Schwennesen, 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. Mathew, J. Glibby, and R. G. Lusk, 1928 (U. S. G. S. Bull. 706B). 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 quartzite 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.
6,800 ± 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.

Hyman 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. 709, 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 Pottaville 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) ore clay and sh. 0 to 5 ft.; (10) Lower Iaeger ss. (massive to flamy, 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.)
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 Is. 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. Wimarath, 1936.

Named for exposures at Iatan, Platte Co., Mo.

Iberville formation.
Ordovician: Quebec.

Ice River formation.
Age (?): British Columbia.

Ice River intrusive complex.
Post-Cretaceous: Alberta.
J. A. Allan, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 185).

Iconium member (of Wellington formation).
Pennsylvanian: 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 Iconlum being placed at base of massive ss. of Garber. The shales of Iconlum are red, blocky, nonlaminated, and contain calc. or dolomitic material in form of septarian concretions and veined goodes. The ss. 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 Lower ss. bed. Named for little town of Iconlum, near S. quarter cor. of sec. 10, T. 16 N., R. 1 E., Logan Co. The town is 80± ft. above base of Iconlum 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 Pilo. series. It may be called Lake Idaho, and its sediment the Idaho fm.


V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 198-201, 232-239). 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 Pilo. 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 ss. 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 Pilo. age. Invertebrate and vertebrate fossils indicate Pilo. 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.

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).
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. orig. 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 under-
aln 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.

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 im-
perfectly 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 ssa. The Ignacio qtzite overlies Aignion 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.


Illes 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). *Illes 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 Ilea 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.


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 *Illinoi* 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 ss. 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 Meeteeetse 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.

Imlay moraine.


Imperial formation.

Miocene (late lower): Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, No. 18, pp. 424-435). There appears to be good reason to suspect that more than one Plioc. fm. is represented on banks 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 Alverton 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. ass. 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 altitaine mem. (1,400+ ft. thick) and a basal cgl. mem. (a few inches to 700 ft. thick). He correlated the basal cgl. mem. with Imperial fm. of Hanna in narrow sense, and the siltstone mem. with Latrania sands, Coyote Mountain clays, and interbedded Yuha Reefs of Hanna. He assigned his Imperial fm. to late lower Mio., and its overlying Palm Spring fm. (nonmarine) to middle or upper Mio.

Incarnacion fire clay.

Pennsylvanian: Central northern New Mexico.


Incarnacion granite.

Age (?): Central New Mexico.


Inch Arran latites.


Independence shale member (of Wapsipinicon limestone).

Middle Devonian: Central eastern Iowa.


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 Is. (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 Is., 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.


†Independence limestone.

Pennsylvanian: Southeastern Kansas.


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 ss. 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.


Indian sand.

A subsurface sand in western Pa. that is correlated with Morgantown ss. memb. of Conemaugh fm.

Indiana oolitic limestone.

Mississippian: Indiana.

Harrodsburg Is. and underlying Mitchell Is. Formerly called Bedford oolitic stone, Spergen Hill Is., White River stone, etc.

Trade name for Spergen Is. 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 Is. of Ind., which is known to the trade as “Indiana oolitic Is.”

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.)

Indianaan 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.

Indianan Cave sandstone.
Pennsylvanian: Eastern Kansas.
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 50, 201). Indianan 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 Is. 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 Is. levit and underlies “bed No. 5” of Drake.

Named for Indian Creek, Coleman Co.
See also under Indian Creek bed (Penn.).

Indian Creek Fields formation.
Siliurian (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 Is. at top, Plum Creek clay in middle, and “those layers of Is., 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 subquadrate and oolitic iron ore bed.” Included in Crab Orchard div., of Niagaran age. Overlain by Alger fm. and underlain by Brassfield Is.

Named for Indian Fields, Clark Co.
Indian Gap limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.


Indian Gulch.

Mesozoic: Sierra Nevada, California.


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 Martha's 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 Cotamay 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 Cotamay 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.s., 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).


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. Hub. 10, p. 43). **Indian Ladder beds** consist of thin ss.s and shales with massive ss.s 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 fauna of kitherto 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.


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, 1928 (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, 1928 (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 ss.; 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).


Indian River group.

Age (?): Canada.

R. G. McConnell, 1900 (Canada Geol. Surv., Rept. on Klondike gold fields, p. 8).

Indian River series.

Cambrian: Canada.


[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. 380, 403). Indian River sh.—The fm. that furnishes the well-known red sl. of N. Y. sl. industry. Is mainly bright red sh. with, locally, a few thin seams or layers of fine green quartz. Red color is due to iron oxide. Conformably overlies Poultny sh. and conformably underlies an unnamed black sl. Named for Indian River, a few mi. S. of Granville [Washing- ton 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. Bull., 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.
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 egl. This basal memb. changes considerably in character. Near Indian Springs, 50 mi. NW. of Las Vegas, yellow, orange, and reddish shales are interbedded with las. and subordinate ss. 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.

Indidura formation.
Cretaceous: Mexico (Coahuila Peninsula).

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. Buwald 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 ss. and fangl. 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.

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.).


Ingleside formation.

Pennsylvanian: Central northern Colorado (Larimer County region).

R. M. Butters, 1913 (Colo. Geol Surv. Bull. 3, pp. 68, 75, etc). Ingleside fm.—Alternating ss. and hard fine-grained ss., 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 sh. 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. F. P. 149) published the following as his interpretation of the section at Ingleside, Colo.:

Lykins fm. (basal part):
1. "Crinkled ss."
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. ss., pink to gray, with many solution cavities and masses of calcite, 25 ft.
3. ss., red, intensely cross bedded. 25 ft.
4. ss., 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, prevailinggly 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.

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 Is., because of presence of many species of Inoceramus.

Inola limestone member (of Boggy shale).
Pennsylvanian: Northeastern Oklahoma (Rogers County).
C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503-520), treated this Is. 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 Is. system exposed at Haskell Institute, Lawrence. Included in Lawrence shales.
This Is. 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.
P. 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 sander 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. Sc., 5th, vol. 11, pp. 350-352). Type loc. of Interior fm. is a few ml. W. of Interior, Jackson Co., S. Dak., where thickness is almost 30 ft. Is 45 ft. thick 21 ml. N. of type loc. In my 1922 rept there was some disagreed 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.


Intervale clay slate.


M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, map, p. 50). 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 w. 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 ml. NE. of Intervale (village), in vicinity of the trail, the sl. strikes N. 75° E. and dips vertically. Uncl. 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. Sc., 3d, vol. 39, pp. 389-390). The position and strat. of the Is. 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 800 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 Lowere 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 Calcareous-Trenton [Beekman-town to Trenton]. Underlies Manhattan schist and overlies Lowere qtzite (0 to 16 ft. thick).

P. 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. 381-378), assigned Manhattan schist and Inwood ls. to pre-Camb., and named the underlying qtzite Lowere qtzite. Under description of Sprout Brook Valley he in several places called the Inwood ls. the Sprout Brook 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-Cambrian and offers good evidence that they are not metamorphosed Paleozoic sediments.


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.]


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).


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., egl., 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).


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 iss. of Inyo Mtns (Meekoceras beds), of Lower Triassic age.


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.] Keres, 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 Iss., 800 ft. of shales, 15 ft. of Iss., 400 ft. of shales, and 100 ft. of cgl. The name Koipatoan series is given to Middle Triassic and Etoan 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.


H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). The Is. exposed at Carlyle Is. is Platteburg Is., but the Is. that has been called Carlyle Is. is an older bed—the Furley Is. bed in Lane sh. memb., which overlies Iola Is. ("Crusher ledge"). R. C. Moore, 1932 (Nebr. Geol. Surv. Bull. 5, 2d ser., issued before Mar. 1932, p. 17), showed Iola Is. of "current nomenclature" as younger than true Iola Is., and called it Argentine Is., which he showed as lying on Lane sh. ("=upper part of so-called Chanute sh. of current nomenclature"). He divided Iola Is. into (descending) Raytown Is., Muncie Creek sh., and Paola Is. The rest of so-called Chanute sh. of "current nomenclature" he divided into (descending) Chanute sh., Drum Is., Dewey Is., and Quivira sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 92, 97). Iola Is. 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 Is. is termed Raytown Is. An underlying black fissile sh. is termed Muncie Creek sh., and a blue dense bed with "middle" characteristic is designated Paola Is. 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 Is. of Kansas City area is Frisbie-Argentine Is. members of Wyandotte Is., and pinches out before Iola is reached. On tracing type Iola Is. N. from Iola I found main upper part of it is continuous with Raytown Is. 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 Is., Muncie Creek sh., and Paola Is.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 112–113). Iola Is. at Iola (where it is 30 ft. thick and extensively quarried) is chiefly light bluish-gray, irregularly thin-bedded fine-grained Is. containing many thin veinlets of calcite. It rests on Chanute sh. and is overlain by Lane-Bouner Springs sh. At Kansas City and vicinity the Is. ("Crusher ledge") that has long been called Iola Is. is now known to be an entirely different fm. that belongs above Lane sh. and is now known as Argentine Is. The main part of true Iola is represented in NE. Kans. and NW. Mo. by Raytown Is., formerly included in Chanute sh. The Iola is now divided into 3 (descending) members—Raytown Is., Muncie Creek sh., and Paola Is. 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 Is. of Okla.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Iola shale.

Pennsylvanian: Eastern Kansas.

Conflicts with Iola Is. For present interpretation of relations see 1936 entry under Carlyle Is., and also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Probably named for Iola, Allen Co.

†Iola beds.

Pennsylvanian: Eastern Kansas.


Ion member.

Middle Ordovician (Trenton): Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

G. M. Kay, 1928 (Scl, n. s., vol. 67, p. 16). *Ion memb. of Decorah fm.*—Calc. sh. and argill. iss., the iss. 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 (Rock-land) age. [See also Kay, 1929 (Jour. Geol., vol. 37, No. 7, Oct.-Nov., pp. 639–671), who stated this memb. corresponds to Fucold bed and Chasmatopora bed of Minn.]


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 ss.s. 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 clays, 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 sh., 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 anauxlite; 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.s. 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
rhylolitic 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).

For further information see Woodville sl.

Ionia moraine.

†Iota subdivision.
A Greek name applied by F. W. Cragin (U. S. G. S. Bull. 268, 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 Kinderhook 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. 408-418). 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 Is. (exclusive of Shuttlerville 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—Hearthly belded (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 Is. 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 mem. 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 Koevatin 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 Kansa 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 Kansa 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. 869-873, 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.)
Pennsylvania: Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.
G. E. Condon, 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


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.

Ippava 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 Ippava 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.


Ipperwash limestone member.
Devonian: Ontario.


Ira slate.
Lower Ordovician (Beekmantown): Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 368). 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 contain 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 ml 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 (6th Rept. Vt. State Geol., p. 171). Irasburg cgl. assigned to Ord. All its boulders are pre-Ord. Underlies Waits River ls.
Irasburg conglomerate.

Devonian: Northeastern Vermont (Orleans County).

E. J. Foiles 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, 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 Is. 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 Is., Stranger fm., and probably in places with Iatan Is. 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 Is. lenses.


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. Is.
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.


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.


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.


†Iron Mountain series.

Pre-Cambrian (Llano series): Central Texas.


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.
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 poryphyry.*—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.

Iron Ridge ore bed.
Silurian: Southeastern Wisconsin.
E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 581). 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.

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 Is. Is of Recent, or possibly of Pleist., age.
Ironside beds.

Pliocene: Northeastern Oregon (north part of Malheur County).

J. C. Merriam. 1918 (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 Pli., and not older than late Mio." Merriam seems to have studiously avoided naming the beds or using the term Ironside beds.


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 Pli. [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 mem. of Sultan ls. Thickness 5 to 125 ft. Underlies Valentine ls. memb. of Sultan ls. and overlies Goodsprings dol. Exposed near Ironside mine, 1 ml. N. of Boss mine, on W. side of Spring Mtns Range. B. 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 hornblende 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).


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. Wisc. 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. Wisc. 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.

Ironwood iron-formation.
Pre-Cambrian (middle Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic).
Later repts give thickness 850 to 1,500 ft.
C. B. 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. F. 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, 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.

Iroquois clay.
Pleistocene: Ontario.

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 Carb. 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.

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
Algongian cgls. and qtzites, from which they are separated by an erosion interval of unknown extent, the overlying Algongian cgls. 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 Algongian.

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 mafic and schistose. Prominently exposed in SE. part of quadrangle and composes Irving Peak. Distinguished from underlying Archean schists by distinctive character of certain of its more massive members and by presence of sediments. Actual base nowhere seen. Thickness exposed appears to be at least 10,000 ft. Overlain unconformably by Vallecito cgl. Considered to be most probably of Algongian 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 “Algongian 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. 179-183) to an undescribed ss., 7 to 50 ft. thick, near top of Pottsville fm. (Penn.) of central western III. Shown on p. 192 as unconformably overlain by a thin bed of sh. underlying coal No. 2, and in places cutting out all beds down to near top of his Bernadotte ss. Derivation of name not stated.

Isabella stage.

Quaternary: Puerto Rico.


Isabella granodiorite.

Late Jurassic (?) : Southern California (Kernville quadrangle).


Isanti moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Isanti County).


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.


Ishawooa intrusives.


A. Hague et al., 1904 (U. S. G. S. Mon. 32, Atlas; Canyon, Lake C and Shoshone sheets). Ishawooa intrusives.—Massiveandesite, diorite, and granite porphyry bodies penetrating the late basic breccia in Ishawooa quadrangle. 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).


Unnecessary name, the Bijiki and Goodrich both being recognized in the dist.

Isidro formation.

Tertiary: Mexico (Lower California).

A. Heun, 1922 (Geol. Mag., vol. 50, p. 536).

†Island series.

Upper Cretaceous: Southeastern New York (Staten Island) and southeastern Massachusetts (Martha's Vineyard).


A. Hollick, 1906 (U. S. G. S. Mon. 50). The Raritan and Cliffwood (Magotty) fms. are "Island series" of Ward.

Island Creek shale.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.


[See under Wyandotte Is. Derivation of name not stated. On p. 46 Island Creek sh. is described as consisting of 1 to 14 ft. of gray argill. sh.]


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

Island Hill formation.

Lower Devonian: Northwestern 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 ml. 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.


Island Mesa beds.

Upper Devonian: Northern central Arizona.

A. A. Stoyanow, 1938 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 500). Twelve ml. 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 extima and
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O. *zeacatilis* 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., under-lying 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 ls. here designated *Island Mena beds*.

**Island Mine conglomerate.**

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).


Named for occurrence in Island mine, Isle Royale.

Island Run ss.

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. In 8 ft. thick at Watertown and 12 ft. thick at Isle La Motte. Is called *Seven-foot tier*. Underlies Trenton ls. and overlies Birdseye (Lowvllle) ls. [As thus defined applies to post-Lowville part of Black River group. Isle La Motte is an island of 4,870 acres in Lake Champlain about opposite village of Chazy, N. Y., in Rouses Point quad., Grand Isle Co., Vt.] W. W. Mather, 1845 (*Geol. N. Y., div. 4, geol., pt. 1, p. 287). Black marble of Isle La Motte belongs to Black River ls.

C. B. Adams, 1846 (2d Rept. Geol. Vt., p. 164). *Isle La Motte* is. 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 finely granular marble, underlying Trenton ls. and overlying Birdseye ls.

G. H. Perkins, 1904 (4th Rept. Vt. State GeoL, map opp. p. 113, pp. 121-143). Isle La Motte ls. is. 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 Beckmantown 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.

H. M. Seely, 1910 (7th 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 Beckmantown.]

**Isle La Motte sandstone.**

Lower Ordovician: Northwestern Vermont (northern part of Lake Champlain).

Isle Royale amygdaloid.
Pre-Cambrian (Keweenawan): Northern Michigan.

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 Battle 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.

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 Molongonan till sheet. (See Pan-Am. Geol., vol. 47, No. 5, 1927, p. 352.)

**Ithaca shale member** (of Portage formation).
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, 1845 (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.
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 laevigatus* 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.


J. M. Clarke, 1894 (N. Y. State Mus. 47th Ann. Rept., p. 750). Downward succession: Chemung; Portage sst. 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. 16th 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 is. and a portion of Genesee sh. 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 sst. 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.


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.


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).

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.


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 1st ravine N. of Ivy (or Willow) Point on E. side of Skaneateles Lake, about ½ 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 maccharoidal ls. 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 $\frac{1}{4}$ to $\frac{1}{2}$ 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 Plattei and Joachim ls. 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 3,800 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.


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, 1909 (U. S. G. S. Bull. 380, p. 289). *Jackfork* ss. of Osageo 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 16,000 to 13,918 ft. thick, provided whole section of ss. 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 report 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 lithologc 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 Caney Creek Valley, 6 mi. N. of Eubanks, Pushmataha Co., Okla.) rests on Jackfork ss. This relation holds in a fairly large part of Ouatchita Mtns of Okla., but Caney seems to overlap progressively both Jackfork and Stanley toward N.W., 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 the. 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-Choahtaw belt of Ouatchita 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-Choahtaw belt of Ouatchita Mtns, Okla., the downward succession is Atoka fm., Wapanucka Is., 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).


According to F. B. Plummer and R. C. Moore, 1922 (Tex. Univ. Bull. 2132, p. 138 and table 2), Jacksboro Is. memb. of Graham fm. is characterized by Campophyllum torquium, but Campophyllum bed of Drake is the much younger Gunsight Is. memb. of Graham fm.

Jacksboro limestone 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. 127-143). Jacksboro Is. lentil.—A Is. near base of Graham fm. (of Cisco group) in Brazos River Valley. In vicinity of Jacksboro it consists of 2 Is. 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 Is. bed is dark gray (weathering rusty yellow), hard,
crystalline, 1 to 4 ft. thick, and filled with *Campophyllum torquium*. The upper
Is. is poorly bedded, massive, shaly, 6 to 18 ft. thick, in places very fossiliferous,
and 5 or 6 mi. to SW. changes to calc. as., and to NE, of Jacksboro grades
into shales.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 104), transferred Jacksboro Is. and
Flints sh. to Caddo Creek fm., and stated (p. 112) that Home Creek Is. memb.
includes Jacksboro Is.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 62+),
included Flints sh. and Gonzales Creek sh. in *Graham* fm. The U. S. Geol.
Survey draws base of Graham fm. at top of Home Creek Is. This is where base

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).

entry under *Vicksburg group*.]

E. W. Hilgard, 1860 (Rept. Geol and Agric. Miss., pp. 128-135). *Jackson* group.—
Marls and soft Is., the marls white and blue, often indurate. [Fossils listed.]
*Zeuglodon* common. Thickness 50 ft. Underlies Red Bluff group, which seems to
be intermediate, in position and fossils, btw. Vicksburg group above and Jackson
group below.

present at Red Bluff, where it underlies Red Bluff group.

Most early repts excluded the Red Bluff clay (“group”) from the Jack­
sion, 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*.)

*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, 1928) 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 Is.; 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 Is. (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.
Pennsylvania: Michigan (Lower Peninsula).
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 ss., the ss. 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).

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, 1982.)

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 Is.—A stratum of Is. containing very numerous casts of shells and occasionally a silified specimen, on the whole not unlike Tampa Is. 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.
Later studies of T. W. Vaughan and C. W. Cooke showed this Is. to be a bed in Tampa Is.

Jacksonburg limestone.
Middle Ordovician: Northern New Jersey.
H. B. Kümml, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). Jacksonburg Is.—The Is. hitherto called Trenton Is. in N. J. repta, 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 Is., 30 to 40 ft.; (3) shaly beds, 30± ft.; (4) dark blue or black fossiliferous Is., 30 to 40 ft.; (5) basal cgl., few inches to 50 ft. At Jacksonburg, Warren Co., shales and thin-bedded shaly Is. 19 or 20 ft. thick occur at base of section, overlain by 102 ft. of Is., and top of section is not seen. Underlies Martinsburg sh. and uncon. overlies Kittanning Is.
Jacksonian.

Time term used by some geologists to cover the epoch during which the Eocene Jackson fm. and contemporaneous 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 Kansa. Underlies Clay Creek ls. [Derivation of name not stated. On p. 52 Jackson Park sh. is stated to be 52 ft. thick.]


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 Chocotawhatchee 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, Martha's Vineyard, No Mans Land, and probably Cape Cod).


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.


Jacob stage.

The time covered by deposition of Jacob sand (Pleistocene).
Jacob sand.

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 ft. (4,000 ft.)? In view of uncertainty of relation of the three parts of the Lake Superior ss. ss. 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. undetermined, and may be same fm.

Named for exposures at Jacobsville, Houghton Co.

Jacque Mountain limestone member (of Maroon formation).
Permian: Western central Colorado (Tennmile district).
S. F. Emmons, 1898 (U. S. G. S. Tennmile Special folio. No. 48). Jacque Mtn Is.—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 Jacob 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).

Jagger Bend limestone. (In Belle Plains formation.)
Permian: Central Texas.

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, Martha's Vineyard, and probably Cape Cod and Nantucket Island).
A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 760-776). Jameco gravels (glacial), 100 ft. thick. Underlie Sankaty beds and uncon. overlies 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 m. of Jamaica, N. Y., where borings first revealed the beds. Correlated with Kansa glacial stage of Mississippi Valley.


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. 457-469). Jameco gravel, 100 ft. thick, granitic, often sandy. Regarded as outwash from second, probably Kansa, glacier. Writer in 1904 recognized this fm. in cliffs of Block Island, Martha's 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 Kansa 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 Martha's Vineyard, where it is divided into Mesophut 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 Kansa stage of Mississippi Valley.

Jameco stage.
The time covered by deposition of Jameco gravel.

†Jamesburg formation.
Pleistocene: New Jersey.


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 on W. bank of Potomac btw. Mount Vernon and Aquia Creek.


James River shale.
Devonian (?) : Southwestern Missouri.

quently fossiliferous shales, thin-bedded and often accompanied by pyrites. Under­
lie Kings [King] Is. 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.

Jamestown conglomerate.
Upper Devonian: Western New York.
G. D. Harriss, 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).
Jamestown Is. memb.—Dark-blue Is., 2½ ft. thick, containing Productus sp. Top
lies 4½ to 7 ft. below Bankston Fork Is. 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).
Rather dark-blue Is. 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 Is. and overlies, with sharp contact, Clark Reservation Is. Included in
Manlius in Vanzandt’s 1842 rept. p. 115. Has been classed as Heldebergian,
or probably Heldebergian, 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.
Manlius Is.]

Jane Lew sandstone. (In Conemaugh formation.)
Pennsylvanian: Northern West Virginia.
Jane Lew ss.—Massive, greenish gray, weathering to dark brown, fine grained,
micateous, 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.
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).
202). Jasper Is.—Consists of Is. interbedded with considerable ss. The Is. 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 Ercerton 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.


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 ss.s., 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 ss.s. 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-specific 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.)


A. C. Peale, 1893 (U. S. G. S. Bull. 110). Jefferson ls.—Brown and black crystalline ls.s., 640 ft. thick. Underlie Three Forks shales and conformably overlies Gallatia 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.


Jefferson City dolomite.

Lower Ordovician (Beekmantown): Missouri and northern Arkansas.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 8, pp. 331, 373, 375). Jefferson City ls.—Mag. ls.s., 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 Is. as indicated by following succession (downward): St. Peter ss.; Everton; uncon.; Yellville Is.; 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 Is. 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 Is. above. As a result of recent-work this fs. 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.


Contains Onondaga fossils. Regarded as probably= Columbua Is. of Ohio. Named for Jeffersonville, Clark Co., Ind.

Jellico formation.

Pennsylvanian: Northern Tennessee coal field.

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 238, pp. 14, 18-21). Jellico fs.—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 ss. are more prominent in it than in either underlying Briceville or overlying Scott fs. The Pioneer ss. is top mem. of fs. and Smith coal (=Blue Gem coal) is basal mem. Named for occurrence of Jellico coal within the fs. 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 fs.—New name proposed for upper 250 ft. of Chugwater fs. in SE. Wyo., consisting of a pebble cgl. composed of small ls. pellets, wood fragments, and fragmentary remains of Triassic vertebrates. Is.=Dolores fs. [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 fs., to which name Chugwater should be re-
Lexicon of Geologic Names of United States

stricted. 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.]

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.]

Named for former post office of Jenkins, Comanche Co., Kans.

Jennings formation.
Upper Devonian: Eastern West Virginia and northern Virginia and Maryland.

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 Devonian time the NW. and SE. areas of deposition were separated by a land barrier toward which limestone grade into arenaceous 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, 1938 (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 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 quartzites, 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. 130-148).

Jerusalem.
Cretaceous: Jamaica.
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 ls. 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.


**Jesse sandstone member** (of Catron formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.


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. Bas., 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.


(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 Is. Prob­
ably 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 as­
signed 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. Burbat, 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 Peno 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 Rend 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
beds,” resting on; (3) Vedder sand memb.

Jim Creek limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

[See under Dover ls., Moore, 1932.]

rocks of Nebr. and Kans.), replaced Jim Creek ls. with Nebraska City ls.

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 fol­
lowing downward sequence of members of his Pony Creek sh. fm.: Sh., 5½ ft.;
Grayhorse ls., 1 ft.; Caseville sh., 17 ft.; Nebraska City ls., 2± ft.; French
Creek sh., 18 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.

applied to thin but persistent Is. 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.
*Joachim fm.* or First Mag. Is. overlies Pacific or First, ss. and underlies Trenton Is.

Yellow and buff to light-gray thin-bedded mag. Is. alternating with beds of compact,
brittle Is., and with locally thin beds of ss. Thickness 0 to 150 ft. Over­
lies St. Peter ss. Is=First Mag. Is. and Folley Is.

The overlying Is. has for many years been called *Plattin Is.*

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 Is.*—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
Chairman sh. and overlies Pilot sh. Named for Joana mine, on S. side of
Robinson Canyon, 2 mi. above Ely.

†*Joe Rock granite.**

Devonian (?): Southeastern Massachusetts.

*Joe Rock granite.*—Pinkish to purplish granites, aplite and felsite, including
quartz porphyry, feldspar porphyry, fine granite, and felsite. [Mapped over large
area, including Joe Rock, W. of Sheldonville, Mass.]

B. E. 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).

burg 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. Inter­
bedded with these varying types of gneisses there occur rather important quanti­
ties of massive and quite coarsely crystalline white marble in beds 1 to 20 ft.
thick. In places thin layers of light-colored gneises are intercalated with the Is.
A subordinate amount of qtzite, which may be massive or coarsely banded, is inter­
bedded with the marble and the gneisses. The fm. is predominantly if not entirely
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.**


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.

B. D. Cope, 1888 (Am. Geol., vol. 2, pp. 290-292). John Day 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 Merycochoerus beds of Wortman, but as Merycochoerus does not occur in the John Day, the upper beds will be called Paracotylopus 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 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 200-300 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.]


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 quartzite, 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-beded. 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 quartzite, and is basal fm. in Spring Mtns section, Clark Co. No fossils found.
Johnsonburg limestone.

Pre-Cambrian: Northeastern New York (Adirondacks).

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 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. F. 160, pp. 127-128, map). The most centrally located, most silicous, 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 Yingle-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 as. [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 Johnon Run as. 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.

Johnson River sandstone.
Misprint (on p. 211 of U. S. G. S. Bull. 191) for Johnson Run as., 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 as.
C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R). The Johnson Run as., 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.

†Johnstown cement bed.
Name applied in early Pa. and W. Va. repts to Johnstown Is. 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 Is. above and Brush Creek coal below. (See J. D. Sisler, Pa. Geol. Surv., 4th ser., Bull. M., 1925, p. 208.)

Johnstown moraine.

Johns Valley shale.
Pennsylvanian: Southeastern Oklahoma (Ouachita, region) and central western Arkansas (Scott County).
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 ss. referred to Atoka fm. Its lower part contains abundance of large and smaller, often fossiliferous, erratics of Is. 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 Is. 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. 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-Chocataw 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. 13, No. 8.) According to Miser, Johns Valley is 10 mi. 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 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).

Joliet limestone.
Silurian (Niagaran): Northeastern and western Illinois.

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 515, 522, 530, 533). Joliet 1a. 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) Is. and underlies, in Joliet region, a cherty Is. that is believed to correspond to Waukesha Is. of Waukesha, Wis. In Jersey and Calhoun Counties [SW. Ill.] it consists of 45 ft. of yellowish gray dolomitic lns., in layers 1 to 40 inches thick; overlies Kankakee (Brassfield) Is. and is overlain by Dev. In NW. Ill. it consists of 30 to 38 ft. of yellowish brown dol. overlying Kankakee (Brassfield) Is. and underlying Waukesha ls. Fossila. 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 equlv. 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. is absent an important uncon. should separate the Joliet and the Kankakee.

Joliet conglomerate.

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, 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.
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, 1824 (Bur. Geol. [Okla.] Bull. 2, pp. 74-75). Jolly ls. memb.—A thin Is. 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 abun-
dant gastropod fauna, the most prominent species of which is *Bellerophon crassa*
var. *weeukasua*. At point just mentioned the Is. 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 direc-
tion, while the strike of underlying strata continues southeasterward. In this way
a greater and greater section is exposed btw. the diverging outcrops, until in area
near E. edge of the outcrop the Is. is approx. 200 ft. above top of McAlester fm.

**Jollytown limestone member** (of Washington formation).

Permian: Southwestern Pennsylvania, western Maryland, and northern
West Virginia.

from 5 to 35 ft. above Jollytown coal, and 25 to 30 ft. below Dunkard coal, all of
which are younger than Upper Washington Is. Ranges in thickness from 1 ½ to
10 ft. Included in Dunkard Creek series [Dunkard group]. Named for exposures
in vicinity of Jollytown, Greene Co., Pa.

Survey the Jollytown Is. and Jollytown coal are older than Upper Wash-
ington Is.

**Jollytown sandstone.** (In Washington formation.)

Permian: Southwestern Pennsylvania (Washington County).


_Jollytown ss._, massive ss., of irregular structure, weathering into fantastic forms.
Overlies Middle Washington Is. and at Lantz’s, ½ 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 Is. (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.
18, 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,

**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 Is. 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 Jones-
boro, Union Co., and is known in that region as Jonesboro Is. 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.

moderately thick-bedded, usually fine-grained and in part mag. Is. 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. as at least as Greenville, this Is. rests on Upper

**Jonesboro limestone.**
Camb. Nolchucky 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 Macurea oceans and M. affinis and to Steller—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 Nolchucky. 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.]


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 ls. is a distinct and easily separable unit in SW. Va., and Jonesboro ls. is here redifined and restricted to the ls. which near Jonesboro, Washington Co., Tenn., underlies Nittany dol. and rests on Nolchucky 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. 1981, 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. 329–380). Jonesburg ss.—A persistent bed which forms rim of many minor ridges and plateaux 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 ss. of these tps., 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.


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 Is. (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. 187-184 he proposed to redefine Ervine Creek Is., 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 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 1/2 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. Scl., Arts, and Lett., vol. 21, pp. 72-84) E. O. Ulrich restricted Jordan ss. to the wholly unfossiliferous ss., such ss 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.)


A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 21–79). Jordan ss. = 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 ss. 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).

Pennsylvaniaian: 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.


**Jualin diorite.**

Early Cretaceous (?): Southeastern Alaska (Berners Bay region).


**Juana Díaz shales.**

**Juana Díaz marls.**

Tertiary: Puerto Rico.

Juan Ascencio chert beds.
Cretaceous (?): Puerto Rico.

Juan Ascencio member (of Fajardo shale).
Cretaceous: Puerto Rico.

Jubilee limestone.
Cambrian: British Columbia.

Judique series.
Mississippian: Nova Scotia (Cape Breton Island).

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 (Phil. 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.
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.
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.
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. xlvii) 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. 8 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. a., vol. 10, 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 (Scl., 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 ss.); and (4) Eagle fm. (250 to 300 ft. of coarse, light-colored ss. 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 prevalently 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 ss. 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 fm. 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 Mts. 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 fmns. of mica schists, slates, qtzites, and l., 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.
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.
Juland member.

Upper Devonian: Southeastern New York (Greene County).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 90, 285). East of Ithaca both Enfield and Ithaca become divisible, the latter separating into Otsego sh. below and Cinncinatus sh. above; the Enfield into Kattel sh. below, a middle memb. I have been calling the Juland, from exposures in Juland Hill, just E. of village of Greene, N. Y., and at top Van Etten sh. ("First Tropidoleptus 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 Is. 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 1± sq. mi. Assigned to Tert. [The Rossland volcanic group is now assigned to Carbt (?), Trias. (?), Jurassic (?).]

Jumbo dolomite member (of Talladega slate).

Probably Paleozoic: Eastern Alabama.

C. Butts, 1928 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 53). Jumbo dol. memb. of Talladega.—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. Thickness at least 120 ft. Extends from NE1/4 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.


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 ss., 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 Is., 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. 506), 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. Piatt, 1877 (2d Pa. Geol. Surv. Rept. He, pp. xxxi-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 ash, alternating with red shales. Thickness 685 to 1,125 ft. Underlies Tuscarora gneiss and overlies Martinsburg sh. Is basal part of Medina of early repts on this region. Assigned to Sil. [Derivation of name not stated.]


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.

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, p. xxiii), applied Juniata River coal group to part if not all of his Hamilton series, which occupied interval btw. Genesee black shales above and Marcellus black shales below.

Juniper andesites.
Age(?): Northern California (Lassen National Park).

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).

Jupiter River formation.
Silurian: Quebec (Anticosti Island).

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. 760, 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).
Jutten volcanics.

Pre-Cambrian: Ontario (Savant Lake area).
G. Rittenhouse, 1936 (Jour. Geol., vol. 44, No. 4, p. 456).

Kaaterskill formation.

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 Catsauyus and overlying the Oneonta, and advocated the continued use of Catskill in the broad sense, which "is synonymous with Dev. red beds, continental."

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 sats. and shales now thought to be of Tully age, which make up a part of original Catskill group of Mather in Catskill Mins., N. Y. Their type is the principal reddish and olive-gray sats. ledges and associated red shales overlooking the Kaaterskill close on N. and making the falls of the Kaaterskill. Further field work may be necessary precisely to determine the strata 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).

Kachess rhyolite.

Eocene: Central Washington (Snoqualmie quadrangle).
G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie follo, No. 139). Kachesa 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 sats. and in part contemp. with the Naches, so that a heavy flow of Kachess is interbedded with the Naches sats. and basalt.

KaegeI fanglomerate.

See KaegeI 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 Waynevilie beds or Lower Richmond and Kagawong beds or Upper Richmond, the former being correlated with Waynevilie of Ohio and northern Ky., the Kagawong faunas being distinctly younger than Waynevilie 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, Manitoulin 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 overlies Manitoulin dol. along S. side of Georgian Bay. According to interpretation of writer, all the
red shales are to be included in Kagawong mem. 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 over­
lain 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).


*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.

of Aubrey group. Heretofore called "Aubrey" Is. 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 Is. 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.
thickness at other places 100 to 410 ft.

is exposed in Kaibah Gulch (a deep canyon cut entirely across N. part of Kaibab
Plateau), 8 ± ml. SW. of abandoned settlement of Paria, Utah, about 6 ml. N. of
Ariz. line. Here the Kaibab beds can be seen resting on Hermit sh. and overlain
by Moenkopi fm. The section in Kaibah Gulch is therefore proposed as the type
section, because it is only section of Kaibab Is. 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).

Bull. 1). *Kailua volcanic series.*—Composed of amygaloidal 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. Quarts 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. Kanehoe and Waimanalo.

Kaimuki volcanics.  
Pleistocene (late) : Hawaii (Oahu Island).

basalt.*—Varies from a dense rock nearly free from vesicles to very scorlaceous
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 1½ mi.
from rent. Seems to be younger than Diamond Head tuff.
Ka`imuki volcanics.—Chiefly basalt; some cinders and spatter. Overlies Diamond Head tuff. Included in middle part of Honolulu volcanic series [q.v.]. Formed Ka`imuki Hill. Assigned to late Pleist.

Kaimozaic. 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 idiotite 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. clg. 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.


Kalama volcanics.

Latest Pleistocene or Recent: Hawaii (Oahu Island).


Kalorama member.

Pleistocene (late): Hawaii (Oahu Island).


Kalkberg limestone.

Lower Devonian; Eastern and east-central New York.

G. H. Chadwick, 1908 (Sch. 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-barraek. [Thickness not stated.]

The commonly accepted classification of Helderberg group in N. Y. is (descending) Becraft, New Scotland, Kalkberg, and Coeymans ss.

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).

{Derivation of name not stated.}


Kaltag formation.


See under Skaktolik group. Also see U. S. G. S. P. P. 159, 1930.

Kamanaikl basalt.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii; Div. Hydrog. Bull. 1). Kamanaikl basalt.—Fresh, dark-gray, slightly vesicular basalt. Forms a V-shaped fill in Kamanaikl Valley SE. of Kamanaikl 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.


Kaministikwa group.

Pre-Cambrian: Canada (Rainy River district).

T. L. Tanton, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 114, abstract). The Kaministikwa group (Upper Copper-bearing series of Logan), a granite intrusive, is divisi-
ble into following 3 series (descending) Osier series, Sibley series, and Animikie series. Rests with great uncon. on Basement Complex. [All of definition. Type localities not stated.]

See also Kaministiquia fm.


Kaministiquia formation.

Age (?): Western Ontario.


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. 30, 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.


Kamouraska formation.

Cambrian (?): Quebec.


†Kanab sandstone.

Jurassic (?) and Upper Triassic: Southwestern Utah (Kane County).

E. Huntington and J. W. Goldthwait, 1903 (Jour. Geol., vol. 11, pp. 48-62), divided the rocks btw. Colob [Navajo] ss. above and Shinarump cgl. below into Upper Kanab (red ss.) and Lower Kanab (red ss. 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. 246) 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).

R. 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, 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.
†Kanawha 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) is. 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. Mertle, Jr., 1930 (U. S. G. S. Bull. 816, p. 138). 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 s.s.s. No calc. sh., ls., chert, or sличious 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.)
Pennsylvania: Central northern Pennsylvania (Elk County).
C. A. Ashburner, 1885 (2d Pa. Geol. Surv. Rept. R, pp. 72, 73). Kane is., 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. Pistor'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. 23 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.

Kaneok silts and gravels.
Pleistocene: Central southern Alaska.

Kaneoh volcanics.
Pleistocene (late): Hawaii (Oahu Island).

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; cgls. 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 and M. L. Nebel, 1923 (Ill. Geol. Surv. Bull. 43, pp. 22-72). Kankakee ls., relatively pure nonmag. Is., 0 to 50 ft. thick, was deposited at about same time as Sexton Creek Is. 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.]
on Edgewood Is. and is overlain uncon. by Joliet Is. (of early Lockport age), Clinton being absent. Is same as "Waucoma Is." [which has priority over Kankakee, and is an Iowa name].


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 Is. and dol. in layers 3 to 36 in. thick. Commonly cherty in NW. Ill. and Iowa. Includes Platymereilla manniensis zone at base. Overlies Edgewood Is. and underlies Joliet Is. 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 Is.

Kankakee torrential deposits.


Kano quartz diorite.

Jurassic (?): British Columbia.


Kanouse sandstone.

Middle Devonian: Northern New Jersey and southeastern New York.


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 1895 (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 Measure 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 Is.) and Lower Coal Measure or Lower Kansan epoch (from top of Iola Is. to base of Cherokee sh.).

Kansan 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 Is. 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 Is. memb. of Kansas City fm. and same as Kansas City Is. of Gallaher, according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13), but is older than Drum Is., according to N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 35, 40), and is upper part of Westervile Is., the lower (nonoolitic) part being called "Bull ledge" at Kansas City.
R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 95, 100, 282). Kansas City oolite of Broadhead refers to beds now classed as Westervile Is. and Is abandoned.

Kansas City limestone.
Pennsylvanian: Northwestern Missouri.
J. A. Gallaher, 1898 (Mo. Geol. Surv. Blen. Rept., p. 51), and 1900 (Mo. Geol. Surv. vol. 13, p. 206), used Kansas City Is. for a bed of Is. in Upper Coal Measures of Mo. btw. coals Nos. 5 and 6, which is same as Kansas City oolite of repts., and comprises upper part of Drum Is. memb. of Kansas City fm. of Hinds and Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), who divided Drum Is. 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 (1938), however, the Drum of Hinds and Greene Is Westervile Is., and true Drum is younger. See Kana.-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.
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 Is. and base of Wyandotte Is. It includes (descending) Lane sh. [restricted], Iola Is., Chautau sh., Drum Is., and Cherryvale sh. [This definition excluded from lower part the Winterset Is., Galesburg sh., and Hertha Is.]
R. C. Moore and G. E. Condrea, 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 Is. and its base at top of Winterset Is., 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 Is. of Hinds and Greene is not true Iola but is Argentine Is.; according to Newell (1935) it Is=Frizable and Argentine Is.
For Moore and Condrea'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 Is. and base at base of Hertha Is. 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. Eakins suggests that some he studied may be as old as Ord.

**Kanuyak formation.**

Pre-Cambrian: Arctic Canada.


**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.


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 Is., instead of at base of Kanwaka sh. When Condra introduced Kereford Is. in 1927 he included it and an underlying sh. in Kanwaka sh., and treated Plattsmouth Is. as top memb. of Oread Is. But in 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 89-97) R. C. Moore transferred Kereford Is. and underlying sh. (Heumader sh.) to Oread Is.; and Condra's 1935 and Moore's 1936 classifications followed latter definitions of Kanwaka sh. and Oread Is.; but Moore stated (p. 169) that where Kereford Is. is absent Kanwaka sh. extends down to top of Plattsmouth Is. 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. Crugin (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.

Karquines 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 Adolfa 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 Leptostrophya 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.


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 Is. or Upper Archimedes Is.—Extensive and important Is. fm., constituting the Is. of Kaskaskia and Chester, Ill., and those below Ste. Genevieve, Mo. Consists of beds of Is., of greater or less thickness, alternating with thin seams of marl or sh., and in some parts heavy-bedded Is. 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-masures 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.


Kaslo schists.

Jurassic: British Columbia.

Kaslo series.
Triassic: British Columbia.

Kasota sandstone.
Lower Ordovician: Southeastern Minnesota (Le Sueur 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) between Jordan sand and Oneota dol. is unique, and on basis of fauna the bed is here described as Kasota s.s. 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 bluffs 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 bluffs of Minn. River, and at Raripan, 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 between 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) dolomitie, 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 minnesotens, together with several species of Ophiacta, 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, Le Sueur Co., Minn., according to O. Bowles (U. S. G. S. Bull. 633, 1918).

Katahdin granite.
Carboniferous (?): Western Maine (eastern part of Piscataquis County).
F. W. Toppan, 1932 (Geol. of Maine, Contr. Dept. Geol. Union Coll., Schenectady, pp. 68-99). 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, 5,207 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, 1908 (U. S. G. S. Bull. 835, 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. Talaferrro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 2, 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 Burts Creek sh. memb. above and Split Creek sh. and es. below. It occupies fully 85 percent of Katalla dist.; the Redwood is restricted to a broad, steeply plunging syncllue btw. Redwood and Burts 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. (?).

†Katemy series.

Upper Cambrian: Central Texas.

T. B. Comstock and E. T. Dumble, 1889 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. ix, 259-288). Katemy (Potsdam) series.—Consists of (descending): (1) Cgl. and is. called Potsdam is; (2) greenish shales and sandy is. 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 Katemy Creek, Mason Co.

Katherine granite.

Pre-Cambrian: Northwestern Arizona (Katherine district, Mohave County).


†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 (18th 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 mts. mis-called "Catskills" by the English (kil is creek), namely *Katsberg* (pronounced cots-barrakh). Grades down into red beds, of Tully to Oneonta age, here named *Ontoora 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 Chautauquaq age).

K. E. Caster, 1934. (See 1934 entry under *Catskill fm.*)


**Kattehol shale.**

**Upper Devonian: Southeastern New York (Otsego County).**


G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862). The Enfield splits into (ascending) *:Kattehol* ("Leiohynchus globuliforme") zone and the Juliand and Van Etten ("Rfsc Tropidolepit") 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, 40-46, 48, 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. 548). 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. 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 (f), 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.
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 prismas 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 Calcareous 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. By Guide, p. 58), 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 katasonal 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, Turritella columbiana Dall, a new species of Conus, numerous diminutive (dwarfed?) natillas, and a few achatas. 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.]


†Keddie formation.
Pennsylvanian: Northern California (Lassen Peak and Taylorsville regions).
Name used † 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).
Above is definition still in use. (See F. B. Plummer and J. Hornberger, Jr., Univ. Tex. Bull. 3534, 1966.)

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.].

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 ss.s. 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 eqs. 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).
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.

Kelligrew Brook formation.
Cambrian: Newfoundland.

Kelly limestone.
Mississippian: Central New Mexico (Magdalena district).
C. L. Herrick, 1904 (Am. Geol., vol. 13, pp. 310-312). [See under "Graphic-Kelly ls."]
and overlies pre-Camb. rocks. Is same as Herrick's Graphic-Kelly Is. So far as known is confined to Magdalenia dist. Cannot yet be correlated with Lake Valley Is.

Named for Kelly, Magdalenia dist.

Kelly Hill facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 136, etc., 1931) to a lithologic development of his Carwood fm. in a part of southern Ind.

Kelly Island formation.

Lower Ordovician: Newfoundland.

O. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). Kelly Island fm.—Ss. and shales carrying Lingula bowiei, 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 Kelvin's 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.


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 (Mi.e.)—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 Mi. 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.
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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 \( \frac{1}{2} \) 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 contemporaneous. Greater part of the tuff is near or at base of the tuff. 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.

Kendall Green slate.
Pre-Cambrian: Eastern Massachusetts (Boston Basin).
W. E. Hobbs, 1890 (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 sl, 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. 98-104). Kendrick sh.—Fossiferous limy sh., generally soft blue-gray calc. sh. carrying many calc. and magnesite 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 limy sh. 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 sh.
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 19½ 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 strike 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 Kendricks homestead. 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.)
Kennecook limestone.
Mississippian: Nova Scotia.

Kenneth limestone.
Silurian (Cayugan): Northern central Indiana (Cass County).
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.


Kennett rock.
Pre-Cambrian: Southeastern Pennsylvania (Chester County).

The qtzite at and around Kenneth 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 ls. 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 Kenneth, 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 Carbt. 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.

The ls. at and around Kenneth 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).

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.
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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. Moffitt (rept on Chiltina 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-colorsd 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.


Kenoshia shale. (In Tecumseh shale.)

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 47, 52). Kenoshia sh. is proposed in this rept. for the 6 or 7 ft. of sl. at base of Tecumseh sh. memb., and underlying Ost is. Type loc. in Missouri River bluff near Kenoshia 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).


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 sl. in the Carbf. rocks succeeding the Sub-carbf. 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. Iss. of Ky.

Kentville formation.

Silurian: Nova Scotia.


Kenwood beds.

Middle Devonian: Eastern Iowa.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, p. 23). Kenwood beds.—Massive arkil. and ferruginous shales, buff and reddish-brown iss., 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., 1835, 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, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 29). Kenwood ss. extends southward perhaps only to Lebanon Junction, Bullitt Co., Ky.


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. 94 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). Keokuk cherty Iss.—Gray cherty Iss., forming wall of rock washed by the Mississippi below Keokuk Landing, Iowa. Overlain by Shell beds and underlain by Hannibal beds (brown Encrinital iss. alternating with bands of chert), which rest on Burlington beds (the Encrinital group of Burlington). [According to later Iowa repts the Keokuk cherty Iss. of Owen are the “cherty beds of passage” separating the Keokuk and Burlington Isss. of Hall.]

J. Hall, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pt. 2, pp. 53-56). Keokuk or lower Archimedes Iss.—Highly fossiliferous Iss., separated from overlying Warsaw or Second Archimedes Iss. by “Geode bed” (a mass of shales or marls with impure iss. containing geodes), overlain, locally, near Warsaw, Ills., Appanoose, Iowa, and other places, by 10 ft. of mag. Iss. Separated from underlying Burlington Iss. by 60 to 100 ft. of beds of passage, consisting of cherty layers with intercalated beds of light-gray Iss.

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. Udlen in 1901; by H. Hinds in 1909; and by C. B. 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 Tuyll in 1912. They were included in Keokuk by A. W. Vodges in 1888 and by F. M. Van Tuyll 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 Is.

The present accepted definition of Keokuk Is. 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 Is.) 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 Iss. forming top memb. of St. Louis group and overlies brecciated Iss. of the St. Louis.

According to F. M. Van Tuyll (Iowa Geol. Surv. vol. 30, p. 259, etc., 1925) this iss. is of basal Ste. Genevieve age, is overlain by Iss. of Ste. Genevieve age, underlain by true St. Louis Iss., 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).

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.

These beds appear to be same as Manitoulin memb. of Williams, 1914, and Manitoulin Is. 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. F. 169). *Kerber fm.*—Series of coarse-grained sand or grits and black carbonaceous shales which overlie, with possibly a stratigraphic break, the Leadville sandstone and extend up to the 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 lags, for which name *Kereford la.* is proposed. Herefore this lag has been known as "Waverly Flags," 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 arenaceous, and fossiliferous. In writer's opinion this bed belongs in Kanwaka sh. memb. and not in Oread la., where Hinds and Greene placed it.


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, 582). *Kerens memb.*—Forms upper two-thirds of Wills Point fm. Dark gray silt 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, 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 Neogene.


**Kern River series.**


**Kernville series.**

- Jurassic or older: Southern California (Kernville quadrangle).
- T. Chapin, 1919 (U. S. G. S. P. P. 120, p. 88).

**Kerrick morainic system.**

- Pleistocene (Wisconsin stage): Northeastern Minnesota and northwestern Wisconsin.
- Named for Kerrick, Pine Co., Minn.

**Kessler limestone member (of Bloyd shale).**

- Pennsylvaniaan (Pottsville): Northwestern Arkansas.
- Named for Kessler Mtn, Washington Co.

**Ketchikan series.**

- Upper Triassic and Carboniferous: Southeastern Alaska (Ketchikan region).
- T. Chapin, 1919 (U. S. G. S. P. P. 120, p. 88).
Ketchum Bluff conglomerate.
Pennsylvanian: Central southern Oklahoma (Jefferson County).
See under Oscar ss.

Ketona dolomite.
Cambrian (Upper): Northern central Alabama.

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. 333). Kettle meta-andesite.—An extended aeries 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 e.g. 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 interlobe moraine.

Kettleman lake bed.
Probably Pliocene: Southern California (Tulare Lake region).
J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 187). 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 118° 50'). Kettle River fm.—Olig. ss., cgl. ab., arkose. Underlies Midway volcanic group. [Mapped along Kettle River, B. C., N. of 49th par.]
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R. A. Daly, 1913 (Canada Dept. Int. Rept Chief Ast. 1910, vol. 2, p. 294). 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 (Carb. 1).


Keuka flagstone.


†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.
†Keweenaw series.
†Keweenawic.
†Kewenian.

Variants of Keweenawan.

Kewstoke conglomerate.


†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 fercuginous 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 Grew ss. Underlies Izard Is. and overlies Yeultille 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, 1899 (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.


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 ml.

**Keys sand.**

A subsurface sand, of Penn. age and 15 to 20 ft. thick, in Cotton Co., Okla. Lies 96 to 100 ft. below top of Priddy sand and higher than Zypsle sand.

**Keyser limestone member** (of Helderberg limestone).

Lower Devonian: Pennsylvania, western Maryland, northern West Virginia, and western Virginia.


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 Tomoloway 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.


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 oolites 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 between hand specimens of the two. Is of marine origin. Apparently overlies Key Largo Is. Relations to nonoolitic Lostmans River Is. 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 between 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, Shellkof Strait).

S. R. Cappe, 1923 (U. S. G. S. Bull. 739, pp. 90, 91, 94, map). Kialagvik fm.—A few hundred ft. (500-) of sa., 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 Shellkof 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.


In southern Okla. overlies Goodland Is. and underlies Caddo Is. 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.

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 s.s., 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 lea., and forming upper memb. of Quadrant in this quad. The Kibbey ss. rests on Madison Is. [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.
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.
Named for Kickapoo, Leavenworth Co., 5 mi. S. of Iatan.

Kickapoo beds.
Pleistocene (Wisconsin stage): Central western Illinois.

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).
E. H. Seilbards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), replaced Millsap fm. with Millsap Lake fm., and described Kickapoo Falls Is. 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. 3334, pp. 15, 16). Kickapoo Falls Is. 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.
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.
Kiewitz shale. (In Stanton limestone.)
Pennsylvanian: Southern Nebraska.
G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 55). Howard Is. 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 l. of Howard memb. was named "Louisville Is." by Condra and Bengston, from Louisville, Nebr., and that name, although preoccupied, is in use for this unit in Nebr. The lower l. of Howard memb. is here named Church Is.
G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 27, 31). The units called Louisville Is., Kiewitz sh., Du Bois l., Severo sh., Topaka Is., and Meadow Is. in Bull. 1 are parts of Stanton l. The name Louisville Is. is preoccupied hence Stoner Is. is proposed for this unit, to include also Kiewitz sh. and so-called Du Bois Is.

Kiger division. (In Cimarron group.)
Permian: Southern Kansas and northwestern Oklahoma.
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).
*Kigluaik series.—Highly crystalline Is., interbedded with gray mica schists, also some amphibole schists. The Is. usually massive, pure, generally white but sometimes bluish. Intruded by granites. More metamorphosed than overlying Kuzitrin series. First found in heart of Kigluaik Mts., and later identified at other places.
F. H. Modit, 1913 (U. S. G. S. Bull 634, pp. 20-25, maps). *Kigluaik group divided as follows (descending): Tigaraha schist, several thousand ft.; biotite gneiss. All except upper siliceous part of Tigaraha schist were included in Kigluaik series as originally defined and hereofore used. Assigned to Paleozoic, possibly pre-Paleozoic.

Killbuck conglomerate lentil.
See Killbuck cgl. lentil, the approved spelling.

Killarney granite.
Pre-Cambrian (post-Keweenawan): Western Ontario (north shore of Lake Huron).
See also A. C. Lawson, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 361-383); also C. K. Leith, 1933 (16th Int. Geol. Cong. Guildebook 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). Killbuck cgl. lentil.—Massive flat-pebble cgl that weathers into large flat blocks. Thickness 10 to 15 ft. Best developed NE. and E. of Killbuck, 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.
K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 81). Killbuck lens of Glenn is same as “Tuna” or Tunaugwant cgl.

Killians limestone.
Middle Devonian: Northeastern Michigan (Thunder Bay region).

Klin shale.
Upper Devonian: Alberta (Jasper Park).

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.)

Kimbell or Madder dirt.
Name applied by drillers to a bed of sh., 10 to 20 ft. thick, underlying Raytown Is. bed and overlying Cement City Is. 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 cgl.s.
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.

Kimberly bed.

Eocene (Upper): Northwestern Louisiana (Grant County).
T. L. Casey, 1902 (Sci., n. s., vol. 15, p. 716). Kimberly 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 Kimberly horizon. Is older than Young's 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 Kimberly 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 la.—More or less crystalline l 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 Is.
32. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), defined Kimmswick Is. 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 Is. was repeated by R. S. Bassler in 1915.
J. H. Bradley, Jr., 1925 (Jour. Geol., vol. 33, pp. 55-54, 65, 69). Beds that have been included in Kimmswick Is. are McCune or Fusi spira zone at top; Comarocystites or Echinospaerites zone (which forms top bed of Kimmswick at Cape Girardeau) 30 ft.; Rece t a t a l i t e s o v e n i zone, 68 to 80 ft.; and basal beds, 50 ft. It seems likely Kimmswick Is. in its type exposures does not rise above base of Fusi spira 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.
B. Well er and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 104-110), restricted Plattin Is. by removing the shaly beds at top, which they designated as Decorah sh. The Kimmswick Is. of Mo., SW. and central western Ill. has, therefore, for several years been defined as resting on Decorah sh. (See under Decorah sh., later entry.)

The Kimmswick Is. 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 "Myrlck fm." on Frio River, about 3/2 mi. above Myrick's lower apiary (now Bob Evans apiary), as given in U. S. 6. S. Uvalde folio, No. 64, 1900. The Kincaid fm. in that section consists of (descending): (7) Rather soft yellowish s., 22 ft. 6 in.; (8) 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 ex-
posures are on old Kincaid ranch (Lewis ranch) ½ mi. above Bob Evans' apiary
to ¾ 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 Venerocardia
bulla Dall, that appear for first time; (4) a large percentage of the foraminifers
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.
3. 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.

hook group” is now proposed to include the beds lying btw. Black si. 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, 1880 (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 ls., 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 Is. of Rock-
ford, 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.

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).
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 mts 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 mts. 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, 1896 (Mo. Geol Surv. vol. 12, pt. 1, pp. 49, 71-74). **King ls**.—Soft fine-grained, compact light ashy-gray Is. ("cotton rock" of miners), 1 to 15 ft. thick. No fossils found. Overlss [?] Black or Eureka sh. and underlss Sac Is. 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 aer., pp. 113-114). Sac ls. uncon. underlies "Phelps" (Syiamore) ss. and overlsses King Is. 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. Is.
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 Syiamore 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. LeBongwell, 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.
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.)
Pennsylvania: 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 Is. and overlies Cullom Is. [Later named Bette Is. and still later Cullom was abandoned]. All included in Lecompton Is.

Kings limestone.
Devonian: Missouri.

Kings Branch limestone.
Age (?) : Southwestern Missouri (Greene County).
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 Is. generally called Kingsbridge marble commences and continues to Kingsbridge, a distance of nearly 1¼ mi. Is mostly granular Is. 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 Is.
J. F. Kemp, 1887 (N. Y. Acad. Sci., Trans., vol. 7, pp. 49-64). The Is. 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 Is. 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 Is. 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 Pinny 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 mts. 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 silified marls; also Kings Creek phase.*—Comprises ledges of highly siliceous rock inclosing many echinoids of sponges and other forms now silicified. The surface of high ground between 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 in places strewn with small masses of chaledony of many hues of white, red, and blue; at the King's Creek locality a moderately prominent knoll lies well aligned 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, 1938 (U. S. G. S. Bull. 887). *Kings Creek phase* of Sloan includes Glendon fm. and upper part of Eocene, and is abandoned.

Kingsdown marl.

Pleistocene: Southwestern Kansas.


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. 371-589). *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., pp. 72-77). *Kings 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 Dunecannon, Perry Co.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 585). As Shobols 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).

500 ft. Underlie Delville 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 Delville 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 Mt 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 Mt slates (Archean).—Comprise large bodies of quartz schist, quartz-mica schist, qtzite, mica schist, sericites, monzonite schists, gneissoids, and some argilites 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 Mt 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 Blackburg schist and rests uncon. on Battleground schist (Algonkian) and on Archean rocks.

Named for development on Kings Mtn, in Cleveland and Gaston Counties.

Kings River sandstone member (of Everton formation).

Lower Ordovician: Northwestern Arkansas (Eureka Springs-Harrison region).

Kingston group.

Pre-Cambrian: New Brunswick.

Kingston conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.
According to B. S. Butler (U. S. G. S. 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.
J. M. Clarke and C. Schuchert, 1899 (Scl., 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 Is. Top fm. of Helderbergian group.
The name "Kingston" being preoccupied, it was in 1903 replaced by Port Ewen Is., which is now included in Oriskany group, having been transferred to that group by Schuchert in 1903 (Am. Geol.).

Kingston formation.
Pleistocene: Jamaica.

Kingston limestone.
Carboniferous: British Columbia.

†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 quartzite ss. (almost an arkose), cgl., medium-grained and fine-grained ss., and dark blue shales. Basal part consists of 100 to 200 ft. of arkose and cgl., 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.

Kinilshba beds. (In Supai formation.)
Permian: Southeastern Arizona (Fort Apache Indian Reservation).

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 Is.—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 lss. 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 Degenia ss. with apparent conformity. Uncon. overlain by Pottsville fm. Included in Clore fm. as mapped in previous reports. 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 Iss. 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, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 947, etc.). Kinnikinio 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).


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. f.), 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.

Kinter sand.

Ordovician: Northeastern Oklahoma (Oklahoma City oil field).


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.


Kinzers formation.

Lower Cambrian: Southeastern Pennsylvania.


†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. Carli in 1880 (2d Pa. Geol. Survey Rept. L, 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, 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 sa.**—Top lies 410 ft. above base of Bearpaw sh. and 150 ± ft. below Rye Grass sh. Base lies 100 ± ft. above McGrath sa. 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 sa., but very few occur below it.

†Kirby clay.

**Lower Cretaceous (Comanche series)**: Central southern Kansas.


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 Know Mtn granite, 1906.

Kirk gas sand.


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 Sopranite 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 (1908) 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.


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.
H. B. Kümkel, 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 reprs) underlain by 80 to 90 ft. of chocolate or drab-colored clay. Uncon. overlies Shark River marl and uncon. underlies Cohawney 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. Geol. Surv. Bull. 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 1,150 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. Geol. Surv. Bull. 716, 1921). 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 ss. 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.

Kishenehn formation.
Tertiary (Eocene?): Southern British Columbia.
R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 88). Kishenchn 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 Kishenehn, and Rose, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 31), spelled it Kishenehn.)

Kishwaukee moraine.


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 Otsego 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 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 sats. 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. 837). 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.

Kisk volcanics.

Pre-Cambrian: Manitoba.


Klsner 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.

Kissigeynew 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. Dilly, 1905 (Canada Geol. Surv. Summ. Rept. 1904, pp. 98-100). Kitchener gisite.—Hard sats. and argilites interbedded; contain high proportion of dissemi-
nated 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 quartzite. The intrusive Moyie sill of gabbro, 2,500 ft. thick, lies in middle of Kitchener quartzite.


**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 achiaite.*—Greenstone achiaites 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 cgl.* [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.*


**Kitsilano formation.**

*Tertiary: British Columbia.*


**Kittanning coal group.** *(In Allegheny formation.)*

*Pennsylvania: Western Pennsylvania and Maryland.*

J. P. Lesley and J. C. White, 1878 (2d Pa. Geol. Surv. map of southern Butler County). *Kittanning group, Kittanning coal.* [The block beneath Darlington coal reads (descending): “Kittanning group, Kittanning coal.” This map is in library of U. S. G. S.]


I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Kittanning group* extends from top of Upper Kittanning coal to top of the Buhstone iron ore overlying the Ferriferous (Vanport) Is.


*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.*


W. G. Piatt, 1880 (2d Pa. Geol. Surv. Rept. H, 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 Kittening 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.)
Pennsylvania: Western Pennsylvania.

Kittanning fire clay. (In Allegheny formation.)
Pennsylvania: Southwestern Pennsylvania.
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.)
Pennsylvania: 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 Is. occurring lower in Ohio section than Freeport Is. 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 Is. "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.]

†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 (Pennsylvania?): Southwestern Maine and southeastern New Hampshire.
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 contempor. Elliot 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, ass., 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.

Kitzault River formation.
Jurassic: British Columbia.

†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.
Klondike member. (In Columbus limestone.)

Middle Devonian: Central Ohio (Delaware County).

Klusha intrusives.

Tertiary or Pleistocene: Yukon Territory.

Klutina group.

Carboniferous or older: Alaska (Copper River region).
F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 410, 418). The Valdes rocks, roughly speaking, extend N. to region of Lake Klutina. Here they form a base of the mts., 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 mts. and extend into foothills at edge of Copper River Plateau. These rocks are provisionally called Klutina series. They form most of the mts. about the lake and seem to overlie Valdes rocks. They consist of mica schists, quartz schists, sometimes cherty or jaspery, and crystalline Is. or marble. Judging from lithologic resemblance they may belong to Fortymile series. If so, they are probably pre-Silurian.
T. Chapin, 1918 (U. S. G. S. Bull. 688, p. 22), assigned Klutina group to Carbt. or pre-Carb.

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 cgs. 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 Devonian 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. rept. as "sub-Olean cgl." It lies 350 to 400 ft. lower than Shenango as., with which it has heretofore been correlated.
Smethport sh. memb. or lower upper "Bleville" 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 Hayfleld sh. into (descending) Hayfleld 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.]


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 Carb.

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 Hayfleld 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 non-conformity 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.


C. K. Leith, B. 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.


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 quartzites 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 interbedded 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.


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.

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.

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 cpl. 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 ss. In places usurp most of the Mahantango. Contemp. in part with Montebello ss.

Knobtown sand.
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 Is., or Mosheim Is., where that Is. 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, 204-226). 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].

Named for Knox Co., Tenn.

Knox sandstone.
J. M. Safford, 1869 (Geol. Tenn., pp. 151, 158-159, 204-226). 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 fusoidal impressions
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 B. by Penobscot fm., of which it may represent a highly intruded phase. 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, 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 between 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 fm. 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 cgts., 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 piochil. [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 sparly 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 la. 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.

Knuckle Island granite.
Age (?) : Ontario (Rainy Lake district).

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 sh. introduced to replace “gray band” in Genesee Gorge at Rochester, which was formerly called, by writer and others, Thorold as., but which is now known to be younger than true Thorold as. 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 as. 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 quartzitic and argill. beds at head of Buena Vista Canyon. To N. it consists of argillltes and silaceous beds interposed with silaceous argillltes; 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.

†Kolpatoan 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 [Kolpato “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 Kolpato 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).


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.


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.

Kona dolomite.
Pre-Cambrian (lower Huronian) : Northwestern Michigan (Marquette district).

Konawa formation.
Permian (?) : Central Oklahoma.
G. D. Morgan, 1924 (Bur. Geol. [Oklahoma] Bull. 2, pp. 140-141, pis. 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 sas. are often prominent and sometimes outcrop over large areas. No lls. observed. Top of fm. is drawn at base of 30± ft. of coarse red and brownish red sas. 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 sas. 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.

Named for development at and around Konawa, Seminole Co.

Koochiching granite.
Pre-Cambrian (Laurentian) : Northern Minnesota (2 miles west of Rainy Lake).

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. sas. and cgs., and eolian calc. sas. On p. 42 Wentworth maps Koolau basalt in Diamond Head dist.
H. T. Stearns, 1935 (Geol. and gd. water rep. 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 basalts 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. Geol. 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 Jurassic-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 ...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 cycada 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.


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 seams, containing a flora of Lowest Cret. age, and older than the Dakota of Middle Cret. age. The flora has Jurassic affinities. The series overlies Triasslc 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. (T) 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.


†Kootenayan series.

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, 1906 (U. S. G. S. P. P. 46, p. 214). In 1900 (U. S. G. S. 21st Ann. Rept. pt. 2, pp. 337, 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. 285, 327, map). Kowak clay.—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 Pliol. 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. 18-23). The Palisades form typical exposure of lacustrine phase of deposits Spurr and Collier designate "Yukon slits" 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), al., dark sh., some ss. and arkose, all more or less associated with or intruded by igneous rocks. Lower Cret. fossils. Correlated with Anaktuvuk series. Occurs along Koyukuk River and may have very wide extent over Koyukuk Basin.
Krao limestone.
Age (?): British Columbia.

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. capped on hills a few mi. N. of Coalinga, but thickest to S. and SE. and at Kreyenhagen wells, for which it is named. It is about 800 ft. thick. Thins to 250 or 300 ft. at head of the Jacalitos and on Zapata Chino. Underlies Domijean sands and overlies Avenal s.s. Of Eocene age.

For many years *Kreyenhagen sh.* has been applied to beds described as uncon. underlying Vaqueros s.s. 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 Is. The ss. is common only at base of fm., whereas 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 ss.s., 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 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. s.s.s. and sandy shales (variously called Domengine, Tejon, Meganos, or Martinetti). 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 Canhua-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., Bucumian," 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 1 1/2 ft.; (2) olive-drab to gray calc. massive sh. weathering buff, with usually a thin calc. concretion near middle, 2 1/4 ft.; (3) light-gray to buff massive l. weathering buff, 1 1/2 ft. Thickness 4 1/2 to 6 ft. from Nebr. to southern Kans. and Okla. Underlies Paddock sh. memb. and overlies Odell sh. memb. Type loc. road cut 1/4 mi. S. of Krider, Gage Co., Nebr.


R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 12, 119°30' to 120°). Kruger alkaline body.—Mallgnite and eleollie 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 Kougark River, instead of Kugruk River, and that the rocks should have been called Kougark 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 Kougark group.


G. W. Evans, 1912 (Wash. Geol. Surv. Bull. 3, pp. 42–49). Kummer series.—Top div. of Puget fm. in King Co. Chieflly coarse-grained light-colored ss. with numerous sh. and clay beds and 9 coals that are worked at Kummer mine, 1/4 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.


See under Kummer series.
Kupiklipikio basalt.

Kupiklipikio black ash.

Pleistocene (late) : Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 40, 41, 42, 44). Kupiklipikio basalt.—Basalt flow covering higher part of Kupiklipikio 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 Kupiklipikio black ash and with Kaimuki basalt.

Same as Black Point basalt of H. T. Stearns. The meaning of Kupiklipikio 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 Wehmeier memb. Is normally dark-brown to limonite brown aren. sh., not materially different from underlying Oswayo sh. Fossils throughout. Includes, near middle, Marvin Creek Is. 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.

Kushatka formation.

Oligocene or Miocene: Southeastern Alaska (Controller Bay region).

G. C. Martin, 1905 (U. S. G. S. Bull. 250, p. 14). Kushatka fm.—Series of coal-bearing strata exposed in valley of Bering River and its tributaries and on shores of Lake Kushatka. Consists of at least many hundred and probably several thousand ft. of sh., arkose ss., and coal seams. Lower ldy 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 Renal fossils.

G. C. Martin, 1906 (U. S. G. S. Bull. 284, p. 66), gave thickness of Kushatka fm. as 3,500 to 4,000 ft.

G. C. Martin, 1908 (U. S. G. S. Bull. 335, pp. 24, 30), gave thickness of Kushatka 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) Kushatka fm. on W. shore of Kushatka Lake. Did not mention any coal in Stillwater. This may or may not be a restriction of Kushatka fm. He also stated that Kushatka fm. occupies part of crest and much of E. slope of Kushatka Ridge, and that largest known area extends in broad belt from E. edge of Kushatka Glacier to NE. edge of area mapped. The fm. overlying the Kushatka he named Tokun fm.

N. L. Talliferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, p. 771). "Writer suggests that Tokun fm. is=lower part of Katalln fm., or the beds he herein names Split Creek memb., and that this is underlain by Kushatka 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.


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 silaceous 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 Is. Underlies Nome series and overlies Kigluaik series. Typically exposed in Kigluaik Mtna. Named for Kuzitrin River along whose lower course it is well exposed.

Kyle sandstone.

Tertiary: Southeastern Nevada.


Labadie limestone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 688F, p. 45). Labadie Is.—Where best developed is a crystalline Is. 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 m. N. of that place. Thins so rapidly to N. that it cannot be recognized N. of E. quarter corner of sec. 24 but a 2 in. thick at about same horizon was seen at several places farther N. in Twp 28 and 29 N., R. 10 E. Lies 175 ± ft. below middle bed of Oread Is. and 65 ft. above lower Fusulina-bearing Is.

D. E. Winchester, K. C. Heald et al., 1918 (U. S. G. S. Bull. 688G, p. 50). Labadie Is. is first Is. of any prominence below Oread Is. (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 Cobahee ss. and 60 ± ft. above Chesewalla ss.

Named for Labadie Point, sec. 9, T. 26 N., R. 10 E., Osage Co.

Labahla member (of Goliad formation).

Pliocene: Central Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3222, pp. 530, 752, 754). Labahla 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.


Laberge series.

Jurassic or Cretaceous: Yukon Territory.

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. 39-37, 92, 94, 100). Labette shales, suggested by G. I. Adams, in field notes, for shales, with some sa., coal streaks, and thin Iss., 30 to 75 ft. thick, underlying Pawnee Iss. and overlying Oswego [Fort Scott] Iss.

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 Curbf. rock system of eastern Kansa.). Labette beds Include (descending) Pawnee Iss., Labette sh., and Fort Scott Iss.

Preoccupied. Same as Henrietta fm.

La Biche shales.

Cretaceous (Upper) : Alberta.


†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.


†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.


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, p. 73). Lackawaxen cgl.—Separated from overlying Montrose red sh. by 30 ft. of greenish gray ss., and from underlying Delaware flags by 350 ft. of ss. 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.


The Lackawaxen cgl. of I. C. White's Huntingdon County rept (2d Pa. Geol. Surv. Rept. T, 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. 1930 (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. aer. 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.


Laclede sandstone.

Upper Cambrian: Central Missouri.


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.


Lacoste series.

Pre-Cambrian: Quebec.


La Cruz marl.

Miocene: Cuba.


Lac Seul series.

Pre-Cambrian: Ontario.

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 Is. memb. and underlies Hertha Is. memb. of Kansas City fm. Consists of 125 to 150 ft. of shales and intercalated ashs., 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, La Cygne 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 Is. 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 Kümmei).—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 aropy flow structure indicative of an intrusive sheet. [The compiler does not find that Kümmei 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) sh.—Underlies Coosa Valley (Knox) sh. and ss. and overlies Talladega (Ocone) group. [Only definition is on map legend.]

Probably same as Weisner quartzite.

Named for Ladiga, Calhoun Co.

Ladner series.

Jurassic: British Columbia.


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 Is. and underlying Mound Valley [Bethany Falls] Is. 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 Is. (basal memb. of their Swope Is.) and as overlying Unlontown Is., 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 Unlontown Is. a considerable distance below Hertha Is.

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21), placed restricted Ladore sh., 7 ± ft. thick, above Hertha Is. and below Swope Is. 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 Is. 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, 1938 (Kans. Geol. Surv. Bull. 22, p. 82). Ladore sh. includes beds btw. top of Hertha Is. and base of Swope Is. In region N. of Erie, Kans., the top of Ladore sh. is base of Middle Creek memb. of Swope Is., but S. of Erie, where Middle Creek Is. is absent, the top of Ladore is considered to extend up to base of Bethany Falls Is. 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. Is. belongs to the cyclothem that includes Bethany Falls Is. 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.

Ladystep intrusives.
Devonian (Middle or Upper): Quebec (Dartmouth River area).

Ladystep volcanics.
Silurian or Ordovician: Quebec (Dartmouth River area).

†Lady Washington sandstone.
Pennsylvanian: Southwestern Indiana (Spencer County).

Probably same as Mansfield ss.
See also under †Martha Washington ss.

†Lafayette formation.
Cretaceous, Eocene, Neocene, and Pleistocene: Coastal Plain of southeastern United States.*
W J McGee, 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, pp. 347-321), 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 ml. 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, 1889, and Lagrange of Longbridge), 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 the "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 1906 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. 96L and 96M) 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.
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 Carb. (?) .
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, 1 1/4 ml. N. of Penters Bluff Station. Named for West Lafferty Creek, which is 3/4 ml. E. of the exposure.

Lafonde gravel and marl.
Age (?) : West Indies.
Lagarto clay.
Miocene (?) : Southern and eastern Texas.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, p. 560). Lagarto div.—Light-colored clays (illic, lavender, sea green, greenish brown, and motting of these colors) and sands of different character from those of Lapara div. The clays contain quantities of semicrystalline ls. pebbles with manganese dendrites. Upper part usually a ss. Underlies Reynosa div. and overlies Lapara div. Assigned to Pilö.
A. Deussen, 1924 (U. S. G. S. P. P. 126, pp. 21, 106, etc.). Laparto clay.—Light-colored or mottled pink and green clays, with numerous lime nodules; stained heavily with manganese in places. Strings of la. extend downward into the clay where it is capped by Is. Includes also sands and ss. 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 Llale fm. 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 2,600 ft. in wells.

Lagonda sandstone member (of Cherokee shale).
Pennsylvanian : Northern Missouri.


Is now treated as a memb. of Cherokee sh.
Named for exposures at Lagonda, Charlton 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, 1884 (Am. Jour. Sci., 2d, vol. 37, pp. 301, 309–370). Orange sand or La Orange 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 more than 100 ft. exposed at Lagrange. Forms more than third of entire surface of W. Tenn., in belt 40 ml. 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 "La Grange 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 La Grange, Fayette Co., Tenn.

†La Grange sandstone. (In Chester group.)
Mississippian: Northwestern Alabama.
La Grange ss.—Fine to coarse-grained, sometimes heavy-bedded, sometimes slaty ss. Only ss. in midst of Mountain Is. 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. is duplicated, with Is. between.
Preoccupied. Replaced by Hartselle ss., Golconda fm., and Cypress ss. Named for La Grange, Colbert Co.

La Grange moraine.

La Grange 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.
Piocene (?) : 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 alluvial shore 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.


La Jara shale.

Name applied by C. [R.] Keyes (Conspicuus of geol. fms. of N. Mex., 1915, pp. 2, 8) to "uppermost black shales section of the Coloradoan 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. 6, 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 Domenegine fm. described in this paper. Many species are common to La Jolla and Domenegine fms. Overlying the La Jolla fm. are the Poway cgl.s., which previous workers have referred to Pilo., 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 Caflon 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.=Domenegine 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.


†Lake quartzite schist.

Early Paleozoic or older: Northern Alaska (Chandalar Lake region).

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.

Lake Agassiz silt.
Name applied to the silt deposited in Pleist. glacial Lake Agassiz in Minn. and N. Dak.

Lake Albany clays.

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.

Lake Aylmer series.
Devonian: Quebec.

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 flue, 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.

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 Is. below and Rock Hill Is. above. They increase in thickness from less than 100 ft. 2 ml. 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 % ml. N. of Chico. To W. and N. of Bridgeport they consist of (descending): (1) Sh. and flaggy sands, 45 ft.; (2) prominent escarp-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 Waubatee 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 iron concretions; large tough iron concretions very rare; poor cone-in-cone structure rarely developed; gypsum in places very abundant. Thickness 200± ft. in outcrops in secs. 5 and 7, T. 13 S., E. 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 iron 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.
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. 56, p. 53, 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.

†Lake Flint marl.
Recent (?): Southern Florida (De Soto County).
E. H. Sellards, 1916 (Fla. Geol. Surv. 12th Ann. Rept., pp. 73-74). Lake Flint 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 Flint [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 Flint 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).


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. bett.

J. Fulton, 1888 (Am. Inst. Min. Engrs. Trans., vol. 16, pp. 525-538). 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 in 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 Michigannme sl. The underlying iron-fm. is Vulcan iron-fm. (middle Huronian); and the older Is. are the Randville dol. (lower Huronian).

Lake Huron shale.

Upper Ordovician: Northern Indiana (Kokomo).

M. Thompson, 1886 (Ind. Dept. Geol. and Nat. Hist. 18th Ann. Rept., p. 325), listed following fms. In Kokomo gas well No. 2, in descending order: (1) Upper Sil. and Dev. Is., 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 Is. 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.]


Lake Lahontan beds.

Pleistocene: Northwestern Nevada.

I. C. Russell, 1885 (U. S. G. S. Mon. 11, p. 143). Lahantant 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, 3). 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 Is. to top bed of Arroyo fm., and showed it as 40± ft. above Rainy Is. It therefore appears to be a synonym of Lytle Is.

Lake Mills morainic system.

Lake Missoula beds.
Pleistocene: Southwestern Montana (Missoula, Ravalli, and Granite Counties).

Lake Monongahela deposits.
Pleistocene: Southwestern Pennsylvania.

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, 1935 (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 Basler 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).
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 Rochster. 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 cgl. 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).


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.


Laketown dolomite.

Silurian (Niagaran) : Northeastern and western Utah and southern Idaho.


Named for exposures in Laketown Canyon, Rich Co., NE. Utah.

Lake Trammel sandstone.

Permian: Central northern Texas (Taylor and Nolan Counties region).


C. N. Gould, 1926 (Jour. Geol., vol. 34, p. 412). 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.


E. H. Small, 1933 (Univ. Tex. Bull. 3232, p. 167). Lake Trammel ss. of Wraisher ls 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 Is.
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 "Footwall lime"); (4) compact grayish ls., filled with nodular chert, and sh. partings, usually rather thick, 50 ft. Rests on Pecora 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 Winnipesaukee gneiss (or, for short, Lake gneiss). In previous repts he had used gneiss about Lake Winnipesaukee. (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 Winnipesaukee 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, Winnipesaukee gneiss; and in other parts Lake or Winnipesaukee 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. unconf. 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 Winnipesaukee 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 Winnipeagoo 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 and C. C. O'Harr, 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.


La Luz basalts.
Triassic: Mexico.

A. Wandke and J. Martinez, 1928 (Econ. Geol., vol. 23, p. 8).

Lamar limestone member (of Delaware Mountain formation).
Permain: Western Texas (Delaware Basin).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). Lamar Is. 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 Is., and finally becomes pale-gray Is. at base of the escarpment. In places it is overlain by additional Delaware Mtn beds, of Is. 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 Is. was previously called Frijole ls. by Blanchard and Davis, from Frijole P. O., but the similar dark Is. that occurs at Frijole P. O. is an older Is., and the name Frijole Is. is therefore abandoned, to avoid confusion.
**Lamb dolomite.**

Upper Cambrian: Western Utah (Gold Hill district).


Lamb dol.—Lower third largely thick-bedded oolitic and pisolithic 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 Is. 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.


**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 Is.

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, 1895 (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 Is. 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 cgl. encircling the peak of Iron Mtn alone. On same horizon of uncon. and over a large area similar cgl. 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.


Named for Mine La Motte Station, Madison Co.
Lamoureux shale (also spelled Lamoureux).  
Devonian: Eureka district, Nevada.


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 1/2 mi. E. of Lampkins Bridge (3 mi. SW. of Belmont) and 1/4 mi. N. of Lampkins Bridge and 2/4 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.


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. qzite 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 qzite, 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. Probable named for Falls of the Lana.]

Lana basalt.
Age (?): Lanai, Hawaiian Islands.


†Lancaster limestone.


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.

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. 360), 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 in 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.

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 Mts., 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.

Landgraff sandstone. (In Pocahontas formation.)
Pennsylvanian: Southern West Virginia.

Landisburg sandstone.
Silurian: Central Pennsylvania (Perry County).
J. P. Lesley, 1852 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 761-777). In Rept. P. 2 this is called Bloomfield ss., but I have changed the name to Landisburg, where it is equally remarkable, so as to avoid confusion wth. the names Bloomfield and Bloomburg. 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 Lepidostrobus 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.

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 and J. Bennett, 1908 (Univ. Geol. Surv. Kans., vol. 9), defined Lane sh. as overlying Iola Is., and as separated from the higher Villas sh. by a ls. which they called Allen Is. (=Carlisle ls.), and stated that Garnett Is. of Haworth and Kirk included (ascending) Allen [Platteburg] ls., Villas 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 Platteburg ls., which is lower bed of "Garnett" ls. and is the ls. exposed at Carlisle, 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 ls. to lower part of Lane sh. of previous repts, and defined it as separated from overlying Platteburg ls. by (ascending) Argentine ls., Island Creek sh., Ferley 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 Is. 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 (Platteburg ls.), as Haworth thought, but is a third ls. lying btw. the Iola and the Platteburg. 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 Is. 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 Is. next above Lane sh. at Lane is not Allen (Platteburg ls.), but a lower fm. that is absent in Allen Co. The base of Platteburg ls. does not mark upper bdy of Lane sh., as inferred by several geologists. The Is. next above Lane sh. is traced into ls. now called Argentine Is. The Lane as thus defined is variable in lithology and thickness. In places, mostly where it is thin, t. 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 is. 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 flaggs; 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.


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 ls., some of which are oolitic; also some dark-colored bituminous sh. Thickness 0 to 900 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).


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.


Langston limestone.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

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).
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. Strati-
graphically 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. 163). Lanoria qtzite.—
Mass of pre-Camb. qtzite that outcrops along E. flank of Franklin Range. Con­
sists 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. 301, 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
2638). Lansdale shales.—Red shales with a few scattered green layers, 4,700+ ft. thick. Underlie Perkasie shales and overlie Gwynedd shales. Underlie Lans­
dale, Montgomery Co., and a broad area.
Corresponds to basal part of Brunswick sh. of Newark group.

L'Anse series.
Age (?): Northeastern Michigan.
not name, the rocks of L'Anse iron dist. On p. 153, under heading Huron Bay
states, he stated that those shales, 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.
L’Anse au Loup limestones.
Cambridge: Canada (St. Lawrence Valley).

Lansing group, in Kansas.
Lansing formation, in Missouri.
Pennsylvania: In 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 Is, only locally important. Top of fm, however, Is Stanton Is, 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 Is, and underlies Douglas sh.

Lansing group, in Kansas.
Lansing formation, in Missouri.
Pennsylvania: In Kansas, southeastern Nebraska, Iowa.

R. C. Moore and W. F. Haynes, 1917 (Kans. Geol. Surv. Bull. 3, p. 99). A very important faunal break, clearly defined by Bede and Rogers and Girys, occurs at top of Kansas City fm. (the top memb. of which is Iola Is.). Accordingly the beds above Iola Is, 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. Usually 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 Is, Vilas sh., Plattsburg Is., and Lane sh. [This was generally accepted definition of Lansing group until 1931.]

E. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), redefined Lansing group by including in its top Weston sh., Iola Is., 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 from above the top Weston sh., Iola Is., and lower part of Lawrence sh., to which latter bed he applied new name Hardesty sh. The 3 upper units he assembled under new name Peedee group.


R. C. Moore, 1932 (Kans. Geol. Surv., Bull. 21, p. 70). Edy 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 Is, coalesces with Argentine Is. Moore therefore proposes to redefine Lansing to include only Plattsburg Is., Vilas sh., and Stanton Is. This usage corresponds to Garnett Is. of early Kans. Surv. [which has long priority]. [See under Garnett Is.]

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 Is, and base at top of Iola Is.

Lansing moraine.

Lantern Hill quartz rock.
Age (?): Connecticut.

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 report was called Laona ss. It is somewhat peculiar in character, being much thicker here than in other parts of county. It is about 5 ft. thick. Upper 3 ft. often forms a single course. It 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. 1023-1029). 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.]


**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.]


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 Manabuilla 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 Texas 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 ss.), 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 ss. 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.

La Plata fm. 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.

La Point 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).

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 protaxls. 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 Vermillion 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). Lignite 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 Lignite lake or sea this barrier did not prevent water communication with Laramie Plains. With exception of Bear River and Cowlville group we may connect the coal-bearing beds of Laramie Plains and Colorado with the vast group in the Northwest. Everywhere it rests on Fox Hill group. [Hayden's 1874 rept. stated that he had traced "Lignite 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 Lignite 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 ss.s. and in places 200 ft. of white ss. at base.

A. Hague, 1877 (U. S. Expl. 40th Par. Rept., vol. 2, pp. 28, 58-55), 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 ss.s. 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 Lignite 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 Vermillion Creek group (=Wasatch group of Hayden).
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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.

Lardeau series.
Pre-Cambrian: British Columbia.

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.
Lares formation of Puerto Rico assigned to Olig. by H. A. Meyerhoff, 1933 (Geol. of Puerto Rico, p. 67).
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 ochorous bands of sh. and as., 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 Memainatherium, and similar in appearance to the lower (Almagre) beds, except that red strata are more dominant. The lower, or Almagre beds are 688 ± 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. Schwennesen, E. W. Krampert, and C. H. Henley as distinct from Hygiene ss., and was mapped and named by them [unpublished reps.] “Waverly ss.” but that name being preoccupied, writer substitutes for it the name Larimer ss. It lies 171 ft. below Richard ss. and 183 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. C. Luk, 1928 (U. S. G. S. Bull. 798B). 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).


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 Is., 15 ft. thick, in middle part of Oquirrh fm. (Penn.) of Stockton dist., NW. Utah. Lies 500± ft. below their Ben Harrison Is., and 2,000± ft. above their Paisley Is. Outcrops in Muerbrook mine, which is owned by Mrs. Larsen. (See U. S. G. S. P. P. 173, 1932.)

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 is.—Blue-gray to light cream-colored Is., 20 to 30 ft. thick, forming topmost part of Coal Measures where it outcrops. Upper Is. bed is 5 to 15 ft. thick, lower Is. bed is 6 to 18 ft. thick, the two Is. 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 Is. of LaSalle, NE. Ill. He stated: Base of LaSalle Is. is arbitrarily taken as top of a black shale sh. about 1 ft. thick, commonly associated with a coal seam 1 in. thick. The bottom sh. forms floor of quarry of LaSalle Cement Co., E. of LaSalle. The Is. terminates below 20 ft. of red concretionary sh. Typical LaSalle Is. 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 Is. 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 Vermillion 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 Is., which he placed 19 to 15 ft. above coal No. 8.


J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129-133). In Clark Co., SE. Ill., the LaSalle Is. has been called Livingstone, Marshall, Casey and Quarry Creek Is. It also embraces the 16 to 20-foot Is. in Vermilion Co. that has been called Fairmount Is., also the Baldicinierville Is. of Edgar Co., and the Ryan's Ford Is. 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, ss., 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 Is. 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.


Las Esperanzas formation.
Cretaceous: Mexico.


Las Mutus gravels.
Pliocene: Dominican Republic.


Lasoya Creek conglomerate.
See Lasoya Creek cgl.

Las Posas formation.
Pleistocene: Southern California (Ventura County).

E. D. Pressler, 1929 (Univ. Calif. Publ., 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 cgl. 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, Pl.). 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.


D. Cassell and A. J. Tjoje, 1933 (Pan-Am. Geol., vol. 59, p. 378), stated Las Posas fm. overlies Timna Point. (See under Timna Point fm.)


Las Puerca marl.
Pleistocene (?): Cuba.


Las Salinas formation.

Miocene: Dominican Republic.


Lassen dacites.

See under Divide Peak andesite.

Last Chance andesite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 757). Andesite, breccia, and aggl. The flows thin (rarely exceeding 50 ft. to a flow) and alternating with pyroclastic rocks. In places the breccias and aggs. 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.


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 Concho River Valley, northern Chihuahua, W. of Presidio, Tex. According to interpretation of C. Burckhardt it overlies upper Jurassic Plomosas fm. of Burrows. It consists of gray, black, and red quartz ss., gray limy ss., black shales, and sandy ss. Some of ss. and shales contain veins of copper. The upper part, transitional to underlying Cuchillo fm., contains gyp. and fossiliferous ss. (Eozoa). Thickness in Concho Valley reaches 1,968 ft. Outcrops in southern Quitman Mts with est. thickness of 500+ ft.

Las Virgenes sandstone.

Eocene (lower): Southern California (Ventura County).

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, 1928 (U. S. G. S. P. P. 140, pp. 4–12). Latah fm.—Chlidy 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.; H. 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 mts., 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 Noz 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 chlidy 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.


**Latour formation.**

Tertiary (middle or upper Miocene): Northern Idaho (Coeur d’Alene region).

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-Carb., 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 Tusculumab ls. =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.


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 Is. thins out E. of St. Paul at least as far as Yellow Springs, Ohio, where it is overlain by Maaslle clay sh., 5½ ft. thick. It may be present at Cedarville, Ohio, but is not exposed. The identification of Laurel Is. 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.

Laurencian 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 Is.) 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 1938 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 [Otego 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, 1965, 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."

 trie formation.

Pre-Cambrian: British Columbia.


Lauzon formation.

Ordovician or Cambrian: Quebec.

J. Richardson, 1866 (Canada Geol. Surv. Rept. 1863–66, pp. 32–36). Lauzon Sh.—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., In 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.

Laverne formation.
Tertiary: Northwestern Oklahoma.

La Vielle formation. (In Chaleur series.)
Silurian (Niagaran): Quebec (Gaspe Peninsula).

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 ss., 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, 1938. 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. Laurencian terrane. Also see H. D. Rogers, Geol. of Pa., vol. 2, 1858, p. 775.)

Lawrencian period.
Term used by C. [R.] Keyes. Same as his Laurencian 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 NW 1/4 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.

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. 3334, 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, sas., and iss. 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 ls.—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 fm. 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, 1918 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 279). Lead Creek Is.—Three or four ledges of Is. 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 Is.
D. B. Chisholm, 1931 (Ky. Geol. Surv., ser. 6, vol. 41, pp. 224-225). Lead Creek Is. 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. si. with minor bands of quarts-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 Is. [Derivation of name not stated, and there is no geographic feature called Lead Point on map.]

Leadville limestone.
Mississippian (lower): Colorado.
S. F. Emmons, 1895 (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. 229-240). Leadville ls. here restricted to the Miss. Is. 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 Is. rests uncon. on Dev. Is., 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.

Leaning Tower quartz monzonite.
Probably Cretaceous: Yosemite National Park, California.

Lea Park formation.
Cretaceous: Alberta.

Leatherwood granite.
Pre-Cambrian: Central southern Virginia (Henry and Pittsylvania Counties).
A. A. Pegau, 1932 (Va. Geol. Surv. Bull. 33, pp. 16, 28, 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.

Lebanon limestone. (In Stones River group.)
Lower Ordovician: Central and western Tennessee.
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
Is." and "Carter's Creek Is.," and substituted Lebanon Is. for Is. previously called "Lower Lebanon Is." and "Glade Is."

Included in Stones River group. Underlies Carters Is. and overlies Ridley Is. Named for exposures at Lebanon, Wilson Co.

‡Lebanon group.
Lower Ordovician (Chazy): Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 159, 258–258). Trenton or Lebanon group.—Divided into (descending): (1) Carter's Creek Is. [= Upper Lebanon Is. of earlier repts and Carters Is. of later repts]; (2) Glade Is. [=Lower Lebanon Is. of earlier repts and Lebanon Is. restricted, of later repts]; (3) Ridley Is.; (4) Pierce Is.; and (5) Central Is. [=Murfreesboro Is. 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.—Fossillerous even-bedded semicrystalline blue lsa., alternating with blue shales: 300 ft. thick. Lie stratigraphically higher than highest stratum of Cincinnati hills (Hill Quarry beds) and underlie Upper Sll. Medina ss. Topmost fm. of Cincinnati group. Not present at Cincinnati, Ohio.


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. 155–150, 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 gneias," and several areas in N. H. and Vt., the rocks of which resembled each other, were grouped together and given the name Bethelham gneises. 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." Howes calls it "protogene gneisses," Iddings calls it "epidote-mica-gneiss." Is of medium to fairly coarse grain; texture tends to gneissic. Is intruded underneath or into a schist, and probably has a laccolithic 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 Carb.].

Lebo andesitic member (of Fort Union formation).
Eocene: Central northern, southern, and eastern Montana.


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., pp. 101, 103, 104, 112, 239, etc.). The Venango Lower ss. (Third oil sand): 50 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 sandstone. East of Le Boeuf Creek it is partly coarse cgl. containing a great many pebbles of metamorphic rock.


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 Carb.) K. E. Caster, 1934 (Bulls. Am. Pol., 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.


S. Colvin, 1895 (State Univ. Iowa Lab. Nat. Hist. Bull., vol. 3, No. 3) and 1896 (Iowa Geol. Surv. vol. 5, pp. 50-56). *Leclaire Is.* restricted to 80 ft. of generally heavy-bedded, chertless, highly crystalline dol. underlying Anamosa Is. and overlying Delaware Is.; 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. Kansas Geol. Soc., p. 42). Type loc. of LeClaire dol. (Leclaire, Scott Co., Iowa) is just across Miss. River from type loc. of Port Byron Is. 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).

Pennsylvaniaian: Eastern Kansas, southeastern Nebraska, central northern Oklahoma, northwestern Missouri, and southwestern Iowa.


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 Is. as a fm. In northern Okla. it is a memb. of Pawhuska fm. Named for exposures at Lecompton, Douglas Co., Kans.

**†Lecompton shale.**

Pennsylvaniaian: Eastern Kansas and northwestern Missouri.


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 reports 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.

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 Centerfold Is. (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 Wannahak 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 Is. 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. 43). 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, l. c., 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 is. 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 sh. and cgl., shales, and coals, 1,200 to 1,600 ft. thick. At Big Stone Gap contains massive s. (Bee Rock), 95 ft. thick, at top; heavy cgl., 250 ft. thick, at base; and, in
middle, 506 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.


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 Reconm. 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. 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 — Mainhath volcanics of B. C.)

Leeport limestone.

Middle Ordovician: Southeastern Pennsylvania (Berks County).

G. W. Stose and A. I. Jonas, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 505-556). Leesport ls.—The uppermost beds of the ls. 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., 1/2 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 Salyards 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 1/4 mi. SW. of Manhattan, Kans.

G. E. Condra, 1935. (See under Roca sh.)
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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 Is.—Lss., 30 to 45 ft. thick, overlying Waldron bed and underlying Dixon red clay in Tenn. River Valley. Of Niagaran age. Occupies same strat. position as Louisville bed. Usually no sharp line btw. Lego Is. and overlying Dixon red clay. Lithologically the ls. 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 Is. 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 abandoned this name in Jan. 1936, further collections of fossils proving that this Is. is same as Grove Is., and that it is of lower Beekmantown age.

Le Grand beds.

Mississippian : Central northern Iowa (Marshall, Tama, and Grundy Counties).


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.; 25 ft. of buff mag. ls. cherty below; 15 ft. of gray white oolite; and 20 ft. of argill. bl. 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 Is. occasionally oolitic, 12 ft. (Spiriferina zone); (3) thin-bedded brown banded Is., 8 ft. (Cactocrinus zone); (4) hard brown crystalline crinoidal Is., locally carrying chert and oolite, 18 ft. (Orophochnus zone); (5) massive, soft, gray Is., chert and calcite abundant, 16 ft. (Pachylocrinus zone); (6) massive white hard oolitic Is., 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).


Lehigh Valley cement rock.
Evidently same as Lehigh ls. of Peck.

Lehmer limestone member. (In Admire shale.)
Pennsylvanian: Southeastern Nebraska.
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.

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.

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Leighton gray shale member (of Pembroke formation).
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 debris, which grade into distinctly tufaceous 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, 1888 (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 quadr., changing in E. part of quadr. 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 Wayneboro quadr. 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). Leipers Creek bed. Including the ls. 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 marl.—Green, purple, red, and blue marly shaes, 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
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lex., 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. iss., 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 Is. 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.

Leitchsville formation.

Middle and Lower Cambrian: Eastern Pennsylvania (Lehigh Valley district).


Probably named for Leitchsville, Northampton Co.

Lemieux Creek formation.

Carboniferous (?): British Columbia.


Lemont argillaceous limestone member (of Carlim limestone).

Lower Ordovician (Chazy): Central Pennsylvania (Blair to Center Counties).


Lenapah limestone.

Pennsylvanian: Northeastern Oklahoma and southern Kansas.


D. W. Ochern, 1910 (Okla. State Univ. Research Bull. 4). Lenapah Is., 8 to 20 ft. thick, overlies Nowata sh. (top fm. of Tulsa group) and underlies Crlf fm.


In Kans. Lenapah Is. 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 Is. as a distinct fm. (See Kans. Geol. Surv. Bull. 22, 1938.) 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).

Lenoir limestone. (Of Stones River group.)
Lower Ordovician (Chazy): Eastern Tennessee, northern Alabama, and western Virginia.

J. M. Safford and J. M. Killibrew, 1876 (Elements of geol. of Tenn., pp. 108, 123, 130-131, 137). *Lenoir Is.*—Soft blue shaly fossiliferous Is. 100 to 600 ft. thick. Same as *Machurca* Is. of Rept. on geol. of Tenn. In W. part of valley, next to Cumberland Plateau, is not separated from overlying Is. 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 Is. (Ulrich, 1911) was originally included in Lenoir Is. 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 Is. were excluded from the Knox by Safford in his definition and in his mapping.

The Lenoir Is. 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 Is., 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.

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 Is. memb. of Bingham qzite.*—In Lenox mine consists of dark silicious Is., either bluish or blackish. Much of silica is in chert nodules and layers, but more is disseminated through Is. mass in microscopic grains. Top passes by sandy Is. and marbles into overlying qzites. About 50 ft. below top is a layer of Is. qz. a few ft. thick. At 50 ft. below the qz. are layers of qzite that grade through calc. ss. into the Is. above and below. Thickness 200± ft. in Lenox mine but considerably less at other places. [Sections show Lenox Is. as lying much lower than Jordan Is. memb. of Bingham.]

Lenoxdale moraine.
Pleistocene (Wisconsin stage): Western Massachusetts (Berkshire County). (See P. B. Taylor, 1908, Jour. Geol., vol. 11.)

Leon series.
Upper Cambrian and Lower Ordovician (?) : Central Texas:

Is a part of Ellenburger Is.
Named for Leon Creek, Mason Co.

Leona formation.
Pleistocene: Southern Texas.

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 cebt., 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. 1,500 to 2,300 ft. Underlies Word fm. and uncon. overlies Raymond 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. Interca)ated with well-cemented calc-sh. breccias; in lower two-thirds, ss. and cgl. are predominant, but cherty and sandy shales are interbedded, also some ss. beds. Thickness 200 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 shales. It makes greater part of S. face of Leonard Mtn.


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 silicious shales and cherts, and of ss. 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 interdnger, but the Hess and Leonard fm.s., 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 fm.s., 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. 697-708). The Hess fm. of previous repts is contemp. with and grades into lower part of Leonard fm. It is therefore here designated Hess thin-beded 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.


†Leptarchenia beds.

A paleontologic name that has been applied to upper part (Leptarchenia 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-Portum 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. 145, pp. 79-90, 97). *Leray Is. 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 Is.* Underlies Watertown Is. and rests on lower part of Lowville fm., here called *Lowville Is. 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 Is.*, of which Leray Is. 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.
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.
In broad sense in which name was subsequently used it represents all of Douglas group as originally defined except Oread Is.; in restricted sense it is same as Weston sh.
Named for development in vicinity of LeRoy, Coffey Co.

Le Roy moraine.

Lester limestone member (of Dornick Hills formation).
Pennsylvanian: Central southern Oklahoma (Carter County).
LEXICON OF GEOLOGIC NAMES OF UNITED STATES

C. W. Tomlinson, 1929 (Okl. 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 considerable distances is called Lester la. 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 la. 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 las. 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 An. Rept., pl. 14, pp. 142–146). Lester River group.—Succession of heavy distinct beds of fine-grained brown rocks, largely of "asbed" 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 la. and underlying Recent alluvium in Mine La Moutte 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 la., and it is doubtful if it occurs at all in Potosi la. farther N. near typical Potosi locality.


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. 98–99, 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.


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 Lelerbychus 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, 120-131, 271+; and vol. 2, p. 733) 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).


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 1/4 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.


The Ohora 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 Ohora” is strictly the Renault of Ill. The “Lower Ohora” is a well-defined memb. of the Ste. Genevieve and is worthy of a distinctive name. Were it not for persistent use of Ohora 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 Ohora 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.

Lower Sil.; eastern Canada; exact synonym of Calciferous; included in Quebec group.


The paleontologists of U. S. Geol. Survey interpret the faunas of Levis fm. as Lower Ord. and Upper Camb.

Levis shale.
Devonian: Quebec.

Devonian, Quebec.

Levyville formation.
Eocene (upper): Northern Florida.

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 Mantellite, 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).


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 Mancoa 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.
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 ss.

†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.


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., 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.] Blissell. “Lewisburg” (preoccupied) is apparently a misprint for LewIsberry and “Lisbon” (preoccupied) is apparently a misprint for Lakeburn. When the Triassic of New Cumberland quad. (in which occur the geographic features Lakeburn 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 is.—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 ss, 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 Is., which lies 85 ft. lower in Tradewater fm. Fossils not so large as those in Lead Creek Is. [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, 1883, pls. 17, 20, p. 28.)

†Lewiston shale.

Upper Ordovician (Richmond) : Western New York and Ontario.


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 Is.

Lewistown limestone.

Devonian and Silurian : Central Pennsylvania.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 1-9). Lewistown Is. included in Lower Helderberg series. Underlies Oriskany sh. and overlies Waterline series. [As thus defined the name applied to rocks now called Helderberg group and differentiated into several named units, but as used in some rep'ts it included beds of Cayuga age.]

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, pp. xvii-xxxii). Lower Helderberg Is. divided into Lewistown Is. sh. and Lewistown Is., the latter resting on the Waterline. The Lewistown Is. consists of heavy bed of subcrystalline bluish gray Is.; in some places it carries a bed of chert at top. The Is. is 185 ft. thick at Lewistown [Mifflin Co.,] 215 ft. thick at McVeytown, and only 35 ft. thick at Mount Union.

This is. has also been called "Lewiston Is." In parts of central Pa. it has been divided into several named units. (See Pa. chart.)

Lewistown limestone shale.

Lower Devonian : Central Pennsylvania.


†Lewistown chert lentil.

Lower Devonian : Northeastern West Virginia.


Apparently same as Shriver chert.

Lewisville marine member (of Woodbine sand).

Upper Cretaceous (Gulf series) : Northeastern Texas.

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.

*Lexington group.*—Shales and lss., with little sa. and clay, 70 ft. thick, including beds Nos. 43 to 55 of detailed section of lower Coal Measures from Salina to Kansas City. Underlies Holden group and overlies Wartensburgh 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.


Lexington limestone.
Middle Ordovician: Central Kentucky.
M. R. Campbell, 1898 (U. S. G. S. Richmond folio. No. 46, p. 2). *Lexington lss.*—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 High bridge ls.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 4), placed top of *Lexington stage* at top of the cherty horizon, which is Flanagan chert of Campbell.


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 phylite* (argillite).—Overlies Conway schist.

B. K. Emerson, 1894, as reported by R. Pumppelty (U. S. G. S. Mon. 23, pp. 29-30). *Leyden argillite,* with intercalated quartz schist, overlies Conway schist.

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* bed.—Even-bedded lls. in layers averaging 3 inches in thickness, prevalently blue in color, with intervening clayey and shaly layers, also usually of blue color, thickness 35 ft. Overlain by Whitewater or *Homotrema wortheni* beds and underlain by Wayneville or *Bythopora mecki* beds.

In many subsequent repts was stated to be Saluda Is. (see under *Saluda Is.*), 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 Is. as a distinct fm.

J. J. Wolford, 1930 (Ohio Jour. Scl., 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. Scl., 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. Is. That weathers shaly. Upward in the fm. calc. sh. predominates and Is. 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 has been standing for more than a century and is as well known as Lexington itself.


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 Is. (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* ee. 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 50 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.

†Lignite formation. (†Great Lignite formation.)
†Ligntic group.
Late Cretaceous and Eocene: Rocky Mountain States.
Terms applied in early repts (1852 to 1876 and later) to coal-bearing rocks of Rocky Mt. 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."
the same year (U. S. Geol. Surv. Terr. Bull. 5, pp. 406-411) 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.
†Lignite beds.
†Lignite 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 "Eocene Lignitic." The Wilcox group alone has also been called "Lower Lignitic" and "Lignite." 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 Connelsville ss. memb., which replaces it.

Lilac argillite.

Lower Jurassic: Northern California (Mount Jura).


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 la. 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
Blaber and Lilley members, if indeed the latter is present, that a collective term seems desirable. For this service *West Union*, used by Orton [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 Blaber memb.

A. F. Foerste, 1923 (Denison Univ. Scl. 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 Blaber fauna is contained in beds immediately beneath Springfield is. along creek ¾ mi. W. of Port William, NE. of Wilmington, Ohio; but no trace of Lilley fauna is to be found so far N.


**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. 69, 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 Allegheny River 1 mi. NE. of Portville, N. Y., and in quarries adjacent to the creek. Is predominantly Sagggy, with intercalated shales. Usually pinkish to purple red, and not abundantly fossilliferous.

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 *Hinadale* by Chadwick, but that the ss. exposed in Lillibridge Creek Valley lies up in Haymaker beds of Chadwick or higher.

**Lillls formation.**

Tertiary (Oligocene?): Southern California (North Coalinga region).

J. H. Ruckman, as reported by J. C. Merriam, 1875 (Am. Phil. Soc. Trans., n. s., vol. 22, pt. 3, p. 194), placed *Lillls fm.* (in table of North Coalinga region) opposite Olig., and called the overlying Mio. beds *Monterey* (“Temblor”) and the underlying beds *Tefon 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 “Lillls 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 *Ledo 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, 1981 (Geol. Soc. Am. Bull., vol. 42, No. 1, pp. 302, 303, 305, 306), applied *Lillls ss.* to the younger ss. 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 Is. 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 bed* for fossiliferous beds exposed along Lime Creek near Rockford, Iowa, and said to contain same fauna as High-point beds of Cheumng of N. Y.

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 46-47). *Lime Creek shale*—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 Is. below. Some repts apparently included Montpelier ss. in the Cedar Valley, and some writers have regarded Sweetland Creek sh. of SE. Iowa as contempor. 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 Is. 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 Is.

A. C. Trowbridge, M. A. Stainbrook et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, pp. 286+), 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).


**Limerick keratophyre.**

Triassic (Middle?): Northwestern Nevada (Humboldt Range).

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 bed* 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.

Limon clays.
Pliocene: Costa Rica.

Limon beds.
Cretaceous: Mexico.

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).

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.

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
boring of Annelida about 1 mi. NW. of R. R. Station of South Lincoln. Overlies Kendall Green sl. and lies stratigraphically uncon. lower than Boxbury cgl.

B. H. 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 basaits 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.


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 Bo. sed. and volcanic rocks.

Lincoln Creek formation.

See 1913 entry under Lincoln fm.

Lincolnville chert. (In Boone limestone.)

Mississippian: Northeastern Oklahoma (Ottawa County).

S. Weldman, 1932 (Okl. Geol. Surv. Bull. 58, p. 17). A thick bed of cherty l. in upper part of Boone fm. is exposed along Spring River 10 mi. below Baxter Springs at "Devil's Promenade," in SE 1/4 NW ¼ sec. 5, T. 28 N., R. 42 E. This cherty l. 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).


Linden group.

Lower Devonian (Helderberg): Western Tennessee.


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 Quail l.

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. Rege, 1928 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 505, 518). *Lindside sa.*—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 [as]. 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).


Probably named for village in Milwaukee Co.

Linneham member.

Cretaceous: Alberta.


Lingle limestone.

Middle Devonian: Southwestern Illinois and eastern Missouri.


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.

Linletta clay.

Mississippian: Central northern Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, pp. 145, 156). *Linletta 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.


C. B. Read, 1936 (Jour. Pal., vol. 10, No. 3, pp. 215-216), stated that Linletta 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 Linletta 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. In 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. 13-38). Linville slts.—Semi­metamorphic argill. slates and shales, ss., iss., 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 ash­colored and bluish slates and shales and iss. with occasional outcrops of thin­bedded light-colored ss. or qtsite. Linville Mtn consists almost exclusively of ss. and qtsite slts., in places very thin bedded and flexible (itacolumite) and in a few places interbedded with thin layers of a greenish shaly ss. 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 porphyroldal 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. qtsites, and in several narrow banda S. of Blue Ridge in Cranberry granite.
Named for Linville, Mitchell Co., N. C.

Linwood shale.
Pennysylvaniaian: 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 Naleh 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.
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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.—Sa. 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 Pliocene. 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. Wooldrige, 1931 (Carnegie Inst. Wash. Pub. 418, pp. 1-25). Lion ss. of F. E. Vaughan is the lower Miocene of some 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, 1837 (U. S. G. S. P. P. 1861). Lion Mtn as. 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. 37, 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 Algokian 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., quaitte, volcanic ash and beds of peaty material, capped by an indurated ss. with a highly reticulated surface. Thickness probably 150 ft. Uncon. underlies Whissett 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.
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For several years considered same as Fayette ss.
F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 680, 685, 688). 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.
Or dovician or Cambrian: Northwestern New Hampshire (Ammonoosuc River region).
C. H. Hitchcock, 1877 (Geol. N. H., pt. 2). Lisbon group (Huronian) overlies Swift Water series (also Huronian).
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. Scl., 5th, vol. 5, pp. 257-302). Lisbon fm.—Fairly coarse schistose clgs. and sandy schists, with very subordinate amount of calc. sediment; greenish and grayish color; includes hydromica and cupriferous schists, quartzes, 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 ofrafton 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, Calcareaous sand bed, and Lisbon horizon, the latter overlying the Buhrrstone (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 bluffs, on Alabama River, and explained relations of the beds in that bluff (which constitute basal beds of their Claiborne—from which they excluded the Buhrrstone) to the beds in Claiborne bluff, farther down the river. The two lowermost beds in Claiborne bluff are stated to be same as 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; Ostreaellaformis 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 Buhrrstone [excluded from the Claiborne].
G. D. Harris, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 303-304). Lower Claiborne stage is divided into (descending) Ostreaellaformis beds (substage), Lisbon beds (substage), and Buhrrstone (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 Ostreaellaformis zone is included); Lisbon fm.; and Tallahatta fm. (†Buhrrstone). 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 green- sand underlyng 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.
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. ScL, 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. 55-58, 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 ml. 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.
J. B. Mertle, 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 ml. 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).
L'Islet formation.
Cambrian: Quebec.

†Lisman formation.
Pennsylvanian: Western Kentucky.
Chiefly soft shales, in places colored and calc., with some ss. and thin lls. (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 Ck.

Lismore formation.
Carboniferous (Pennsylvanian): Nova Scotia.
W. A. Bell, 1825 (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 clgs. 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 Oolitic 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).

Listmore formation.
Pennsylvanian: Nova Scotia.

Liston Creek limestone member (of Liston Creek formation).
Silurian (Niagaran): Northeastern Indiana (Wabash County).
E. R. Cummings 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 drussy 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.
Liston Creek formation.

Silurian (Niagaran): Northeastern Indiana (Wabash County).

E. R. Cumings and R. R. Shoock, 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 80 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 discord btwn. Liston Creek ls. memb. and underlying Mississinewa sh. Along Pipe Creek 1/4 mi. NW. of Bunker Hill the Liston Creek ls. is disc. overlain by Dev. lss. We believe Louisville ls. is represented in Liston Creek fm.


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 III. (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 srs., often with pink and white striped clay lenses interstratified with gray argill. shales and variegated marls. Thickness 500 ft. Underlies Leroux sh. and uncon. overlies Moenkopi sh. 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 srs. and shales; srs. 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, 560, 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 Plaza 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 Is. memb. of Mauch Chunk fm. (Miss.).

Little Alvord Creek rhyolite.

Tertiary (late): Southeastern Oregon (Steens Mountain).

Little Bell Island formation.

Lower Ordovician: Newfoundland.
G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland. No. 4). Little Bell Island fm.—Ss. 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 Is. 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. Matthews 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: Northwestern Oklahoma (Craig County) and southern Kansas.

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.]
Little Clarksburg Is. (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 Is.

Little Compton shales.
Pre-Cambrian: Southeastern Rhode Island.
A. P. Poerste, 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 Brown's Point to S. side of Fishe 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-Camb. 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.
Pliocene: Northeastern Utah and southwestern Wyoming.

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.
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 fos-foss. phase of “Calciferous sandrock” [Beekmantown] in Mohawk Valley. [Assigned to “Champlainic or Lower Siluric,” and shown as uncon. underlying Lowville Is., 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 Is., which has been both included in and excluded from Little Falls dol., as explained below.]

(type region) to lower part of the fm. as heretofore defined, as explained in item 11 under Beekmantown 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 (Ozarkian)," 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 Ozarkian types."

In 1910 (N. Y. State Mus. Bull. 145, p. 87) 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 B. 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 Cambrian or Ozarkian 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 Gascouade 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 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 Is.* 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 Is.* 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 Is.* 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 uncon. underlain by Stissing dol.


W. Goldring, 1931 (X. Y. State Mus. Rpt. 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 Is.*, which is a more calc. and more fissile 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 Is.* 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, 92, 94, 96), *Little Genesee ool.*, exposed N. of Little Genesee, Allegany Co., is believed to be same as Olean ool.
Little Grizzly Creek beds.
Pennsylvanian: Northern California (Taylorsville region).
At SW. base of Mount Ingalls [Plumas Co., in Downeville 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 Robi­
son beds. These beds are stratigraphically nearly in line with Robinson beds.
Creek beds, which consist of highly metamorphic tuff containing many fossils, will
probably be correlated with Robinson fm. [In Downeville 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).
Hominy is.—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 Is. containing many shell fragments. Few
is unusually sandy, and in places impossible to separate from overlying massive
Is. that forms top memb. of Pawhuska Is. The abrupt disappearance of this Is.
at many localities is probably due to its transition from a sandy lime into a
calc. Is. that is indistinguishable from overlying sand. Thickness 3 to 15 ft.
Lies 12 to 30 ft. above Deer Creek Is. memb. of Pawhuska Is. Named for out­
crops on Little Hominy Creek in SW. part of T. 25 N., R. 8 E. 

Littlehorn limestone.
Mississippian (lower): Northern Wyoming (east side of Bighorn Moun­
tains).
Light-gray massive bedded Is., many of lower beds of darker color and contain­
ing some sand admixture; uppermost 100 ft. of fm. is pure Is. 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 Is. of
Mont. and Pahaska Is. of Black Hills. Overlies Bighorn Is. and underlies Anadarko
fm. without apparent uncon. Named for fine exposures in Little Horn Canyon, on
E. side of Bighorn Mts.

Same as Madison Is.

Little Kaw limestone member.
Pennsylvanian: Central eastern and northeastern Kansas.
memb.—Bluish gray blocky Is., 2± ft. thick, forming top memb. of Stanton Is. 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, Leaven­
worth 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 com­
piled 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).
cine tongue of Dinwoody fm.—A tongue of Dinwoody consisting of a widespread bed
of variegated limy Is., separated from the older Erway 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 Seminole Mts., 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.


Probably belong to Wilcox fm.

Little Oak limestone.

Lower Ordovician (late Chazy): Northern central Alabama.


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. 191). Little Pine Ridge ss.— Bluish gray ss., 50 to 90 ft.; in upper part 2 coal beds, 10 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. by Big Muddy 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.

Little Pittsburgh member. (In Conemaugh formation.)

Little River.
Lower Cretaceous: Arkansas.
See Upper Little River ls.

Little River group.
Silurian or Devonian: New Brunswick.
G. F. Matthew, 1883 (Canadian Nat., vol. 8, pp. 244, 251-253).

Little Saline limestone.
Lower Devonian (Oriskany): Eastern Missouri (Ste. Genevieve County) and southwestern Illinois.


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 1 1/2 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. Sc., 5th, vol. 49, pp. 139-144), extended Little Saline ls. into III., 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, 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) ls.; in one or two instances has been reported to lie immediately below Corry ls. 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.


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 Lakee's Blueberry Mt. 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 ss., sh., 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 Moselauke quads., N. H., pp. 17, 23). C. P. Ross's suggested name "Littleton argillite" is not very satisfactory, as the rocks are slates, ss., 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 sh. 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 ss., 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 sh., 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 la., 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 la. weathering to chips and calc. clay, and composing rest of Cedar Valley.


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 la., 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).


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 Pleistocene. Hippo zone of White River Badlands. Uncon. overlies upper Pleistocene. Procachius 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.


J. B. Mertie, Jr., 1926 (Wash. Acad. Sci. Jour., vol. 16, No. 3, p. 79). Southward, in Yukon Basin, several fms. of Carboniferous rocks are known. The Miss. rocks include Rampart volcanics, Calico Bluff fm. (composed of thin-bedded sh. and ls.). Livengood chert fm., and a cherty-siltstone 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).


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.)

Pennsylvaniaian: 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. 127); 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 overlying 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 ass. 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. Culvert, 1910 (Econ. Geol., vol. 5, pp. 551–557, 652–609, 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., Leanep as., Bearpaw sh., and Judith River and Claggett fms. The underlying beds (called Laramie by Weed) are in reality Eagle as. [This is present generally approved definition.]

LIVINGSTON CONGLOMERA TE. (IN POTTSVILLE GROUP.)

Pennsylvanian: Southeastern Kentucky (Rockcastle County).

A. M. Miller, 1908 (Ky. Geol. Surv. Rept. Prog. 1900, 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. Is. 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 Roundatone 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 as. It lies in a channel cut out of St. Louis is., 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. McMaster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, pp. 217-218). Llajas fm., middle Ec., 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 Domengaue ss. and underlying "Meganos" ss. of dist. N. of Coalinga.


Llano DE ORO FORMATION.

Pleistocene (Wisconsin stage): Southwestern Oregon (Josephine County).

P. J. Shonin, 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. Uncons. 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.


Replaced by *Ogallala fm.* (in this area all Pli.; no Mio. in this part of Tex., according to recent work).

**Llano Estacadaan series.**

Tertiary: New Mexico.


Probably same as †Llano Estacado fm., now replaced by *Ogallala fm.* (regarded as all Plio. in this region).

Llanos formation.

Pleistocene (?): Trinidad.


**Lloyd sand.**

Upper Cretaceous: Southeastern New York (Long Island).

A. C. Vestach, 1906 (U. S. G. S. F. 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 sh. 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 sgl. at base. Uncon. underlies Sarten ss. (Lower Cret.) and uncon. overlies Gymp and older iss. 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 arkose 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. is. rich in stromatoporoids, the entire group being strongly reminiscent of the Ripogenoua is., 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.)

†Lockhart formation. (In Chester group.)
Mississippian: Western Kentucky.
F. J. Fobs, 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 Is.
Probably named for Lockhart, Livingston Co.

Lockport dolomite. (Of Niagara group.)
J. Hall, 1889 (N. Y. Geol. Surv. 3d Rept., pp. 289, 327). Lockport Is.—The Is. 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 Is. Overlies Rochester sh. and underlies the red sh. [Sallna fm.] forming basal part of Onondaga saltiferous 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 Is." 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 Is. 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. Sill. 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 Is. and top of Louisville Is., 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 formalional 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.
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.
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. 708-718). Locust Point fm.—Mainly massive or shaly siltstone in southern part of Ind. outcrop area. Northward the fm. becomes a succession of fine-grained sh. beds and alternating shaly zones. Fossils rare, aside from worm marks. Average thickness 125 to 150 ft. Underlies Carwood fm. and overlies New Providence fm. [In 1899 (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 faoiea 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-beded 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 Lodl yellow and purple sandy thin-beded 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 Masonville, 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 ss.s. and aren. shales, with cgs. at base, 465 ft. thick, conformably underlying Redwall group of ls. 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.).
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.
between 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 reports 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.

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 cgl., 160 to 250 ft. thick, held together by common fossils, included in Cuyahoga sb. by some authors, but overlying (Lower) Cuyahoga sb. 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).
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. Be-
tween 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.

Slurrian: Central Pennsylvania (Mifflin County).


†Logan sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.


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 subsage.—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 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 rept. 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.


Lohali sandstones.

Jurassic: Northeastern Arizona.


This ss. appears to correspond to Navajo ss. of U. S. G. S. classification. (See U. S. G. S. P. F. 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,
Lohrville granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 428-428, 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 quartzites, slates, 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 in Lolo series should be coordinated with thick pre-Camb. series of central Mont.

F. L. Ransome, 1905 (U. S. G. S. Bull. 280, p. 278). The Algionkian 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).


R. D. Reed, 1933 (Geol. Coll., 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 Pilo.; to N., at San Pedro, the sandy Lomita underlies San Pedro ss. and overlies lower Pilo. 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.)

Pennsylvania: Western Maryland ( Allegany and Garrett Counties).


C. K. Swartz, 1922 (Mo. 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 George Creek S. of Lonaconing.

Lone quartzite.

Upper Cambrian: Southwestern New Mexico (Silver City region).


The Upper Camb. qzite 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 Is. 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 Is. memb.—Underlies Spotted Bear Is. and overlies Coopers Lake Is., all members of Jefferson Is. 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 lust-r on fresh surfaces, and very petroliferous content. Type loc. on SE. side of S. spur of Lone Butte, in NE ¼ 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 Is., thin-bedded in lower part, thicker-bedded and more massive upward, 170 ft.; (2) massive chocolate to chocolate-gray fine-grained mag. Is. that weathers white buff and to sharp angular surfaces; (3) steel-gray vitreous dolomitic aren. fine-grained petroliferous is. that weathers light buff-brown, 141 ft.; (4) thick-bedded tan to steel-gray vitreous, very petroliferous aren. Is., 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 Is. (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.

Same as Packsaddle schist.
Named for Lone Grove, Llano Co.

Lone Land formation.
Pre-Cambrian: Mackenzie.

Lone Mountain limestone.
Silurian and Upper Ordovician: Eastern Nevada (Eureka region).

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, 15+ 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 quartzite, E. Kirk, 1932.

Lone Mountain dolomite.
Silurian: Mackenzie, Canada.
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 is. 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.


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. Scl., 6th, 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. 8, p. 826, 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 ss. that appear in N. wall of ravine above the falls at Wisconsin, and in the sides and bottom of the river channel 1 mi. S. of Fillmore, where they form “Long Beards riffs.” The lowest coarse ss. 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 Wisconsin shales, and is assigned to Chemung.]

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 sec-
tion. Overlies Wiscoy 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 ss. that occupy lower
half of Dunkirk sh.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 407). The ss. 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 ss. include Longbeards Riffs ss.

Long Branch sand.
Eocene: Eastern New Jersey.
S. WeUer, 1905 (N. J. Geol. Surv. Ann. Rept. 1904, pp. 147, 167, 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 limest.

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).
Pliocene: Southern California (Ventura County).
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 200-4 ft. Upper part of Las Posas fm. Contains a warmer water
(marine Pliet.) 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.
ls.—Named for exposures on Longs Creek, at foot of bluff W. of cemetery at Au-
burn, Nemaha Co., Nebr. Usually weathers buff to yellowish, somewhat cavernous
and irregular. Thickness 3½ to 5 ft. In Nebr. and 3 to 6 ft. In NE, Kansa. Un-
derlies 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., 38 to 38 ft.; and Americus ls., 2 to 3 ft.
B. 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.
of Lewis town 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 ls., 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. contains
more shaly strata. Rests conformably on Coronado quartzites, from which it is in
places separated by an intrusion of porphyry. Is conformably overlain by Morenci
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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.

†Long Island division.
W. W. Mather, 1843 (Geol. N. Y., pt. 1, p. 244). 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. 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 Grabaub, 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 198 ft.
A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Scl. 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 Killiana 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. Ailing, 1919 (Am. Jour. Scl., 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, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). The deposits of the Juratras 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. (2007 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 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 offshore area, and in the central zone of this latter area, where the basin was widest, the still finer Chicopee sh. was laid down.

B. R. 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 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. iv, 131, 255-267). Long Min series.—Hornblende and pyroxene schists, schists containing garnets, and with these steatite or soapstone, actinolite, etc. Overlie Lone Grove series and probably underlie Bodeville series. Included in Burnetian system.

Same as Packsaddle schist.

Named for Long Mtn, Llano Co.

Long Point series.

Middle Ordovician: Newfoundland.

Long Pond formation.

Cambrian: Newfoundland.

Long Rapids shale.

Devonian: Ontario.

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).

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. 18). (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.]


Longwood shale.


N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 387, 382, 383). Longwood red shales.—Red beds, with green to buff layers, which break into sh. on exposure, over lain by about 12 ft. of light-colored thin-bedded quartzite. 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. ls 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. 667). 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. 255), in description of ls. exposed at Lonsdale quarries, Peoria, in two places called the bed Lonsdale ls.

L. E. Young, 1916 (Ill. Geol. Surv. Cooperative 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 8 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. 28, 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 55± 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. ls.—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 blottite; 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, blottite, 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).


Lopez fanglomerate.

Quaternary: Southern California (San Gabriel Mountains).


Loranger series.

Pre-Cambrian: Quebec.


Lorette formation.

Middle Ordovician: Eastern New York.


Lorette slate.

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

R. C. Allen, 1919 (Am. Inst. Min. Met. Engrs. Bull. 153, p. 2593). Lorette 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.


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.


Lorrain quartzite.

Pre-Cambrian: Ontario.


Lorraine group.


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., u. 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 contemporaneous 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.


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 feldspar). 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 Is. 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 Is. 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, 1906, 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.


Los Guerras sandstone member (of Fayette formation).

Eocene (upper): Northeastern Mexico (Tamaulipas, opposite Starr County, Texas).

Losh Run shale.
Upper Devonian: Southern central Pennsylvania (Perry County).

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 Losoya 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.

Lost Cabin formation.
Eocene (lower): Northern Wyoming (Bighorn Basin).
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.**

*Pennsylvania*: Northeastern Oklahoma (Tulsa County).

C. N. Gould, 1911 (Okin. 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 (Okin. 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.


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.


**Lost Creek limestone.**

*Pennsylvania*: 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, 1910 (Min. and Sel. 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.

Lostmans River limestone.

Pleistocene and Pliocene: Southern Florida.


Lostmans River Is.—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 Dole as very hard and consisting of large masses of Polyzoa more or less completely changed into crystalline Is. 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 Jewlah 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 Is. can not be determined. Miami oolite is believed to be younger than Lostmans River Is.


Named for exposures on Lostmans River, Monroe Co.

Lost River chert.

Mississippiian: 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.

Sec 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). Loudoun 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. al., 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.

Lous limestone.


†Louise formation.


Louisian.

C. [R.] Keyes, 1919 (Scl., 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. Kansas 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. 169-169, 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, 28). Louisville ls. (memb. of Bradbyville 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 is. and higher than Meadow is.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 55, 56). Although "Louisville is." is preoccupied, it is in use for top part of Howard is. memb. in Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 27). Louisville is. is preoccupied, hence Stoner is. is proposed for this unit, to include also Klewitz sh. and so-called Du Bois is. The "Louisville is.," Klewitz sh., Du Bois is., Severy sh., Topeka is., and Meadow is. are parts of Stanton is. memb.


†Louisville-Delphi black slate.

Upper Devonian: Indiana and Kentucky.


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 is. Thickness 300 to 400 ft. All fresh-water fossils. Assigned to Pilo. 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, 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. Is name 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.


Louplan.

Name introduced by C. R. Keyes to include Ogallala (Pilo. 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.
Louvian series.
A term employed by C. [R.] Keyes to cover rocks of Cordilleran region interpreted as having been formed during later part of pre-Annikulde erosion interval. (See Iowa Acad. Sci. Proc., vol. 24, p. 50, 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. 405-422). 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.


Loveland loess.
Pleistocene (Sangamon): Southwestern Iowa and eastern and southern Nebraska.
B. Shimek, 1900 (Geol. Soc. Am. Bull., vol. 20, p. 405) and 1910 (Scl., 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 30 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 pumice occurs at base of loess phase quite generally in Nebr. It is generally 6 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.

Loveland series.
Lovingston granite gneiss.

Pre-Cambrian: Western and northern Virginia.


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 Sabine town [Sabine Co., Tex.], in 1899 and referred provisionally to the Lignitic eob. 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.

Low granodiorite.

See Mount Lowe granodiorite.

Lowell limestone. (In Allegheny formation.)

Pennsylvania: 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. Kelth and G. W. Bain, 1932 (Econ. Geol. vol. 27, No. 2, pp. 173, 175). Lowell Mtn ls., 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. See to correspond to Quebec group on Lake Memphremagog, Quebec. [Lowell MtnIs. 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 ls., and coarse-grained, deep yellow-brown, porous dolomites, the dol. in every way typical of overlying Galena; the chalky earthy ls., 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 Is. 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 Decora, 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.)

Pennsylvania: Northeastern Ohio.

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 Comb, qtzite and overlying “transition shales,” in contradistinction to the younger (Ord.) “Parting qtzite.” It underlies Is. called “White ls.” and uncon. overlies pre-Camb. gz, schists, 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 Bunker Is. 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.

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.

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.

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.

Is a bed in Mercer sh. memb. of Pottsville fm.

Lower Mercer iron shales.  (In Pottsville formation.)
Pennsylvanian: Western Pennsylvania.

Lower Mercer fire clay.  (In Pottsville formation.)
Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

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 Niagaran 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 Is., the names "Second Pentamerus Is." and "Upper Pentamerus Is." being applied to New Scotland Is.

Lower Pittsburgh limestone member (of Conemaugh formation).
Pennsylvanian: Western Pennsylvania and northern West Virginia.

See also under †Pittsburgh Is.

†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. 21-81). At base of metamorphosed Paleozoic Is. (Inwood Is.) 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 ¾ 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-Cambrian 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. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 22). If Lowerre qtzite is Post cambrian [Cambrian] it is to be correlated with Poughquag qtzite [Lower Camb.].
C. P. Berkey and Marlon Rice, 1921 (N. Y. State Mus. Bull. 226, 226). Lowerre qtzite is of uncertain age, but we are now inclined to believe it is pre-Cambrian and belongs to the Grenville. [In chart on p. 140 it is classified as later Grenville.]

†Lower Shaly limestone.
Name applied in early N. Y. repts to New Scotland Is.

†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.

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 80 ft. below Middle Washington Is.

Lower Wurttemburg limestone.

See under Wurttemburg Is. and under Mercer Is.

Lowery sand.

A subsurface sand, of Ord. age, in NE. Okla. See under Kinter sand.

Lowery limestone.

(In Hinton formation.)

Mississippian: Southeastern West Virginia (Summers County).

pp. 296, 344). Low Gap Is.—Yellow and impure calc. stratum, usually shaly or
sandy; marine fossils, 1 to 6 ft. thick. Lies 6 to 8 ft. below Low Gap sh.
and overlies Low Gap sh.; all members of Hinton group [fm.]. Type loc. same
as Low Gap sh.

Low Gap sandstone.

(In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia
(Tazewell County).

pp. 296, 345). Low Gap sh.—Greenish gray micaceous, sometimes shaly, some­
times massive; 5 to 30 ft. thick. Underlies Lower Tarryall sh. and lies 0 to 3 ft.
above Low Gap Is. 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.

pp. 296, 346). Low Gap sh.—Red and variegated, 6 to 40 ft. thick. Underlies
Low Gap Is. and overlies Avia sh., all members of Hinton group [fm.]. Type loc.
same as Low Gap sh. Also observed in Mercer Co.

Lowhee member (of Richfield formation).

Pre-Cambrian: British Columbia (Cariboo district).


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
sh bed associated with the red shales of these bluffs be named Lowrie sh. bed,
from railroad station of Lowrie, in sec. 16. Thickness 20 to 45 ft. Is in
upper part of I'onium memb. of Wellington fm., and in texture, color, and composi­tion like rest of sh. beds in that memb. Lies higher than Evansville sh. 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, 1890 (Scl., n. a., vol. 10, pp. 874-878). Lowville Is.,
instead of Birdseye Is. of common use. Well exposed at Lowville, Lewis Co., N. Y.
Underlies Black River Is. and overlies Chasy Is. 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 Is.; but in 1910 (N. Y. State
group and divided it into (descending): (1) Leray Is. memb., 10 ft., more cherty than underlying ls.; (2) Lowville Is., 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 Pamella ls. of Chazy group. [In subsequent repts the thickness of Lowville was stated as 0 to 86 ft.]

H. P. Cushing, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135-144). Leray fm. (black cherty Is. of Watertown region) is classed provisionally as uppermost memb. of Lowville. In Watertown region it uncon. overlies typical Lowville Is., 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 Is. consists of thin-bedded dove ls. containing little or no chert, and as Lowville Is. 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.


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 Is. above Lowville ls.


G. M. Kay, 1929 (Jour. Geol., vol. 37, No. 7, pp. 684-671; and A. A. P. G. Bull., vol. 13, No. 9, p. 1214), divided Black River group of N. Y. and Ont. into Chaumont ls. (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).


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 Is. of Miller, in central Ky.

Lowville granite.


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-
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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).


Loyal Creek.

Upper Ordovician: Eastern New York (Mohawk Valley).

K. Ruedemann and G. H. Chadwick, 1935 (Scl., n. s., vol. 81, p. 400). Loyal Creek introduced for middle Utica or zone of Dicranograptus nicholoni 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. ScL, 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 replaces lower part of Mauch Chunk sh.

Loysburg formation.

Lower Ordovician: Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. ScL, 4th, vol. 48, pp. 404, 410). Loysburg fm.—Dark and impure dolomitic ls. overlying Beekmantown ls. and underlying earliest 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 Stony River group. Colliie does not appear to have recognized the existence of this formation. Butts also does not mention the lowest div. of the Stony River group, probably because it is poorly exposed at Roaring Spring. Differs from superjacent Carlin in lithology, in paucity of fossils, and in total absence of reef-building organisms, which are so characteristic of the Carlin.

Lucas dolomite.

Lower Devonian: Ohio, southeastern Michigan, and western Ontario.

C. S. Prosser, 1908 (Jour. Geol., vol. 11, pp. 521, 540). Lucas ls.—To include all rocks btw. top of Sylvanias ss. and base of Columbus ls. of Ohio or Dundee ls. of Mich. Is top memb. of Monroe fm.

C. E. Stauffer, 1908 (Ohio Nat., vol. 8, pp. 271-276, and Geol. Soc. Am. Bull., vol. 19, pp. 544-546, footnote). Lucas ls. overlies Sylvanias 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.

ft.; Amherstburg dol., 20 ft.; Anderdon Is., 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 as. In all quarries, showing that Anderdon and Amherstburg have been cut out by overlap of the dol. on Sylvania as.


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.


Lucero beds.

Cretaceous: Cuba.


Lucien shale member.

Permian: Central northern Oklahoma.


Luck-Sure series.

Age (?): Southeastern Arizona (Tombstone district).

W. F. 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, Lucky 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).


Lucky S argillite.

Upper Jurassic: Northern California (Mount Jura).


Ludlow sandstone.
Middle Devonian: Central Pennsylvania (Perry County).
[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 underlying 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.

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, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 61), replaced this preoccupied name with Wetmore ogl

Ludlowville shale. (In Hamilton group.)
Middle Devonian: Western and central New York.
J. Hall, 1859 (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 "Leliorhynchus 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 "Leliorhynchus 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 "Encrinia." 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 Is.) 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. bulletin) and passing on to Mason Rock, which also under Moscow sh. is here divided into (descending) Deep River memb., Tichenor memb., Wanakah memb., Ledyard memb., and Centerfield memb.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 389), defined Ludlowville sh. as underlying Menteth Is. memb. of Moscow sh., overlying Skaneateles sh., and as including Tichenor Is. in upper part and Centerfield Is. 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 Is. above and Marcellus sh. below, or (descending) Moscow sh., encrinia Is., 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.
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 clys. made up mainly of Myalinae and other pelecypods with many gastropods and Bryozoa. The lss. at Ballinger are quite fossiliferous, and the beds are generally 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 24 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.

Lueders limestone member (of Lueders formation).
See 1930 entry under Lake Kemp Is.

†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 Mtne beds.

Same as Yegua fm. (Eo.), the better established name. Named for Lufkin, Angelina Co.

Lufkin rhyolite.
Tertiary: Southwestern New Mexico (Sierra County).

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 Nacodoches 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 Q. 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).

Luisian stage.
Tertiary: California.
See under Zanorrian stage, R. M. Kleinpell, 1934.

Lukachukai sandstone.
Triassic (?): Northwestern New Mexico and northeastern Arizona.

Lukashukai.
See Lukachukai.

Luke clay. (In Allegheny formation.)
Pennsylvanian: Western Maryland (Allegany and Garrett Counties).


Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 183, 1861) to Bv (160 ft. of dark bluish-gray thin-bedded limestone) 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.)


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.

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 under­
lain 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.

Lunan series.

A term introduced by C. [R.] Keyes for a part of the middle Carb. (Penn.)
of N. Mex.—"the main ls. sequence in Manzano Mtns." (See his Con­
spectus 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
885-922, 1931) replaced this name with Tahoe glacial stage, which he
related 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 alumino-ferrous 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, 1908 (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.

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).


*Luning fm.*—Chiefly Is. 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 chert whose pebbles are almost wholly chert. In Gabbs Valley the fm. is chiefly dark Is. and dol. with subordinate sl.; in places there are interbedded lava flows, altered andesites, 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. Pres Bull, on Cat Creek anticline, Twp 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. 15, T. 15 N., R. 29 E. It also yields strong artesian flow of fresh water. Is usually called second Kootenai Band, 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.


Luscar formation.

Lower Cretaceous: Alberta.


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, 1918). 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.


"Marlon fm." has been abandoned by both Kans. Geol. Survey and U. S. Geol. Survey, and Luta Is. 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 Is. to Chase group and treated it as top memb. of Winfield Is., thus redefining Sumner group, Winfield Is., 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).
Luthers Mills coquinite.—Name here applied to type “Burlington Is” 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 Is. to a memb. which they found near Franklindale and at Towanda Narrows, which was to supplant Sherwood’s preoccupied term “Burlington Is,” 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 30 ft. thick in central Bradford Co., near Burlington. The Franklindale Is., according to Williams and Kindle and also the writer’s observations, is more nearly a true Is. or group of thin Is., 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.

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.

Lykins formation.
Triassic (?) and probably Permian: Eastern Colorado.
N. M. Fenneman, 1905 (U. S. G. S. Bull. 265). Lykins fm.—A series of s.s.s. and sandy shales, with a little Is. 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 s.s.s. 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 ml. N. of Boulder], the scenery along which owes its strange and beautiful character to this fm.

In places ls 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, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 461-482), called the *Lyman* of Ammonoosuc district. *Lyman schist,* and stated that it consisted chiefly of argilitic 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 cgs, and another an argillite. Underlies auriferous cgl. and overlies Lisbon group, both of which are Lower Sil. [Ord.] or Camb.


F. H. Lahiée, 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, macroscopic 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 tufts and aggs. 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 cgs., 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 near-by rocks of Niagaran age. As here defined may contain rocks of 2 ages, the older being=Lyman series of Lahiée.

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).


Lyman granite gneiss.

Late Carboniferous or post-Carboniferous (?): Southeastern Connecticut.

**Lynch dolomite.**

Upper and Middle (?) Cambrian: Central northern Utah (Oquirrh Mountains region).


**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. hornblendes 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 fms. [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.)

Pennsylvaniaian: Central Texas.

N. P. 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, grading upward into shaly to massive s.s. and downward into s.s. In places the s.s. is 75 to 100 ft. thick. Basal memb. of Strawn div. Uncon. overlies Dev. 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. 1847, p. 5) and 1932 (U. S. G. S. P. P. 171). *Lyndon Is.*—Consists of 200 ft. of light-gray to white more crystalline Is. (than below), usually thick bedded but showing distinct partings, underlain by 200 ft. of fine-grained dark-gray, rather heavy-bedded Is. Conformably underlies Middle Camb. Chisholm sh. and conformably overlies Lower Camb. Pioche sh. So closely resembles the younger Highland Peak Is. that where intervening Chisholm sh. is absent it is difficult to separate the Is. Typically exposed in Lyndon Gulch, and is present in Highland and ElyRanges. 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 (Tonolaway) group* in central N. Y. is: Chrysler “waterlimes” (“Rondout” of this region); Akron dol.; Williamsville waterline (cement bed); Sexaquada 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 gypsum*, 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 keratophyres, trachytes, dacites, and andesites, with dikes of similar rocks and one basaltite 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 argl. 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.

Lynnheld serpentine.

Cambrian or pre-Cambrian: Northeastern Massachusetts (Essex County).


Named for occurrence at Lynnheld, Essex Co.

Lynx formation.

Cambrian (Upper): British Columbia and Alberta.


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 granite 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 intrusive 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. 285). The rocks of Boulder region bitherto 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 ss. and ects. of reddish color, while the upper and lesser part is a finer-grained quartzose ss. of white, "creamy", or light-reddish color. The coarse ss. 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 ss.” 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 mis-correlation 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 Bozelder 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 Is., which thickens to 126 ft. farther E., there known as Lyons Is., is found capping it in several places in Cromwell field. The Lyons is. is correlated by some geologists with Morrow and Wapanucka Is. 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., Pittsville).

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 mtls. 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 s.s.s., 100 ft.;
(4) dull-colored, deeply disintegrated clays with feldspathic s.s.s. and much gyp.,
31, pp. 60-62) gave thickness of their Lyttae 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.

**Lytte sandstone member** (of Purgatoire formation).

Lower Cretaceous (Comanche series): Eastern Colorado (Colorado Springs
region).

of **Purgatoire fm.**—Consists of 145 ft. (average thickness) of s.s.s. 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 s.s.s., prevalingly siliceous, white, yel­
lowish-brown, or blackish grays. Near Colorado City the base of Lyttae memb.
consists of 100 ft. of fine-grained white or cream-colored s.s.s. Basal memb. of

**Lytte 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). *Lyttae ls.—* A thin ls., of local extent, lying 30 ft. above Rainy Is. and 125±
ft. below Standpipe Is.; all members of Clear Fork fm.

Probably named for Lyttae 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 s.s.s., the latter often cross-bedded. Thick­
ness 300 ft. in Austin quad. Fossils correspond to those of Midway fm. of Eocene.

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,
The use of the subjoined mailing label to return this report will be official business, and no postage stamps will be required.